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Australian evidence-based guidelines for diabetes-related foot disease

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Disclaimer

These Australian Evidence-based Guidelines are a general guide to appropriate practice, to be followed subject to the clinician's judgment and the patient's preference in each individual case. The Guidelines are designed to provide information to assist decision-making and are based on the best evidence available at the time of development.

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Diabetes Feet Australia would like to thank and acknowledge Mikaela Cameron who has created the artwork to represent the guidelines. Mikaela Cameron (M. J. Badagarang) is a proud Dharug saltwater woman from the Hawkesbury River in New South Wales, Australia. She's worked the past 4 years as a cultural educator delivering cultural workshops and creating murals. "Worimi, I am a proud Dharug woman. My totem is the Badagarang (Eastern Grey Kangaroo), and Waroo (the brown-eyes crow). I pay my respects to all Elders past, present and emerging, and extend this acknowledgment to you and your people. Welcome, let's walk together."

FOREWORD

Introducing the first new Australian diabetes-related foot disease guidelines in a decade

Diabetes-related foot disease is a leading cause of Australia's national hospitalisation, amputation, and disability burdens. It is estimated that 50,000 Australians are living with diabetes-related foot disease today, while 300,000 other Australians are considered at-risk. In particular, Aboriginal and Torres Strait Islander Australians have up to a 38-fold elevated risk of developing diabetes-related foot disease.

In 2020, Diabetes Feet Australia and the Australian Diabetes Society established a national multi-disciplinary expert Guideline development working group, including consumer and Aboriginal and Torres Strait Islander Peoples representatives, to develop new Australian diabetes-related foot disease guidelines. The group appointed a further 30 national experts covering six multi-disciplinary panels to develop six guideline chapters across all major aspects of diabetes-related foot disease, including prevention, wound classification, peripheral artery disease, infection, offloading and wound healing interventions. Each guideline also covers Aboriginal & Torres Strait Islander Peoples, geographically remote, and other specific implementation considerations for the Australian context. These new 2021 national guidelines will serve as the new national multidisciplinary best practice standards of care for the provision of diabetes-related foot disease care within Australia for the foreseeable future.

On behalf of ADS council I would like to extend my thanks to the ADS and DFA members who have brought this important project to fruition.

Associate Professor Stephen Stranks

Australian Diabetes Society - President

Director of Southern Adelaide Diabetes and Endocrine Services

Associate Professor at Flinders University of South Australia.

FOREWORD

Australian diabetes-related foot disease guidelines to reduce lower limb amputations for Aboriginal and Torres Strait Islander Peoples

Foot disease and amputations as a result of diabetes have profound impacts for Aboriginal and Torres Strait Islander Peoples, far in excess of what is seen among non-Indigenous Australians. These extend beyond the direct health effects, impacting on peoples' ability to connect to Country, their social and emotional wellbeing, and ability to prevent disease progression. These inequalities in health are a result of ongoing colonisation, manifest most clearly in the experience of unjust social and economic status, and experiences of systemic racism and unsafe healthcare systems.. Aboriginal and Torres Strait Islander Peoples currently have up to 3 times the rates of diabetes, 6 times the rates of foot disease and 38 times the rates of amputation compared to non-Indigenous people. There are few such stark reminders of the disparities that shape the experience of diabetes for Indigenous Australians.

In the last few years, there has been groundswell of positive change in the foot disease space for Aboriginal and Torres Strait Islander Peoples. Yet its impact will need to be measured by how it will reduce amputation rates in Australia. Most recently, we have seen multiple new foot disease initiatives including new research into Aboriginal and Torres Strait Islander foot disease led by Aboriginal and Torres Strait Islander researchers, and new Diabetes-related Foot Complication Programs. These programs are providing more culturally safe local services for Aboriginal and Torres Strait Islander Peoples. In concert, these new 2021 Australian evidence-based guidelines for diabetes-related foot disease, have at their heart considerations on how to implement these recommendations in a culturally safe manner to improve foot care with and for Aboriginal and Torres Strait Islander Peoples.

These new Australian evidence-based guidelines have been developed by over 30 research, clinicians, and consumers. Importantly, they have also included for the first time input from Aboriginal and Torres Strait Islander experts from around the country. Together these experts have systematically developed critical recommendations, covering the length and breadth of prevention and treatment of people with diabetes-related foot disease, as well as how to implement those recommendations within Aboriginal and Torres Strait Islander communities. Importantly, these guidelines have incorporated Indigenous people's voices, user-friendly implementation considerations, toolkits, and pathways to help clinicians use these recommendations in a culturally safe manner.

With the privileging of Aboriginal and Torres Strait Islander Peoples worldviews and knowledges at the heart of these new guidelines, I urge all health professionals around Australia to engage with Aboriginal and Torres Strait Islander people, their representative organisations and Aboriginal Community Controlled Health Services in the pursuit of health equity.

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INTRODUCTION

Diabetes-related foot disease (DFD) is a leading cause of morbidity, mortality and healthcare cost burdens in Australia. DFD is defined as foot ulceration, infection, or tissue destruction in people with diabetes, accompanied by the risk factors of peripheral neuropathy (PN) and/or peripheral artery disease (PAD).

Each year DFD affects approximately 50,000 Australians, with a further 300,000 having risk factors for developing DFD. Although DFD causes a large disease burden, Australian regions that have systematically introduced multi-disciplinary foot care services which adhered to evidence-based DFD guideline recommendations, have significantly reduced their burden of DFD.

A key recommendation of the Diabetes Feet Australia (DFA) Australian DFD Strategy 2018-2022 was to ensure Australia has national DFD guidelines that continually reflect up-to-date robust evidence to guide multi-disciplinary standards of DFD care. However, Australia's most recent 2011 National evidence-based DFD guideline was out-dated by world standards and had been rescinded by the National Health and Medical Research Council (NHMRC).



The following 2021 Australian evidence-based guidelines for DFD have now been systematically developed and released for the first time in a decade using best practice methodology. Over 30 national experts systematically evaluated existing high-quality International Working Group on the Diabetic Foot (IWGDF) DFD source guidelines and made necessary adaptations to be applicable and acceptable to Australian contexts. A month-long public consultation process occurred with feedback transparently incorporated where appropriate. Based on the collated public consultation feedback, the guidelines were revised, approved by the Australian DFD Guidelines working group, and endorsed by ten peak national bodies that are listed under each individual guideline. Covering the following six guidelines, collectively these guidelines should serve as the multi-disciplinary best practice standards of care for the provision of DFD care within Australia.



PREVENTION



INFECTION



**WOUND
CLASSIFICATION**



OFFLOADING



**PERIPHERAL
ARTERY DISEASE**



**WOUND HEALING
INTERVENTIONS**

It is strongly recommended that all Australian health professionals from all disciplines caring for people at risk of or with DFD should implement these new guidelines to help reduce the large national burden of DFD in Australia.

DEVELOPMENT

Guidelines development protocol and findings

Part of the 2021 Australian evidence-based guidelines for
diabetes-related foot disease

V1.0140921

AUTHORS

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Disclaimer

These Australian Evidence-based Guidelines are a general guide to appropriate practice, to be followed subject to the clinician's judgment and the patient's preference in each individual case. The Guidelines are designed to provide information to assist decision-making and are based on the best evidence available at the time of development.

ABSTRACT

Background

Diabetes-related foot disease (DFD) is a leading cause of the Australian disease burden. The 2011 Australian DFD guidelines were outdated. We aimed to develop methodology for systematically adapting suitable international guidelines to the Australian context to become the new Australian evidence-based guidelines for DFD.

Methods

We followed the Australian National Health Medical Research Council (NHMRC) guidelines for adapting guidelines. We systematically searched for all international DFD guideline records. All identified records were independently screened and assessed for eligibility. Those deemed eligible were further assessed and included if scoring at least moderate quality, suitability and currency using AGREE II and NHMRC instruments. The included international guidelines had all recommendations extracted into six sub-fields: prevention, wound classification, peripheral artery disease, infection, offloading and wound healing. Six national panels, each comprising 6-8 multidisciplinary national experts, screened all recommendations within their sub-field for acceptability and applicability in Australia using an ADAPTE form. Where panels were unsure of any acceptability and applicability items, full assessments were undertaken using a GRADE Evidence to Decision tool. Recommendations were adopted, adapted, or excluded, based on the agreement between the panel's and international guideline's judgements. Each panel drafted a guideline that included all their recommendations, rationale, justifications, and implementation considerations. All underwent public consultation, final revision, and approval by national peak bodies.

Results

We screened 182 identified records, assessed 24 full text records, and after further quality, suitability, and currency assessment, one record was deemed a suitable international guideline, the International Working Group Diabetic Foot Guidelines (IWGDF guidelines). The six panels collectively assessed 100 IWGDF recommendations, with 71 being adopted, 27 adapted, and two excluded for the Australian context. We received 47 public consultation responses with >80% (strongly) agreeing that the guidelines should be approved, and ten national peak bodies endorsed the final guidelines.

Conclusions

New Australian evidence-based guidelines for DFD have been developed for the first time in a decade by adapting suitable international guidelines. The methodology developed for adaptation may be useful for other foot-related conditions. These new guidelines will now serve as the national multidisciplinary best practice standards of DFD care in Australia.

Keywords

Classification, diabetes-related foot disease, diabetic foot, guidelines, infection, offloading, peripheral artery disease, peripheral neuropathy, ulcers, wounds.

PROTOCOL & FINDINGS

BACKGROUND

Diabetes-related foot disease (DFD) is a leading cause of morbidity, mortality and healthcare cost burdens in Australia (1-4). DFD is defined as foot ulceration, infection, or tissue destruction in people with diabetes, accompanied by the risk factors of peripheral neuropathy (PN) and/or peripheral artery disease (PAD) (4-6). Each year DFD affects approximately 50,000 Australians, with a further 300,000 having risk factors for developing DFD (1-4). Although DFD causes a large disease burden, Australian regions that have systematically introduced multi-disciplinary foot care services which adhered to evidence-based DFD guideline recommendations, have significantly reduced their burden of DFD (7-9).

A key recommendation of the Australian DFD Strategy 2018-2022 was to ensure Australia has national DFD guidelines that continually reflect up-to-date robust evidence to guide multi-disciplinary standards of DFD care (1, 2). However, Australia's most recent 2011 national evidence-based DFD guideline (10) is out-dated by world standards (11) and has been rescinded by the National Health and Medical Research Council (NHMRC) (12). Thus, there was an urgent need to develop contemporary national guidelines for DFD (1, 2).

The NHMRC Guidelines for Guidelines recommends developing new guidelines either from scratch ('de novo'), or adopting and/or adapting other suitable high-quality international guidelines if no Australian equivalent is available (13). With no known Australian DFD guidelines under development (14), and a low likelihood of acquiring the estimated AU\$1 million needed to develop a guideline de novo (15), Diabetes Feet Australia (DFA) appointed a multi-disciplinary Guideline development working group to oversee a project to adopt or adapt suitable international guidelines. Members of the group ("the authors") were invited based on having an (inter)nationally-recognised DFD guideline and/or research publication track record, or being a consumer or Aboriginal and Torres Strait Islander representative with expertise in DFD (16, 17). The aim was to identify and adapt suitable international source guidelines to the Australian health context to become the new multi-disciplinary Australian evidence-based guidelines for DFD for all Australian health professionals.

METHODS

The methodology for developing this guideline followed eight overarching methodological steps that aligned with best practice principles for adapting suitable international source guidelines as recommended by the NHMRC Guidelines for Guidelines (13) and the ADAPTE and GRADE-ADOLOPMENT frameworks (17, 18). The eight overarching steps and our approach to implementing these steps are detailed below. In summary the steps were: i) defining the scope of the guidelines; ii) identifying potential international source guidelines; iii) determining suitable international source guidelines to adapt; iv) deciding which recommendations to adopt, adapt, or exclude; v) drafting recommendations and the reasoning for those recommendations; vi) developing guideline manuscripts; vii) external consultation and approval of guideline manuscripts; and viii) developing clinical pathways to aid implementation into practice.

i. Defining the scope of the guidelines

The scope of these guidelines were defined using the PIPOH (spelt out below) framework recommended by ADAPTE (17) and based on (inter)national DFD reporting standards (1, 5, 6, 19), i.e.:

- Population(s) of interest - were those defined as at risk of, or with, DFD (5, 6);
- Intervention(s) of interest - were those interventions typically used to screen, diagnose, prevent, or treat the population(s) of interest (5, 6);
- Professions to be targeted - were those multiple medical, surgical, nursing and allied health disciplines that typically provide prevention or treatment for the population(s) of interest (1, 19, 20);
- Outcomes of interest - were those outcome measures typically used for the population(s) of interest, such as ulcer healing or amputation (5, 6);
- Health care context to be targeted - were those secondary and/or tertiary health care settings and organisations that typically provide prevention or treatment for the population(s) of interest in Australia (1, 19, 20).

PROTOCOL & FINDINGS

ii. Identifying potential international source guidelines

Based on the above defined scope we performed a systematic search for potentially suitable international source guidelines (13, 17). The search strategy included any guideline record published until 1 May 2020, in the International Guidelines Library (21) or Australian Clinical Practice Guidelines Register databases (14). These guideline databases were chosen as they were specifically recommended for this purpose by either NHMRC (13) or ADAPTE (17). We used the following free text search terms in these databases: “diabetes”, “foot”, “feet”, “wound” or “ulcer”. All authors were also asked to identify any other potentially suitable guideline records of which they were aware, and these were included in the search strategy as additional records identified via other sources.

The title and abstract (if available) of each unique record identified from the search strategy was independently screened by three authors (PL, AR, JP) for eligibility for full-text assessment. The inclusion criteria were those records: i) with the primary aim of developing clinical guidelines to prevent or manage people with, or at risk of, DFD; ii) developed for an international multi-disciplinary health professional audience; iii) written in English (the national language of Australia); iv) based on systematic review(s) of the available literature; and v) which incorporated a final systematic review search date within 3 years of our search date (i.e. 1 May 2017) for currency. All records screened as eligible by any of the three authors were included for full text assessment.

Each guideline record identified as eligible after screening then had their full text retrieved and assessed based on the same above inclusion criteria by two authors independently (PL, AR, or JP) (22). Any disagreements on eligibility by the two authors were discussed until consensus was reached or if unable to be reached a third author decided (22). Decisions to exclude any full-text records were recorded identifying the criteria the guideline record failed to meet (17, 22).

iii. Determining suitable international source guidelines to adapt

Remaining eligible full text records were then independently assessed by four authors (PL, AR, JP, RC) for their methodological quality, suitability and currency to be adopted or adapted to the Australian health context (13, 17). The Appraisal of Guidelines for Research and Evaluation II (AGREE II) Instrument was used to assess methodological quality (17, 23, 24). The AGREE II instrument is a widely used, valid and reliable 23-item instrument, each using a 7-point Likert scale, for assessing methodological quality of guidelines (23, 24). The scores of the four authors were summed and divided by the maximum possible score to determine a total score (24). Scores were categorised: high quality if scored >70%, moderate if 50-69%, and low if <50% (17, 23, 24).

A customised tool from NHMRC was used to assess suitability and currency (13). The tool is a 22-item tool developed by the authors using the exact questions outlined in the NHMRC Guidelines for Guidelines table of factors that should be considered for assessing the suitability and currency of a guideline to adopt or adapt in the Australian context (13) (Supplementary Material Table S1). The tool included 21 items using a 7-point Likert scale to determine suitability, and, one open item using the final literature search date of the guideline record to determine currency. Total scores for suitability were determined using the same formula used for the AGREE II tool (23, 24) and categorised: high suitability if scored >70%, moderate if 50-69%, and low if <50%. Currency was defined as the total time elapsed between the final literature search date of the guideline record and the search strategy date of this protocol (i.e. 1 May 2020), and categorised: high currency if <1 year since final search date, moderate currency if <3 years, and low currency if >3 years (13, 17).

All documents that informed the development of each eligible full text guideline record were included as part of these assessments, including any systematic reviews, methodology protocols and technical reports (13, 17). Any record deemed as having at least moderate quality, moderate suitability and moderate currency following these assessments was defined and included as a suitable international source guideline to adopt or adapt to the Australian health context for this project (13, 17).

PROTOCOL & FINDINGS

iv. Deciding which recommendations to adopt, adapt or exclude

All recommendations within the above suitable international source guidelines were individually extracted and evaluated to determine if they should be adopted, adapted, or excluded in the Australian context (13, 17, 18). The following five sub-steps were followed: a) recommendations were categorised into six sub-fields; b) national expert panels were convened for each sub-field; c) panels screened all recommendations in their sub-field; d) panels assessed any recommendations if unsure of acceptability or applicability; and e) panels decided which recommendations to adopt, adapt or exclude (13, 17, 18).

a. Recommendations were categorised into six sub-fields

Two authors (PL, AR) independently categorised all recommendations (and the relevant clinical questions they addressed) from all included suitable source guidelines into one of six DFD sub-fields that the authors considered the recommendation was primarily addressing (5, 6). The six sub-fields aligned with international DFD standards and included: prevention, wound classification, peripheral artery disease (PAD), infection, offloading, and wound healing interventions (5, 6). The two authors discussed any disagreements until consensus was reached or if this was unable to be reached then a third author decided (22).

b. National expert panels were convened for each sub-field

All recommendation(s) (and all relevant documentation of reasoning informing the recommendation(s), including rationale, summary(s) of evidence, evidence statements, quality of evidence summaries, risk of bias tables, evidence tables), were forwarded to the relevant sub-field national expert panel to screen. Each national expert panel comprised 6-8 members and was chaired by an author with relevant (inter)national research and/or clinical practice expertise in the sub-field. Panel membership included 4-6 members with either (inter)national research and/or clinical practice sub-field expertise from different disciplines, states (or territories) and genders, plus, a consumer and an Aboriginal and Torres Strait Islander representative with expertise in DFD. An (inter)national research expert was defined as having published in peer-reviewed journals and/or been ranked as an Australian expert in the sub-field according to Expertscape (25). An (inter)national clinical practice expert was defined as having presented at an (inter)national conference and/or been a member of an (inter)national committee in the sub-field.

c. Panels screened all recommendations in their sub-field

At least two panel members independently screened each recommendation (and all relevant documentation informing the recommendation) in their sub-field for acceptability and applicability in the Australian health context, using a customised ADAPTE evaluation form (Supplementary Material Figure S1) (17). The ADAPTE form comprised 7-items, each using a 3-point Likert scale (yes, unsure, or no), organised into the domains of acceptability and applicability (17). Acceptability items included screening the quality of evidence, strength of recommendation and user (patients and providers in the context) values ratings for the recommendation to determine if the panel agreed with the included guideline's original ratings (17). Applicability items included screening the applicability to patients, availability of equipment and expertise, and any legislative or policy constraints for the recommendation in the Australian health context (17). The Australian health context was defined as individual patients with, or at risk of, DFD, attending the multiple health professional disciplines that typically provide prevention or treatment services in the secondary and tertiary Australian health care settings that house those services (1, 19, 20). Any disagreements on item scores were discussed by the two members until consensus was reached, or if it could not be reached, a third member decided (22). All panel members then met to discuss and decide by consensus all ratings for each item in each recommendation. All recommendations that scored "yes" agreement in all items were able to be adopted for the Australian context. Any recommendations scoring any items as "unsure" or "no" agreement in one or more items required full assessment.

PROTOCOL & FINDINGS

d. Panels assessed any recommendations if unsure of acceptability or applicability

All recommendations requiring full assessment were done so using a customised Grading of Recommendations Assessment, Development and Evaluation (GRADE) Evidence to Decision (EtD) template (Supplementary Material Figure S2) (18, 26, 27). This involved one panel member systematically extracting and populating the template verbatim with all relevant text relating to the rationale for that recommendation from the source guideline for eight important EtD criteria: the problem, desirable effects, undesirable effects, quality of evidence, values, balance of effects, acceptability and feasibility (18, 26, 27). The same member also added any additional relevant Australian considerations to each of the eight criteria that they considered necessary to inform the Australian context from relevant literature and/or their expert opinion. The populated EtD was checked for accuracy by another member and any disagreements discussed between the two members until agreement was reached. Based on the populated EtD, one panel member rated the detailed and summary judgement items in each of the eight important EtD criteria (18, 26, 27). Another member checked all judgements made by the first member with any disagreements discussed until consensus was reached (22). All panel members then met to discuss and decide by consensus all summary judgement item ratings for each of the eight important EtD criteria for each recommendation. Finally, the panel compared the level of agreement between their eight EtD summary judgement items with the source guideline's summary judgement items (if able to be determined) to determine the level of agreement for each item as: yes (agreed), unsure, or no (disagreed) (18).

e. Panels decided which recommendations to adopt, adapt or exclude

The decision to adopt, adapt, or exclude each recommendation was made based on the level of agreement between the panel's consensus summary judgement items and that of the source guideline's summary judgement items for each EtD item in each recommendation (18). This was performed via discussion and a consensus decision by all panel members after reviewing their completed ADAPTE form and/or GRADE EtD summary judgement items for each recommendation (17, 18). A decision to adopt was made if all items in the customised ADAPTE form scored "yes (agreed)" and/or the panel's GRADE EtD summary judgement items generally agreed with the source guideline's summary judgement items (18). A decision to adapt was made if the ADAPTE form scored an "unsure" or "no" on any item, and there was disagreement between the panel's GRADE EtD summary judgement items and that of the source guideline's summary judgement items (18). A decision to exclude was made if the ADAPTE form scored an "unsure" or "no" on any item, there were substantial disagreements between the panel's GRADE EtD summary judgement items and that of source guideline's, and/or the panel considered the recommendation was not acceptable or applicable to use in the Australian context.

PROTOCOL & FINDINGS

v. Drafting recommendations and reasoning for those recommendations

All recommendations and supporting reasoning for the recommendations were then drafted via consensus by each panel. Depending on the panel's decision to adopt, adapt or exclude the source guideline's recommendation shaped how the panel drafted each recommendation (18). When adopting a recommendation, the panel re-stated the source guideline's recommendation verbatim (including the quality of evidence and strength of recommendation) (18). Minor wording changes were only permitted if the panel felt exchanging an Australian term for an international term was necessary to improve the interpretation of the recommendation without changing the concept. When adapting a recommendation, the panel drafted the recommendation based on the source guideline's recommendation and adapted/edited the recommendation's wording to reflect the panel's specific difference in judgement(s) to that of the source guideline's judgements (18). As recommended by GRADE the panel drafted each adapted recommendation with the aim of being clear, specific and unambiguous on what is recommended, for which persons, and under what circumstances (18, 26-30). Further, the panel by consensus, re-evaluated the quality of evidence using the GRADE system as High, Moderate, Low, or Very Low, based on the panel's level of confidence that the findings were from studies that reported consistent effects with low risk of bias and further research was unlikely to change that confidence (26, 27). The panel also rated the strength of recommendation using the GRADE system, based on weighing up the balance of effects, quality of evidence, applicability and feasibility (26, 27) in the Australian health context as: Strong, if there was a large clear difference in the balance of effects (i.e. large net benefit or net harm) between an intervention and control; or Weak, if there was a small and/or uncertain difference (26, 27). When excluding a recommendation, the panel simply stated the recommendation was excluded.

Regardless of the panel's decision to adopt, adapt, or exclude the recommendation, the panel drafted transparent reason sections to support their decisions for each recommendation (18). These sections included: rationale for the decision, justifications for the recommendation, and considerations on implementation, special subgroups, monitoring and future research priorities for the recommendation (18, 26-30). The rationale for the decision involved the panel documenting why they decided to adopt, adapt, or exclude the recommendation based on the similarities or differences in judgements with those of the source guideline's judgements. The panel also clearly outlined any wording changes as compared to the source guideline's original recommendation (18). The justifications for the recommendation were based on the panel carefully weighing up the panel's ADAPTE and/or GRADE EtD summary judgements to determine the strength of the recommendation, quality of evidence rating, patient (and provider) values and preferences, and acceptability and feasibility for the Australian health context (18, 26-30). Additionally, for those recommendations that were adapted or excluded, where applicable the panel also outlined their detailed judgements for each of the eight important GRADE EtD criteria: the problem, values, desirable effects, undesirable effects, balance of effects, quality of evidence, acceptability, and feasibility (18, 26, 27). Lastly, based on the source guideline's considerations, literature reviews and expert opinion, the panel outlined any important considerations for health professionals to consider when implementing the recommendations (18, 26-30). These considerations included: implementing the recommendation in the Australian health context, implementing in special subgroups (including in geographically remote, Aboriginal and Torres Strait Islander, and potentially contraindicated subgroups), monitoring the implementation, and any future research priorities for the recommendation (18, 26-30).

vi. Developing guideline manuscripts

Each panel's sub-field guideline manuscript was developed using an introduction, methods, results, and discussion framework. The introduction and methods were brief summaries of the introduction and methods contained in this guideline development protocol manuscript, along with any other relevant sub-field literature. The results sections were a collation of all the panel's consensus recommendations and supporting reasoning (as described in Section v). The discussion sections typically included summaries of the similarities and differences between the new Australian guideline, previous Australian guideline, and the source guideline in terms of recommendations and rationale. The final draft guideline manuscript was approved via consensus of each panel.

Each draft guideline manuscript was then peer-reviewed by at least one author not involved in the sub-field panel, to identify any obvious discrepancies in the recommendations or supporting reasons for the recommendations. If the author(s) identified any discrepancies, the panel was asked to revise the manuscript to consider and address the discrepancy. The agreed final draft of the sub-field guideline manuscript was deemed the consultation draft.

PROTOCOL & FINDINGS

vii. External consultation and approval of guideline manuscripts

The six draft guideline manuscripts used for public consultation (also known as “chapters”), plus this guideline development protocol manuscript, were collated and formatted for consistency ready for public consultation as the new Australian evidence-based guidelines for DFD. . Additionally, a customised public consultation survey based on example surveys from the ADAPTE framework were developed for each guideline to more efficiently gain and collate aggregated feedback from the public consultation process (17) (Supplementary Material Table S2). Finally, the ADAPTE Checklist for Adapted Guideline Content was completed by the authors to ensure all guideline elements had been completed (17).

Public consultation was targeted towards Australian health professionals assessing and managing patients with DFD as well as national peak bodies/organisations representing health professionals, consumers or Aboriginal and Torres Strait Islanders. The consultation material included the six guideline manuscripts, the guideline development protocol manuscript and the consultation surveys. Public consultation for each guideline was open for a minimum period of four weeks and notification of the consultation period was posted weekly on DFA and/or Australian Diabetes Society (ADS) web and social media sites, plus, invitations were sent electronically to relevant national peak bodies for health professionals, consumers or Aboriginal and Torres Strait Islander people. Any Australian health professional or national peak body with an interest was encouraged to respond.

At the conclusion of the public consultation period all consultation survey responses were collated and analysed. The authors disseminated all aggregated survey findings and feedback comments to the relevant sub-field guideline panels for consideration and revision of their respective manuscripts accordingly. The authors subsequently quality checked each panel’s revisions (17). Any substantial disagreements with the panel’s revisions were discussed between the authors and the panel concerned until consensus was reached. All aggregated consultation survey findings and each panel’s response to feedback received were publicly displayed on the DFA website. Endorsement of the guidelines were finally specifically sought from DFA, ADS, and Diabetes Australia, plus, invitations to endorse were sent to all aforementioned relevant national peak bodies. All final endorsed guideline manuscripts were displayed in full on the DFA website, submitted to peer-reviewed journals for publication and registered on the International Guidelines Library (21) and Australian Clinical Practice Guidelines register (14).

These new Australian guidelines will be reviewed every two years by the authors, or equivalent national guidelines committee, to determine by consensus if any substantial new evidence has been published that contradicts or substantially enhances any existing recommendations. If that is deemed to be the case, or after four years (i.e. 2025), whichever comes first, we recommend updating these guidelines using similar adaptation methodology used to develop these new guidelines or develop new guidelines de novo if the requisite funding becomes available.

viii. Developing clinical pathways to aid implementation into practice

To try and facilitate improved implementation into clinical practice, clinical pathways were developed for each guideline that incorporated the recommendations from that guideline. The process used for developing the clinical pathways was that advocated by Flores et al (2019) (31). This process included: each panel extracted any clinical pathways from their source guidelines as examples; the guidelines group developed a clinical pathway template based on these example pathways and similar national diabetes clinical pathways; each panel then used the template to develop their clinical pathway(s) by populating the template with their recommendations; and finally, the guidelines group reviewed all the clinical pathways for final quality assurance, formatting and consistency checks. (31).

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RESULTS

Identifying potential international source guidelines

Figure 1 displays the flowchart of results from the search strategy, which yielded a total of 182 relevant unique guideline records. After title and abstract screening, 158 records were excluded with 24 records remaining for full text assessment. After full text assessment, the only guideline deemed eligible to be assessed to determine if it was a suitable international source guideline to adapt to the Australian health context was the 2019 International Working Group on the Diabetic Foot (IWGDF) Guidelines (32-38).

Determining suitable international source guidelines to adapt

Table 1 displays the quality assessments of the IWGDF guidelines. The total quality score category for the IWGDF guidelines was rated as having high methodological quality. All 23 items also scored high quality ratings, except for four applicability items and one rigour of development item that scored moderate quality, and one stakeholder involvement item that scored low quality. Table 2 displays the suitability and currency assessments of the IWGDF guideline. The total suitability score category for the IWGDF guidelines was rated as having high suitability to the Australian health context. All 21 suitability items also scored high suitability ratings, except two implementability items that scored moderate suitability. Finally, the currency score category for the only currency item for the IWGDF guidelines was rated as having moderate currency. Thus, with high quality, high suitability and moderate currency the 2019 IWGDF guidelines were determined to be a suitable international source DFD guideline to adapt to the Australian health context.

Deciding which recommendations to adopt, adapt or exclude

Table 3 lists all final members of the six national expert panels, alongside the consumer and Aboriginal and Torres Strait Islander expert representatives. A total of 30 (inter)national DFD expert members from all Australian states/territories (except Australian Capital Territory) representing seven health profession disciplines were on these panels, including 12 podiatrists, five vascular surgeons, four wound nurses, three endocrinologists, three infectious diseases physicians, two orthopaedic surgeons and one pedorthist.

Table 4 shows that 100 original recommendations (that addressed 51 clinical questions) were extracted from the 2019 IWGDF source guidelines. After categorisation into sub-fields the IWGDF recommendations were allocated as follows to each of the Australian expert panels: 16 to prevention, five to wound classification, 17 to PAD, 36 to infection, 13 to offloading, and 13 to wound healing. The IWGDF rated the quality (certainty) of evidence supporting these 100 recommendations as six (6%) having a high quality of evidence, 27 (27%) moderate, and 67 (67%) a low quality of evidence. The strength of recommendations were rated as 52 (52%) being a strong and 48 (48%) a weak recommendation. Table 5 shows that after all screening, assessment and/or re-evaluation of the 100 IWGDF source guideline recommendations, 98 Australian recommendations remained. The national panels rated the quality of evidence supporting these 98 Australian recommendations as three (3%) having a high quality of evidence, 24 (24%) moderate, and 71 (73%) as (very) low quality of evidence. The strength of recommendations were rated as 56 (57%) being a strong and 42 (43%) a weak recommendation.

In summary, after screening all 100 IWGDF source guideline recommendations the panels deemed 68 (68%) were acceptable and applicable to the Australian health context and were adopted without further assessment. The other 32 (32%) were judged to have unsure (or no) acceptability and/or applicability in the Australian health context and required full assessment, including nine in offloading, eight in prevention, seven in infection, four in wound healing interventions, three in wound classification, and one in PAD. After full assessment of those 32 recommendations, three more were adopted, 27 adapted and two excluded for the Australian context. Therefore, of 100 IWGDF source guideline recommendations, 71 (71%) were adopted, 27 (27%) adapted and 2 (2%) excluded in the Australian guidelines. The six individual sub-field guidelines report details of all decisions for each sub-field (39-44).

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Drafting recommendations and rationale

Overall, of those 27 adapted recommendations, nine were in offloading, six in prevention, four in infection, four in wound healing interventions, three in wound classification and one in PAD. The main reasons for adapting recommendations included: 20 had wording changed to be considered acceptable in Australia; ten had quality of evidence changed; four had strength of the recommendation changed; four had wording changed to be considered feasible in Australia; and/or, one had the direction for the balance of effects changed. Of the two recommendations excluded, one was in the prevention and one the infection guideline (39, 42). The prevention recommendation was excluded because the panel had substantial differences in judgements compared with the IWGDF judgements for the desirable effects, balance of effects and quality of supporting evidence for a recommendation concerning "performing foot and mobility-related exercises with the aim of reducing risk factors of ulceration" (IWGDF Prevention Recommendation 14) (39). The infection recommendation was excluded because the panel had substantial differences in judgements compared with the IWGDF judgements for the balance of effects and quality of supporting evidence due to the inclusion of evidence for a heterogeneous population for a recommendation concerning to "treat diabetes-related foot osteomyelitis with antibiotic therapy for no longer than 6 weeks" (IWGDF Infection Recommendation 23A) (42).

Developing guideline manuscripts

In total, alongside this guideline development protocol manuscript, six sub-field guideline manuscripts were drafted (prevention, wound classification, PAD, infection, offloading, and wound healing interventions). Collectively these form the new 2021 Australian evidence-based guidelines for diabetes-related foot disease. Detailed reasoning behind all 98 recommendations included in the guideline are described in those six sub-field guideline manuscripts. Therefore, we refer all Australian health professionals caring for people with, or at risk of, DFD, to the 2021 Australian evidence-based guidelines for diabetes-related foot disease (39-44).

External consultation and approval of guideline manuscripts

Table 6 displays the aggregated summary public consultation survey response findings. A total of 47 responses (27 individual and 20 organisational responses) were received across the six sub-field guidelines; with prevention and offloading receiving the most responses with 19 and 14 respectively (39-44). In summary, >85% of respondents (strongly) agreed (with <10% disagreeing) that: there was a need for new Australia DFD guidelines; the methods used to develop the guidelines were appropriate, objective and transparent; the recommendations made were clear; they agreed with the recommendations made; and the recommendations if implemented should produce more benefits than harms, better use of resources, and would be acceptable to people with DFD. However, to implement the recommendations, 60% (strongly) agreed they may require some reorganisation of services, 55% agreed they may be technically challenging and 39% agreed they may be too expensive. Overall, >80% (strongly) agreed (with <5% disagreeing) that the guidelines should be approved as the new Australian guidelines, they would be supported by the majority of their colleagues and they would use or encourage their use in practice. Additionally, all de-identified feedback comments received during public consultation and each panel's responses to each comment were collated and posted on the DFA website.

Based on the collated public consultation feedback, the guideline manuscripts were finally revised and approved by the relevant national panel and authors. The final manuscripts were endorsed as the 2021 Australian evidence-based guidelines for diabetes-related foot disease by ten peak national bodies including the Australian Podiatry Association, Wounds Australia, Australian and New Zealand Society for Vascular Surgery, Australasian Society for Infectious Diseases, Australian Orthotic Prosthetic Association, Pedorthic Association of Australia, Australian Advanced Practising Podiatrists - High Risk Foot Group, Australian Aboriginal and Torres Strait Islander Diabetes-related Foot Complications Program, the Australian Diabetes Society and DFA. The final endorsed guidelines, including pathways, are displayed in full on the DFA website, registered on the Australian Clinical Practice Guidelines register (14) and will be submitted to peer-reviewed journals for publication. Finally, the authors completed the ADAPTE Checklist for Adapted Guideline Content to ensure all guideline elements had been completed (17) (Supplementary Material Table S3).

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DISCUSSION

For the first time in a decade we have developed new Australian evidence-based guidelines for diabetes-related foot disease by systematically adapting suitable high-quality international (IWGDF) source guidelines to the Australian health context. Of the 100 original IWGDF recommendations, 71 were adopted, 27 adapted and two excluded for use in Australia across six guideline manuscripts. These guidelines have now been endorsed by ten peak national bodies to serve as the new national guidelines and multidisciplinary best practice standards for the provision of DFD care within Australia (39-44).

There are some marked differences between these new Australian 2021 guidelines (39-44) and the previous 2011 Australian DFD guidelines (10) which perhaps begin to illustrate the strength and limitations of the new 2021 guidelines (11). A significant strength of the previous 2011 guideline was that it received considerable Australian Government funding to specifically develop a national DFD guideline from scratch ("de novo") (10). This funding enabled systematic reviews to be specifically constructed and performed for the Australian context by methodologist organisations, augmented by the expert opinion of a 13 member DFD expert panel, and all adhering to NHMRC recommendations of the time (10). Whereas, due to a scarcity of funding available for this new 2021 guideline, we had to adapt suitable high-quality international guidelines (IWGDF) to the Australian health context (39-44). This limited the content of these new 2021 guidelines to only those recommendations covered by the IWGDF source guidelines. However, to try and minimise these limitations we followed various NHMRC recommended processes for adapting such suitable international source guidelines to the Australian health context, including using best practice tools from ADAPTE, AGREE II and GRADE systems (13, 17, 18, 24, 26, 27), and six national expert sub-field panels consisting of 30 (inter)national experts, including consumer and Aboriginal and Torres Strait Islander experts (15, 16). Lastly, a limitation of both guidelines was the delay between when the systematic reviews were performed and when the recommendations were published in the guidelines; 2009 systematic reviews for the previous 2011 guidelines (10) and 2019 systematic reviews (32-38) for these new 2021 guidelines (39-44).

Adapting the IWGDF guidelines may also be seen as a strength for the new 2021 guidelines due to the breadth of coverage and methodological quality provided by the IWGDF source guidelines (32-38), plus the ability to address some minor IWGDF guideline methodological limitations identified by our AGREE II quality assessments (Table 2) (11). In terms of coverage, these 2021 Australian guidelines specifically outline 98 recommendations across six individual sub-field guidelines (32-38), compared with 25 recommendations in one overarching previous 2011 guideline (that partially covered four sub-fields of prevention, offloading, wound classification and wound healing interventions, but did not cover PAD or infection) (10). In terms of quality, we not only used the IWGDF guidelines rated as having high overall quality in our AGREE II quality assessments (24), we then followed the gold standard ADAPTE framework as the methodological steps to adapt the IWGDF guidelines (17), and the contemporary international gold standard GRADE system for synthesising and grading both the quality of evidence and strength of each recommendation (18, 26-30, 45). The previous Australian guideline graded only the quality of evidence via the previous NHMRC grades of recommendation, which were the national gold standard of the time (10). Furthermore, in terms of addressing identified minor methodological IWGDF limitations, unlike IWGDF we engaged both consumer and Aboriginal and Torres Strait Islander experts in all panel decisions, plus, asked all panels to provide specific considerations for the implementation of all recommendations in Aboriginal and Torres Strait Islander and geographically remote populations. Additionally, we provided the opportunity for wide public consultation from the Australian DFD community, revised accordingly and developed user-friendly clinical pathways for all guidelines to optimise the ease of uptake of all recommendations for multi-disciplinary health professionals following a formal pathway development process.

In future iterations of these guidelines, we would hope to either align an updated adaptation of new Australian guidelines more closely with the development of the new 2023 IWGDF source guidelines (32) or obtain the significant funding to develop the next DFD guideline de novo (13). An avenue for such funding of de novo guidelines may be that of developing living guidelines as recently published for other Australian diabetes-related complications (46). If such funding does become available to develop new guidelines de novo we suggest that additional sub-fields are also considered and addressed, such as Charcot foot and inpatient DFD care.

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CONCLUSION

New Australian DFD guidelines have been developed for the first time in 10 years using best practice methodology. Over 30 national experts systematically evaluated an existing high-quality international IWGDF DFD source guideline and made necessary adaptations to be applicable and acceptable to Australian clinical contexts. A minimum of a month-long public consultation process occurred with feedback transparently incorporated where appropriate. These new DFD guidelines are endorsed by ten peak national bodies. The authors strongly urge all Australian health professionals from all disciplines caring for people at risk of or with DFD to implement all new guideline recommendations that accompany this guideline development protocol to help reduce the large national burden of DFD in Australia.

LIST OF ABBREVIATIONS

ADS	Australian Diabetes Society
AGREE II	Appraisal of Guidelines for Research and Evaluation II Instrument
DFA	Diabetes Feet Australia
DFD	Diabetes-related foot disease
EtD	Evidence to Decision
GRADE	Grading of Recommendations Assessment, Development and Evaluation
IWGDF	International Working Group on the Diabetic Foot
NHMRC	National Health and Medical Research Council
PAD	Peripheral artery disease
PIPOH	Population, Intervention, Professions, Outcome, Healthcare context
PN	Peripheral neuropathy

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DECLARATIONS

Ethical approval

Not applicable

Consent for publication

Not applicable

Availability of data and materials

Data sharing is not applicable to this article as no datasets containing patient information were generated or analysed during the current study.

Competing interests

The funding/supporting bodies listed in the funding section below provided oversight for this guideline, however, did not have any input into the decisions on the methodology, findings or any specific recommendations contained in these guidelines or in the writing of these guidelines. PAL, AR, RAF were part of the development of the 2019 IWGDF guidelines as co-authors of the offloading, prevention and PAD IWGDF Guidelines and Systematic Reviews respectively, that served as the international source guidelines in which the “2021 Australian evidence-based guidelines for diabetes-related foot disease” were adapted. PAL has also been a speaker consultant with Sanofi Australia, is chair of Diabetes Feet Australia, and a member of the Journal of Foot & Ankle Editorial Board, National Association of Diabetes Centres Foot Network Committee, Australian Foot Forward Project Committee and Aboriginal and Torres Strait Islander Diabetic Foot Complications Program Expert Advisory Committee. AR is a member of the Journal of Foot & Ankle Editorial Board. JCh is employed by Diabetes Victoria and is fully funded by the National Diabetes Services Scheme. Otherwise, all other authors declare that they have no relevant competing interests.

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Authors' contributions

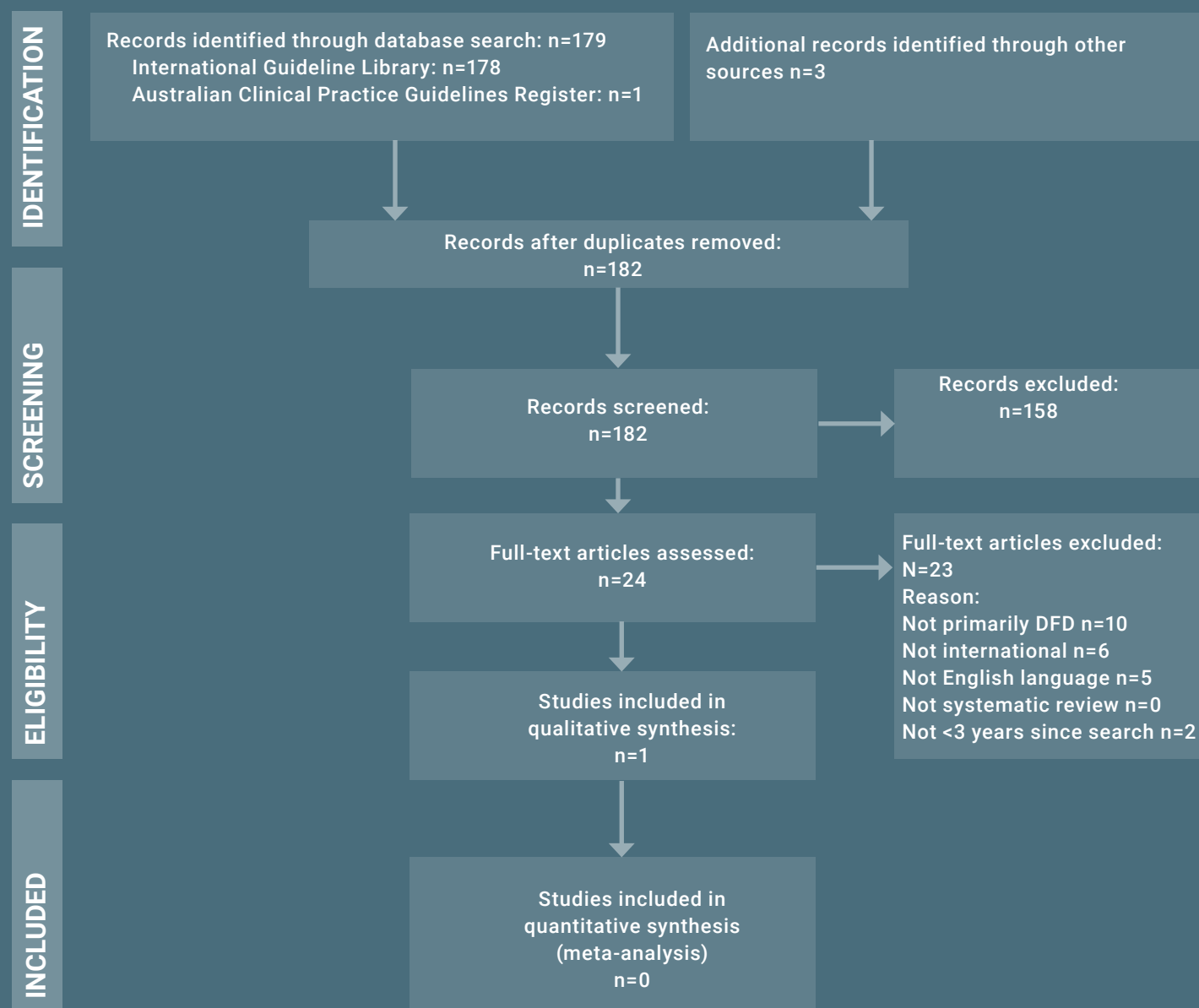
PAL as the Co-Chair of the Guideline development working group, contributed to conceiving the guidelines, designing the methodology, guidelines search, eligibility assessment, quality assessment, suitability assessment, recommendation extraction and categorisation, drafted and critically reviewed the paper for intellectual content. AR contributed to designing the methodology, guidelines search, eligibility assessment, quality assessment, suitability assessment, recommendation extraction and categorisation, wrote and critically reviewed the paper for intellectual content. JP contributed to conceiving the guidelines, designing the methodology, guidelines search, eligibility assessment, quality assessment, suitability assessment, and critically reviewed the paper for intellectual content. RJC contributed to designing the methodology, quality assessment, suitability assessment, and critically reviewed the paper for intellectual content. RAF contributed to conceiving the guidelines, designing the methodology, and critically reviewed the paper for intellectual content. JCh, JCh and NP contributed to designing the methodology, and critically reviewed the paper for intellectual content. SMT as the Co-Chair of the Guideline development working group, contributed to conceiving the guidelines, designing the methodology, drafted and critically reviewed the paper for intellectual content. All authors take responsibility for the content of the manuscript and approved the manuscript for submission.

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Acknowledgements

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FIGURE 1: Preferred reporting items for systematic reviews and meta-analyses flow diagram



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Table 1: Quality assessments of IWGDF guideline to adopt or adapt; using a customised AGREE II instrument*

ITEM NO.	ITEM DESCRIPTION	ASSESSOR 1	ASSESSOR 2	ASSESSOR 3	ASSESSOR 4	TOTAL SCORE	TOTAL SCORE%	QUALITY CATEGORY ^
SCOPE AND PURPOSE								
1	The overall objective(s) of the guideline is (are) specifically described	6	7	6	6	25	89	High
2	The health question(s) covered by the guideline is (are) specifically described	6	6	7	7	26	93	High
3	The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described	6	6	7	7	26	93	High
Domain Score (sum of 3 items)		18	19	20	20	77	92%	High
STAKEHOLDER INVOLVEMENT								
4	The guideline development group includes individuals from all relevant professional groups	5	6	5	4	20	71	High
5	The views and preferences of the target population (patients, public, etc.) have been sought	3	2	1	2	8	29	Low
6	The target users of the guideline are clearly defined.	5	5	7	6	23	82	High
Domain Score (sum of 3 items)		13	13	13	12	51	61%	Moderate
RIGOUR OF DEVELOPMENT								
7	Systematic methods were used to search for evidence	7	7	7	7	28	100	High
8	The criteria for selecting the evidence are clearly described	7	7	7	7	28	100	High
9	The strengths and limitations of the body of evidence are clearly described	6	7	7	6	28	100	High
10	The methods for formulating the recommendations are clearly described	6	6	6	6	24	86	High
11	The health benefits, side effects, and risks have been considered in formulating the recommendations	5	7	7	6	25	89	High
12	There is an explicit link between the recommendations and the supporting evidence	5	6	7	6	24	86	High
13	The guideline has been externally reviewed by experts prior to its publication	5	5	4	5	19	68	Moderate
14	A procedure for updating the guideline is provided.	5	6	5	6	22	79	High
Domain Score (sum of 8 items)		46	51	50	49	196	88%	High
CLARITY OF PRESENTATION								
15	The recommendations are specific and unambiguous	6	6	7	7	26	93	High
16	The different options for management of the condition or health issue are clearly presented	6	6	7	6	25	89	High
17	Key recommendations are easily identifiable	7	7	7	7	28	100	High
Domain Score (sum of 3 items)		19	19	21	20	79	94%	High
*Each item is scored using a 7-point Likert-scale: 1=lowest possible score, 7=highest possible score. ^Quality category definitions: High >70%, Moderate 50-69%, and Low quality <50%.								

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Table 1 (cont.): Quality assessments of IWGDF guideline to adopt or adapt; using a customised AGREE II instrument*

ITEM NO.	ITEM DESCRIPTION	ASSESSOR 1	ASSESSOR 2	ASSESSOR 3	ASSESSOR 4	TOTAL SCORE	TOTAL SCORE%	QUALITY CATEGORY ^
APPLICABILITY								
18	The guideline describes facilitators and barriers to its application	5	5	4	5	19	68	Moderate
19	The guideline provides advice and/or tools on how the recommendations can be put into practice	5	7	3	4	19	68	Moderate
20	The potential resource implications of applying the recommendations have been considered	5	5	2	4	16	57	Moderate
21	The guideline presents monitoring and/or auditing criteria	4	6	1	5	16	57	Moderate
Domain Score (sum of 4 items)		19	23	10	18	70	63%	Moderate
EDITORIAL INDEPENDENCE								
22	The views of the funding body have not influenced the content of the guideline	7	7	7	7	28	100	High
23	Competing interests of guideline development group members have been recorded and addressed	6	7	7	6	26	93	High
Domain Score (sum of 2 items)		13	14	14	13	54	96%	High
OVERALL GUIDELINE ASSESSMENT								
	Rate the overall quality of this guideline	6	6	6	6	24	86%	High
	I would recommend this guideline for use	Yes	Yes - with modifications	Yes	Yes			
Total Guideline Score (sum of all 23 individual items)		128	139	128	132	527	82%	High
Total Guideline Score %		80%	86%	80%	82%			
Total Guideline Quality Category		High	High	High	High			
*Each item is scored using a 7-point Likert-scale: 1=lowest possible score, 7=highest possible score. ^Quality category definitions: High >70%, Moderate 50-69%, and Low quality <50%.								

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Table 2: Suitability and currency assessments of IWGDF guideline to adopt or adapt; using a customised NHMRC table of factors*

ITEM NO.	ITEM DESCRIPTION	ASSESSOR 1	ASSESSOR 2	ASSESSOR 3	ASSESSOR 4	TOTAL SCORE	TOTAL SCORE%	QUALITY CATEGORY ^
RELEVANCE								
1	Is the clinical or public health context similar to Australia?	6	5	5	7	23	82	High
2	Are the population, intended users and settings comparable?	6	6	7	7	26	93	High
3	Are the recommended interventions available in Australia?	6	6	7	6	25	89	High
4	Are the guideline questions relevant in the new (Australian) context?	6	7	7	7	27	96	High
5	Do the values and preferences considered in the guideline reflect the new (Australian) context?	6	6	7	7	26	93	High
6	Are relevant outcomes used?	6	7	7	7	27	96	High
Domain Score (sum of 6 items)		36	37	40	41	154	92%	High
CURRENCY								
7	When was the evidence review conducted (i.e. final literature search date)?	July 2018	Oct 2018	July 2018	July 2018	<3 years	Moderate	Moderate
8	Is the evidence contained out of date?	6	7	7	6	27	96	High
9	Are new studies' findings conducted since the review likely to change the evidence?	6	7	6	6	27	96	High
10	Has new evidence superseded the information contained in the recommendations?	6	7	6	6	27	96	High
11	Does new evidence contradict the recommendations?	6	7	6	6	27	96	High
Domain Score (sum of 4 items)		24	28	24	24	108	96%	High
TRUSTWORTHINESS								
12	Is there a detailed description of the development process?	7	7	7	7	28	100	High
13	Were conflicts of interest declared and managed?	6	7	7	6	26	93	High
14	Was a grading system used for the recommendations?	6	7	7	7	27	96	High
15	Are the evidence tables clearly laid out and accurate?	6	7	7	6	26	93	High
16	Was the evidence review systematic and well-documented?	7	7	7	7	28	100	High
Domain Score (sum of 5 items)		32	35	35	33	135	96%	High
*Each item is scored using a 7-point Likert-scale: 1=lowest possible score, 7=highest possible score. ^Suitability category definitions: High >70%, Moderate 50-69%, and Low suitability <50% #Currency category definitions: High <1 year, Moderate 1-3 years, and Low currency >3years since systematic review search date								

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Table 2 (cont.): Suitability and currency assessments of IWGDF guideline to adopt or adapt; using a customised NHMRC table of factors*

ITEM NO.	ITEM DESCRIPTION	ASSESSOR 1	ASSESSOR 2	ASSESSOR 3	ASSESSOR 4	TOTAL SCORE	TOTAL SCORE%	QUALITY CATEGORY ^
ACCESS TO EVIDENCE								
17	Are the tables detailing the source evidence (e.g. GRADE Evidence to Decision tables) available?	6	7	7	7	27	96	High
18	Can permission be sought to use these tables?	6	7	7	7	27	96	High
Domain Score (sum of 2 items)		12	14	14	14	54	96%	High
IMPLEMENTABILITY								
19	Is information provided in the guideline to assist implementation?	4	6	3	5	18	64	Moderate
20	Are steps taken to improve the guideline's implementability?	4	6	2	5	17	61	Moderate
Domain Score (sum of 2 items)		8	12	5	10	35	63%	Moderate
ACCEPTABILITY								
21	Are the recommendations acceptable?	6	7	7	7	27	96	High
22	Do the recommendations relate to current practice?	6	6	7	7	26	93	High
Domain Score (sum of 2 items)		12	13	14	14	53	95	High
Total Guideline Score (sum of all 21 applicable items)		124	139	132	136	531	90%	High
Total Guideline Score %		84%	95%	90%	93%			
Total Guideline Suitability Category		High	High	High	High			

*Each item is scored using a 7-point Likert-scale: 1=lowest possible score, 7=highest possible score.

^Suitability category definitions: High >70%, Moderate 50-69%, and Low suitability <50%

#Currency category definitions: High <1 year, Moderate 1-3 years, and Low currency >3years since systematic review search date

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Table 3: National DFD expert panel members (discipline, state) for each sub-field panel

CRITERIA*	PREVENTION	WOUND CLASSIFICATION	PAD	INFECTION	OFFLOADING	WOUND HEALING
Expert (Chair)	Dr Anita Raspovic (Podiatrist, VIC)	Prof Stephen Twigg (Endocrinologist, NSW)	Prof Robert Fitridge (Vascular Surgeon, SA)	Dr Robert Commons (ID Physician, VIC)	A/Prof Peter Lazzarini (Podiatrist, QLD)	Dr Jenny Prentice (Wound Care Nurse, WA)
Expert (Secretary)	Dr Michele Kaminski (Podiatrist, VIC)	Dr Emma Hamilton (Endocrinologist, WA)	Prof Vivienne Chuter (Podiatrist, NSW)	Dr Robert Commons (ID Physician, VIC)	Dr Malindu Fernando (Podiatrist, QLD)	Ms Pam Chen (Podiatrist, TAS)
Expert	Prof Jonathan Golledge (Vascular Surgeon, QLD)	Dr Byron Perrin (Podiatrist, VIC)	Dr Frank Quigley (Vascular Surgeon, QLD)	Dr Sarah Lynar (ID Physician, NT)	Dr Mark Horsley (Orthopaedic Surgeon, NSW)	Prof Keryln Carville (Wound Care Nurse, WA)
Expert	Dr Joel Lasschuit (Endocrinologist, NSW)	Ms Hayley Ryan (Wound Care Nurse, NSW)	Dr Carsten Ritter (Vascular Surgeon, WA)	Dr Matthew Malone (Podiatrist, NSW)	Dr Brian Martin (Orthopaedic Surgeon, NSW)	A/Prof Peter Lazzarini (Podiatrist, QLD)
Expert	A/Prof Karl-Heinz Schott (Podiatrist, NSW)	Ms Jo Scheepers (Podiatrist, WA)	Dr Patrik Tosenovski (Vascular Surgeon, WA)	Dr Edward Raby (ID Physician, WA)	Ms Vanessa Nube (Podiatrist, NSW)	Ms Terry Swanson (Wound Care Nurse, VIC)
Expert					A/Prof Sara Jones (Podiatrist, SA)	
Representative (Consumer)	Ms Jane Cheney (Consumer, VIC)	Ms Jane Cheney (Consumer, VIC)	Ms Jane Cheney (Consumer, VIC)	Ms Jane Cheney (Consumer, VIC)	Ms Jane Cheney (Consumer, VIC)	Ms Jane Cheney (Consumer, VIC)
Representative (Aboriginal & Torres Strait Islander)	A/Prof James Charles (Podiatrist, VIC)	A/Prof James Charles (Podiatrist, VIC)	A/Prof James Charles (Podiatrist, VIC)	A/Prof James Charles (Podiatrist, VIC)	A/Prof James Charles (Podiatrist, VIC)	A/Prof James Charles (Podiatrist, VIC)
TOTAL MEMBERS	7	8	7	6	7	7

*Expert: (Inter)national research and/or clinical practice diabetes-related foot disease (DFD) sub-field expert; Representative: Consumer or Aboriginal and Torres Strait Islander representative with expertise in DFD A/Prof: Associate Professor; ID: Infectious Diseases; NSW: New South Wales; NT: Northern Territory; Prof: Professor; QLD: Queensland; SA: South Australia; TAS: Tasmania; VIC: Victoria; WA: Western Australia.

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Table 4: Summary of questions, recommendations, quality of evidence and strength of recommendations from the IWGDF guideline

CHAPTER	QUESTIONS	RECOMMENDATIONS	QUALITY OF EVIDENCE ^a			STRENGTH OF RECOMMENDATION ^b	
			HIGH	MODERATE	LOW	STRONG	WEAK
Prevention	11	16	2 (12%)	3 (19%)	11 (69%)	9 (56%)	7 (44%)
Wound Classification	4	5	1 (20%)	3 (60%)	1 (20%)	3 (60%)	2 (40%)
PAD	8	17	0	3 (18%)	14 (82%)	17 (100%)	0
Infection	11	36	2 (6%)	13 (36%)	21 (58%)	13 (36%)	23 (64%)
Offloading	9	13	1 (8%)	2 (15%)	10 (77%)	5 (38%)	8 (62%)
Wound Healing	8	13	0	3 (23%)	10 (77%)	5 (38%)	8 (62%)
TOTAL	51	100	6 (6%)	27 (27%)	67 (67%)	52 (52%)	48 (48%)

PAD: Peripheral artery disease

a. Quality of evidence rating. The quality of evidence is defined as the extent of the confidence that the estimates of an effect from a body of evidence are adequate to support a particular recommendation (26, 32, 45). Quality of evidence can be rated as:
 High = Typically, this is based on a body of evidence containing either: a) randomised trial(s) reporting similar effects with minimal risk of bias, inconsistency, indirectness, imprecision or publication bias &/or b) observational study(s) reporting similar very large effects, evidence of a dose response gradient and minimal confounding. Therefore, we are very confident that the true effect lies close to the estimate of the effect and further research is very unlikely to change our confidence in the estimate of effect (32, 45).

Moderate = Typically, this is based on a body of evidence containing either: a) randomised trial(s) reporting mostly similar effects, but with some serious risk of bias, inconsistency, indirectness, imprecision or publication bias, &/or b) observational study(s) reporting similar large effects with minimal confounding. Therefore, we are moderately confident that the true effect is likely to be close to the estimate of the effect, but there is also a possibility that it is substantially different and further research is likely to have an important impact on our confidence in the estimate of effect (32, 45).

Low = Typically, this is based on a body of evidence containing either: a) randomised trial(s) reporting some similar effects, but with very serious risk of bias, inconsistency, indirectness, imprecision or publication bias, &/or b) observational study(s) reporting similar effects, but with confounding (45). Therefore, we have limited confidence that the true effect is likely to be close to the estimate of the effect, and there is a high possibility that it is substantially different and further research is very likely to have an important impact on our confidence in the estimate of effect (32, 45).

b. Strength of recommendation ratings. The strength of a recommendation is defined as the extent to which we can be confident that the desirable effects (i.e. benefits, such as improved health outcome, improved quality of life, decreased costs) of an intervention outweigh the undesirable effects (i.e. harms, such as adverse events, decreased quality of life, increased costs) (26, 30, 32). The strength of a recommendation can be rated as:

Strong = Typically, this is based on a body of evidence, supplemented by expert opinion if limited evidence is available, that the desirable effects of an intervention considerably outweigh the undesirable effects for an intervention or vice versa. Therefore, we are highly confident of the balance between desirable and undesirable consequences and we make a strong recommendation for (desirable outweighs undesirable) or against (undesirable outweighs desirable) an intervention (30, 32).

Weak = Typically, this is based on a body of evidence, supplemented by expert opinion if limited evidence is available, that the desirable effects of an intervention may outweigh the undesirable effects for an intervention or vice versa. Therefore, we are less confident of the balance between desirable and undesirable effects and we make a weak recommendation for (desirable outweighs undesirable) or against (undesirable outweighs desirable) an intervention. (30, 32).

PROTOCOL & FINDINGS

Table 5: Summary of questions, recommendations, quality of evidence and strength of recommendations from the new Australian guidelines

CHAPTER	QUESTIONS	RECOMMENDATIONS	QUALITY OF EVIDENCE ^a				STRENGTH OF RECOMMENDATION ^b	
			HIGH	MODERATE	LOW	VERY LOW	STRONG	WEAK
Prevention	11	15	0	2 (13%)	13 (87%)	0	9 (60%)	6 (40%)
Wound Classification	4	5	1 (20%)	3 (60%)	1 (20%)	0	2 (40%)	3 (30%)
PAD	8	17	0	3 (18%)	14 (82%)	0	17 (100%)	0
Infection	11	35	2 (6%)	12 (34%)	20 (57%)	1 (3%)	21 (60%)	14 (40%)
Offloading	9	13	0	1 (8%)	9 (69%)	3 (23%)	4 (31%)	9 (69%)
Wound Healing	8	13	0	3 (23%)	10 (77%)	0	3 (23%)	10 (77%)
TOTAL	51	98	3 (3%)	24 (24%)	67 (68%)	4 (4%)	56 (57%)	42 (43%)

PAD: Peripheral artery disease

a. Quality of evidence rating. The quality of evidence is defined as the extent of the confidence that the estimates of an effect from a body of evidence are adequate to support a particular recommendation (26, 32, 45). Quality of evidence can be rated as:

High = Typically, this is based on a body of evidence containing either: a) randomised trial(s) reporting similar effects with minimal risk of bias, inconsistency, indirectness, imprecision or publication bias &/ or b) observational study(s) reporting similar very large effects, evidence of a dose response gradient and minimal confounding. Therefore, we are very confident that the true effect lies close to the estimate of the effect and further research is very unlikely to change our confidence in the estimate of effect (32, 45).

Moderate = Typically, this is based on a body of evidence containing either: a) randomised trial(s) reporting mostly similar effects, but with some serious risk of bias, inconsistency, indirectness, imprecision or publication bias, &/or b) observational study(s) reporting similar large effects with minimal confounding. Therefore, we are moderately confident that the true effect is likely to be close to the estimate of the effect, but there is also a possibility that it is substantially different and further research is likely to have an important impact on our confidence in the estimate of effect (32, 45).

Low = Typically, this is based on a body of evidence containing either: a) randomised trial(s) reporting some similar effects, but with very serious risk of bias, inconsistency, indirectness, imprecision or publication bias, &/or b) observational study(s) reporting similar effects, but with confounding (45). Therefore, we have limited confidence that the true effect is likely to be close to the estimate of the effect, and there is a high possibility that it is substantially different and further research is very likely to have an important impact on our confidence in the estimate of effect (32, 45).

Very Low = Typically, this is based on a body of evidence containing either: a) observational study(s) reporting similar effects, but with confounding, &/or expert opinion (45). Therefore, we have very limited confidence that the true effect is likely to be close to the estimate of the effect, and there is a very high possibility that it is substantially different and further research is most likely to have an important impact on our confidence in the estimate of effect (32, 45).

b. Strength of recommendation ratings. The strength of a recommendation is defined as the extent to which we can be confident that the desirable effects (i.e. benefits, such as improved health outcome, improved quality of life, decreased costs) of an intervention outweigh the undesirable effects (i.e. harms, such as adverse events, decreased quality of life, increased costs) (26, 30, 32). The strength of a recommendation can be rated as:

Strong = Typically, this is based on a body of evidence, supplemented by expert opinion if limited evidence is available, that the desirable effects of an intervention considerably outweigh the undesirable effects for an intervention or vice versa. Therefore, we are highly confident of the balance between desirable and undesirable consequences and we make a strong recommendation for (desirable outweighs undesirable) or against (undesirable outweighs desirable) an intervention (30, 32)

Weak = Typically, this is based on a body of evidence, supplemented by expert opinion if limited evidence is available, that the desirable effects of an intervention may outweigh the undesirable effects for an intervention or vice versa. Therefore, we are less confident of the balance between desirable and undesirable effects and we make a weak recommendation for (desirable outweighs undesirable) or against (undesirable outweighs desirable) an intervention. (30, 32)

PROTOCOL & FINDINGS

Table 6: Summary public consultation survey responses across all six guidelines

NO.	ITEM	n	STRONGLY AGREE	AGREE	NEITHER AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
BACKGROUND							
1	You are involved with the care of patients for whom this draft Australian guideline is relevant.	47	31 (66.0%)	9 (19.1%)	7 (14.9%)	0	0
2	There is a need for a new Australian guideline in this population.	47	23 (48.9%)	20 (42.6%)	3 (6.4%)	1 (2.1%)	0
3	The rationale for developing a new Australian guideline on this topic is clear in this draft guideline.	47	29 (61.7%)	17 (36.2%)	1 (2.1%)	0	0
METHODOLOGY							
4	I agree with the overall methodology used to develop this draft Australian guideline.	47	20 (42.6%)	23 (48.9%)	4 (8.5%)	0	0
5	The search strategy used to identify international guidelines on which this draft Australian guideline was based is relevant and complete.	47	19 (40.4%)	23 (48.9%)	4 (8.5%)	1 (2.1%)	0
6	The methods used to determine the suitability of identified international source guidelines upon which this draft Australian guideline were based were robust.	47	20 (42.6%)	21 (44.7%)	6 (12.8%)	0	0
7	I agree with the methods used within this draft Australian guideline to interpret the available evidence on this topic.	47	18 (38.3%)	24 (51.1%)	5 (10.6%)	0	0
8	The methods used to decide which recommendations to adopt, adapt or exclude for the Australian context were objective and transparent.	47	17 (36.2%)	27 (57.4%)	3 (6.4%)	0	0
RECOMMENDATIONS							
9	The recommendations in this draft Australian guideline are clear.	46	22 (47.8%)	19 (41.3%)	4 (8.7%)	1 (2.2%)	0
10	I agree with the recommendations in this draft Australian guideline as stated.	46	14 (30.4%)	24 (52.2%)	5 (10.9%)	3 (6.5%)	0
11	The recommendations are suitable for people living with diabetes-related foot disease.	46	15 (32.6%)	26 (56.5%)	3 (6.5%)	2 (4.3%)	0
12	The recommendations are too rigid to apply for people living with diabetes-related foot disease.	46	3 (6.5%)	4 (8.7%)	8 (17.4%)	27 (58.7%)	6 (13.0%)
13	The recommendations reflect a more effective approach to improving patient outcomes than is current practice.	46	10 (21.7%)	13 (28.3%)	17 (37.0%)	6 (13.0%)	0
14	When applied, the recommendations should produce more benefits than harms for people living with diabetes-related foot disease.	46	19 (41.3%)	22 (47.8%)	4 (8.7%)	1 (2.2%)	0
15	When applied, the recommendations should result in better use of resources than current practice allows.	46	16 (34.8%)	13 (28.3%)	13 (28.3%)	4 (8.7%)	0
16	I would feel comfortable if people living with diabetes-related foot disease received the care recommended in this draft Australian guideline.	46	21 (45.7%)	20 (43.5%)	5 (10.9%)	0	0

PROTOCOL & FINDINGS

Table 6 (cont.): Summary public consultation survey responses across all six guidelines

NO.	ITEM	n	STRONGLY AGREE	AGREE	NEITHER AGREE OR DISAGREE	DISAGREE	STRONGLY DISAGREE
IMPLEMENTATION OF RECOMMENDATIONS							
17	To apply the draft Australian guideline may require reorganisation of services/care.	45	9 (20.00%)	18 (40.0%)	12 (26.7%)	5 (11.1%)	1 (2.2%)
18	To apply the draft Australian guideline may be technically challenging.	45	6 (13.3%)	19 (42.2%)	14 (31.1%)	4 (8.9%)	2 (4.4%)
19	The draft Australian guideline may be too expensive to apply.	45	8 (17.8%)	5 (11.1%)	15 (33.3%)	13 (28.9%)	4 (8.9%)
20	The draft Australian guideline presents options that will likely be acceptable to people living with diabetes-related foot disease.	45	10 (22.2%)	29 (64.4%)	2 (4.4%)	4 (8.9%)	0
FINAL THOUGHTS							
21	This draft guideline should be approved as the new Australian guideline.	45	19 (42.2%)	18 (40.0%)	6 (13.3%)	2 (4.4%)	0
22	This draft Australian guideline would be supported by the majority of my colleagues.	45	17 (37.8%)	22 (48.9%)	6 (13.3%)	0	0
23	If this draft guideline was to be approved as the new Australian guideline, I would use or encourage their use in practice.	45	23 (51.1%)	18 (40.0%)	3 (6.7%)	1 (2.2%)	0

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REFERENCES

1. Lazzarini PA, van Netten JJ, Fitridge R, Griffiths I, Kinnear EM, Malone M, et al. Pathway to ending avoidable diabetes-related amputations in Australia. *The Medical Journal Of Australia*. 2018;209(7):288-90.
2. van Netten JJ, Lazzarini PA, Fitridge R, Kinnear EM, Griffiths I, Malone M, et al. Australian diabetes-related foot disease strategy 2018-2022: The first step towards ending avoidable amputations within a generation. Brisbane: Wound Management CRC; 2017.
3. Zhang Y, Lazzarini PA, McPhail SM, van Netten JJ, Armstrong DG, Pacella RE. Global Disability Burdens of Diabetes-Related Lower-Extremity Complications in 1990 and 2016. *Diabetes Care*. 2020;43(5):964-74.
4. Zhang Y, van Netten JJ, Baba M, Cheng Q, Pacella R, McPhail SM, et al. Diabetes-related foot disease in Australia: a systematic review of the prevalence and incidence of risk factors, disease and amputation in Australian populations. *Journal of Foot and Ankle Research*. 2021;14(1):8.
5. van Netten JJ, Bus SA, Apelqvist J, Lipsky BA, Hinchliffe RJ, Game F, et al. Definitions and criteria for diabetic foot disease. *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3268.
6. Jeffcoate WJ, Bus SA, Game FL, Hinchliffe RJ, Price PE, Schaper NC. Reporting standards of studies and papers on the prevention and management of foot ulcers in diabetes: required details and markers of good quality. *The Lancet Diabetes & Endocrinology*. 2016;4(9):781-8.
7. Lazzarini PA, O'Rourke SR, Russell AW, Derhy PH, Kamp MC. Reduced Incidence of Foot-Related Hospitalisation and Amputation amongst Persons with Diabetes in Queensland, Australia. *PLoS ONE*. 2015;10(6):e0130609.
8. Kurowski JR, Nedkoff L, Schoen DE, Knuiman M, Norman PE, Briffa TG. Temporal trends in initial and recurrent lower extremity amputations in people with and without diabetes in Western Australia from 2000 to 2010. *Diabetes Research And Clinical Practice*. 2015;108(2):280-7.
9. Baba M, Davis WA, Norman PE, Davis TM. Temporal changes in the prevalence and associates of diabetes-related lower extremity amputations in patients with type 2 diabetes: The Fremantle Diabetes Study. *Cardiovascular Diabetology*. 2015;14:152.
10. Baker IDI Heart and Diabetes Institute. National evidence-based guideline on prevention, identification and management of foot complications in diabetes (Part of the National Health & Medical Research Council Approved Guidelines on Management of Type 2 Diabetes). Melbourne: Baker IDI Heart & Diabetes Institute; 2011.
11. Parker CN, van Netten JJ, Parker TJ, Jia L, Corcoran H, Garrett M, et al. Differences between national and international guidelines for the management of diabetic foot disease. *Diabetes/Metabolism Research and Reviews*. 2019;35(2):e3101.
12. National Health & Medical Research Council (NHMRC). Australian Clinical Practice Guidelines Portal Search Canberra, Australia2020 [Available from: <https://www.clinicalguidelines.gov.au/portal>].
13. National Health & Medical Research Council (NHMRC). Guidelines for Guidelines: Adopt, adapt or start from scratch - Version 5.2; Last updated 22 November 2018. In: NHMRC, editor. Canberra, Australia 2018 <https://www.nhmrc.gov.au/guidelinesforguidelines/plan/adopt-adapt-or-start-scratch>.
14. National Health & Medical Research Council (NHMRC). Australian Clinical Practice Guidelines in Development Register Canberra, Australia2020 [Available from: <https://www.clinicalguidelines.gov.au/register>].
15. National Health & Medical Research Council (NHMRC). Guidelines for Guidelines: Project planning - Version 5.0; Last updated 5 September 2019. In: NHMRC, editor. Canberra, Australia2019.
16. National Health & Medical Research Council (NHMRC). Guidelines for Guidelines: Guideline Development Group - Version 5.0; Last updated 29th August 2019. In: NHMRC, editor. Canberra, Australia: NHMRC; 2019.
17. The ADAPTE Collaboration. The ADAPTE Process: Resource Toolkit for Guideline Adaptation - Version 2.0. Perthshire, Scotland: Guideline International Network; 2009 <https://g-i-n.net/library/tools>.
18. Schünemann HJ, Wiercioch W, Brozek J, Etzeandía-Ikobaltzeta I, Mustafa RA, Manja V, et al. GRADE Evidence to Decision (EtD) frameworks for adoption, adaptation, and de novo development of trustworthy recommendations: GRADE-ADOLOPMENT. *J Clin Epidemiol*. 2017;81:101-10.
19. Schaper NC, van Netten JJ, Apelqvist J, Bus SA, Hinchliffe RJ, Lipsky BA. Practical guidelines on the prevention and management of diabetic foot disease (IWGDF 2019 update). *Diabetes/Metabolism Research & Reviews*. 2020;36(S1):e3266.
20. National Association of Diabetes Centres (NADC) and Australian Diabetes Society (ADS). NADC Collaborative Interdisciplinary Diabetes High Risk Foot Services Standards Version 1.1 Sydney, Australia: National Association of Diabetes Centres; 2018 [Available from: <https://nadc.net.au/national-standards/>].

PROTOCOL & FINDINGS

REFERENCES

21. Guidelines International Network. International Guideline Library Search Perthshire, Scotland 2020 [Available from: <https://g-i-n.net/library/international-guidelines-library>].
22. Shamseer L, Moher D, Clarke M, Ghersi D, Liberati A, Petticrew M, et al. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015: elaboration and explanation. *BMJ*. 2015;349:g7647.
23. Brouwers MC, Kho ME, Brouman GP, Burgers JS, Cluzeau F, Feder G, et al. AGREE II: advancing guideline development, reporting and evaluation in health care. *CMAJ : Canadian Medical Association journal*. 2010;182(18):E839-42.
24. AGREE Next Steps Consortium. The AGREE II Instrument - Update: December 2017 [Electronic version]. Ontario, Canada: AGREE Enterprise; 2017 <https://www.agreetrust.org/>.
25. Expertscape. Experts in diabetic foot disease 2020 [Available from: <https://expertscape.com/ex/diabetic+foot>].
26. Alonso-Coello P, Oxman AD, Moberg J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 2: Clinical practice guidelines. *Bmj*. 2016;353:i2089.
27. Alonso-Coello P, Schünemann HJ, Moberg J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 1: Introduction. 2016;353:i2016.
28. Schünemann HJ, Mustafa R, Brozek J, Santesso N, Alonso-Coello P, Guyatt G, et al. GRADE Guidelines: 16. GRADE evidence to decision frameworks for tests in clinical practice and public health. *J Clin Epidemiol*. 2016;76:89-98.
29. Andrews JC, Schünemann HJ, Oxman AD, Pottie K, Meerpohl JJ, Coello PA, et al. GRADE guidelines: 15. Going from evidence to recommendation-determinants of a recommendation's direction and strength. *J Clin Epidemiol*. 2013;66(7):726-35.
30. Andrews J, Guyatt G, Oxman AD, Alderson P, Dahm P, Falck-Ytter Y, et al. GRADE guidelines: 14. Going from evidence to recommendations: the significance and presentation of recommendations. *J Clin Epidemiol*. 2013;66(7):719-25.
31. Flores EJ, Mull NK, Lavenberg JG, Mitchell MD, Leas BF, Williams A, et al. Using a 10-step framework to support the implementation of an evidence-based clinical pathways programme. *BMJ Quality and Safety*. 2019;28(6):476-85.
32. Bus SA, van Netten JJ, Hinchliffe RJ, Apelqvist J, Lipsky BA, Schaper NC, et al. Standards for the development and methodology of the 2019 International Working Group on the Diabetic Foot guidelines. *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3267.
33. Bus SA, Armstrong DG, Gooday C, Jarl G, Caravaggi C, Viswanathan V, et al. Guidelines on offloading foot ulcers in persons with diabetes (IWGDF 2019 update). *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3274.
34. Bus SA, Lavery LA, Monteiro-Soares M, Rasmussen A, Raspovic A, Sacco ICN, et al. Guidelines on the prevention of foot ulcers in persons with diabetes (IWGDF 2019 update). *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3269.
35. Hinchliffe RJ, Forsythe RO, Apelqvist J, Boyko E, Fitridge R, Hong JP, et al. Guidelines on the diagnosis, prognosis and management of peripheral artery disease in patients with a foot ulcer and diabetes (IWGDF 2019 update). *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3276.
36. Lipsky BA, Senneville E, Abbas ZG, Aragon-Sanchez J, Diggle M, Embil JM, et al. Guidelines on the diagnosis and treatment of foot infection in persons with diabetes (IWGDF 2019 update). *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3280.
37. Monteiro-Soares M, Russell D, Boyko EJ, Jeffcoate WJ, Mills JL, Morbach S, et al. Guidelines on the classification of diabetic foot ulcers (IWGDF 2019). *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3273.
38. Rayman G, Vas PR, Dhatariya KK, Driver VR, Hartemann A, Londahl M, et al. Guidelines on interventions to enhance healing of chronic foot ulcers in persons with diabetes (IWGDF 2019 update). *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3283.
39. Kaminski MR, Golledge J, Lasschuit JWJ, Heinz-Schott K, Charles J, Cheney J, et al. Australian guideline on prevention of foot ulceration: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
40. Fernando ME, Horsley MW, Jones S, Martin B, Nube VL, Charles J, et al. Australian guideline on offloading treatment for foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.

PROTOCOL & FINDINGS

REFERENCES

41. Chuter VH, Quigley F, Tosenovsky P, Ritter JC, Charles J, Cheney J, et al. Australian guideline on diagnosis and management of peripheral artery disease: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
42. Commons RJ, Charles J, Cheney J, Lynar SA, Malone M, Raby E, et al. Australian guideline on management of diabetes-related foot infection: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
43. Chen P, Carville K, Swanson T, Lazzarini PA, Charles J, Cheney J, et al. Australian guideline on wound healing interventions to enhance healing of foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
44. Hamilton EJ, Scheepers J, Ryan H, Perrin BM, Charles J, Cheney J, et al. Australian guideline on wound classification of diabetes-related foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
45. Balshem H, Helfand M, Schünemann HJ, Oxman AD, Kunz R, Brozek J, et al. GRADE guidelines: 3. Rating the quality of evidence. *J Clin Epidemiol.* 2011;64(4):401-6.
46. Living Evidence for Diabetes Consortium. Australian Evidence-Based Clinical Guidelines for Diabetes 2020 Melbourne, Australia 2020 [Available from: <https://app.magicapp.org/#/guideline/E5AbPE> , accessed on 13 December 2021].



PREVENTION

Australian guideline on prevention of foot ulceration

Part of the 2021 Australian
evidence-based guidelines for
diabetes-related foot disease

VERSION 1.0 140921



AUTHORS

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Disclaimer

These Australian Evidence-based Guidelines are a general guide to appropriate practice, to be followed subject to the clinician's judgment and the patient's preference in each individual case. The Guidelines are designed to provide information to assist decision-making and are based on the best evidence available at the time of development.

Diabetes Feet Australia would like to thank and acknowledge Mikaela Cameron who has created the artwork to represent the guidelines. Mikaela Cameron (M. J. Badagarang) is a proud Dharug saltwater woman from the Hawkesbury River in New South Wales, Australia. She's worked the past 4 years as a cultural educator delivering cultural workshops and creating murals. "Worimi, I am a proud Dharug woman. My totem is the Badagarang (Eastern Grey Kangaroo), and Waroo (the brown-eyes crow). I pay my respects to all Elders past, present and emerging, and extend this acknowledgment to you and your people. Welcome, let's walk together."



ABSTRACT

Background

There are no current Australian guidelines on the prevention of diabetes-related foot ulceration (DFU). A national expert panel aimed to systematically identify and adapt suitable international guidelines to the Australian context to create new Australian evidence-based guidelines on prevention of first-ever and/or recurrent DFU. These guidelines will include for the first-time considerations for rural and remote, and Aboriginal and Torres Strait Islander peoples.

Methods

The National Health and Medical Research Council procedures were followed to adapt suitable international guidelines on DFU prevention to the Australian health context. This included a search of public databases after which the International Working Group on the Diabetic Foot (IWGDF) prevention guideline was deemed the most appropriate for adaptation. The 16 IWGDF prevention recommendations were assessed using the ADAPTE and GRADE systems to decide if they should be adopted, adapted or excluded for the new Australian guideline. The quality of evidence and strength of recommendation ratings were re-evaluated with reference to the Australian context. This guideline underwent public consultation, further revision, and approval by national peak bodies.

Results

Of the 16 original IWGDF prevention recommendations, nine were adopted, six were adapted and one was excluded. It is recommended that all people at increased risk of DFU are assessed at intervals corresponding to the IWGDF risk ratings. For those at increased risk, structured education about appropriate foot protection, inspection, footwear, weight-bearing activities, and foot self-care is recommended. Prescription of orthotic interventions and/or medical grade footwear, providing integrated foot care, and self-monitoring of foot skin temperatures (contingent on validated, user-friendly and affordable systems becoming available in Australia) may also assist in preventing DFU. If the above recommended non-surgical treatment fails, the use of various surgical interventions for the prevention of DFU can be considered.

Conclusions

This new Australian evidence-based guideline on the prevention of DFU, endorsed by 10 national peak bodies, provides specific recommendations for relevant health professionals and consumers in the Australian context to prevent DFU. Following these recommendations should achieve better DFU prevention outcomes in Australia.

Keywords

Diabetes-related foot ulceration; diabetes-related foot disease; education; foot self-care; foot ulcer; footwear; guideline; prevention; surgery.



PREVENTION

AUSTRALIAN RECOMMENDATIONS LIST

PREVENTION

WOUND CLASSIFICATION

PERIPHERAL ARTERY
DISEASE

INFECTION

OFFLOADING

WOUND HEALING
INTERVENTIONS

- 1 Examine a person with diabetes at very low risk of foot ulceration (IWGDF risk 0) annually for signs or symptoms of loss of protective sensation and peripheral artery disease, to determine if they are at increased risk for foot ulceration. (GRADE strength of recommendation: Strong; Quality of evidence: Low)
- 2 Screen a person with diabetes at risk of foot ulceration (IWGDF risk 1-3) for: a history of foot ulceration or lower-extremity amputation; diagnosis of end-stage renal disease; presence or progression of foot deformity; limited joint mobility; abundant callus; and any pre-ulcerative sign on the foot. Repeat this screening once every 6-12 months for those classified as IWGDF risk 1, once every 3-6 months for IWGDF risk 2, and once every 1-3 months for IWGDF risk 3. (Strong; Low)
- 3 Instruct a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3) to protect their feet by not walking barefoot, in socks without shoes, or in thin-soled slippers, whether indoors or outdoors. (Strong; Low)
- 4 Instruct, and after that encourage and remind, a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3) to: inspect daily the entire surface of both feet and the inside of the shoes that will be worn; wash the feet daily (with careful drying, particularly between the toes); use emollients to lubricate dry skin; cut toe nails straight across; and, avoid using chemical agents or plasters or any other technique to remove callus or corns. (Strong; Low)
- 5 Provide structured education to a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3) about appropriate foot self-care for preventing a foot ulcer. (Strong; Low)
- 6 Consider instructing a person with diabetes who is at moderate or high risk of foot ulceration (IWGDF risk 2-3) to self-monitor foot skin temperatures once per day to identify any early signs of foot inflammation and help prevent a first or recurrent plantar foot ulcer. The implementation of this recommendation is contingent on validated, user-friendly and affordable systems becoming approved and available in Australia. If the temperature difference is above-threshold between similar regions in the two feet on two consecutive days, instruct the patient to reduce ambulatory activity and consult an adequately trained health care professional for further diagnosis and treatment. (Weak; Moderate)
- 7 Instruct a person with diabetes who is at moderate risk for foot ulceration (IWGDF risk 2) or who has healed from a non-plantar foot ulcer (IWGDF risk 3) to wear medical grade footwear that accommodates the shape of the feet and that fits properly, to reduce plantar pressure and help prevent a foot ulcer. When a foot deformity or a pre-ulcerative sign is present, consider prescribing custom-made footwear, custom-made foot orthoses, or toe orthoses. (Strong; Low)
- 8 Consider prescribing orthotic interventions, such as toe silicone or (semi-)rigid orthotic devices, to help reduce abundant callus in a person with diabetes who is at risk for foot ulceration (IWGDF risk 1-3). (Weak; Low)
- 9 In a person with diabetes who has a healed plantar foot ulcer (IWGDF risk 3), prescribe medical grade footwear that has a demonstrated plantar pressure relieving effect during walking, to help prevent a recurrent plantar foot ulcer; furthermore, encourage the patient to consistently wear this footwear. (Strong; Moderate).
- 10 Treat any pre-ulcerative sign or abundant callus on the foot, ingrown toenail, and fungal infection on the foot, to help prevent a foot ulcer in a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3). (Strong; Low)
- 11 In a person with diabetes and abundant callus consider digital flexor tendon tenotomy for preventing a first foot ulcer. Where there is an ulcer on the apex or distal part of a non-rigid hammertoe that has failed to heal with evidence-based non-surgical treatment, consider this procedure to help prevent future ulcer recurrence. (Weak; Low)

PREVENTION

AUSTRALIAN RECOMMENDATIONS LIST



PREVENTION

WOUND CLASSIFICATION

PERIPHERAL ARTERY
DISEASE

INFECTION

OFFLOADING

WOUND HEALING
INTERVENTIONS

12	In a person with diabetes and a plantar forefoot ulcer that has failed to heal with evidence-based non-surgical treatment, consider Achilles tendon lengthening, single or pan metatarsal head resection, metatarsophalangeal joint arthroplasty or osteotomy, to help prevent future ulcer recurrence. (Weak; Low)
13	We suggest not to use a nerve decompression procedure, in preference to accepted standards of good quality care, to help prevent a foot ulcer in a person with diabetes who is at moderate or high risk of foot ulceration (IWGDF risk 2-3) and who is experiencing neuropathic pain. (Weak; Low)
14	Consider communicating to a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3) that any increase in weight-bearing activity should be gradual, ensuring appropriate footwear and/or prescribed offloading device(s) are worn, and that the skin is frequently monitored for pre-ulcerative signs or injury. (Weak; Low)
15	Provide integrated foot care for a person with diabetes who is at high risk of foot ulceration (IWGDF risk 3) to help prevent a recurrent foot ulcer. This integrated foot care includes professional foot care, adequate footwear, and structured education about self-care. Repeat this foot care or re-evaluate the need for it once every one to three months, as necessary. (Strong; Low)



BACKGROUND

Diabetes-related foot ulceration (DFU) is recognised as a leading cause of hospital admission and amputations worldwide (1-4). DFU also contributes to high rates of morbidity and mortality, which poses a major burden to the health-related quality of life of patients and has substantial economic consequences (1, 5-7). The lifetime incidence of DFU is between 19% to 34%, with an annual incidence of around 2% (1, 8). DFU recurrence is also very common, with approximately 40% of ulcers recurring within one year and 65% within three years (1, 8).

In Australia, it is estimated that 50,000 people are living with DFU, while 300,000 people are considered at-risk (4-6, 9). Each year, Australia has approximately 28,000 hospital admissions, 4,500 amputations, 1,700 deaths, and \$AU1.6 billion in health care expenditure attributable to DFU (4, 10-12). Aboriginal and Torres Strait Islander peoples have disproportionately high rates of foot-related complications, with a 3 to 6-fold increased likelihood of developing DFU and requiring amputation (5, 13, 14). Prevention is central to reducing the very high national DFU burden and addressing the Closing the Gap in Partnership agreement to help Aboriginal and Torres Strait Islander peoples enjoy long and healthy lives (15).

Key risk factors contributing to the development of DFU include peripheral neuropathy, peripheral arterial disease (PAD) and foot deformity (8, 16, 17). Empirical evidence has shown that history of foot ulceration, amputation and/or end-stage renal disease (ESRD) further increase the risk (1, 8, 16, 17). For those without risk factors, the incidence of DFU is very low (8). Hence, prevention strategies should be targeted to people considered at increased risk (at-risk) for DFU (8). Within existing studies and clinical practice, there are a variety of interventions available for the prevention of DFU, and for the treatment of modifiable risk factors in those at-risk (18, 19). These prevention interventions include examining and inspecting the feet, structured education about foot self-care and management principles, early treatment of pre-ulcerative signs or injuries, surgical interventions (particularly to prevent ulcer recurrence), and the provision of integrated foot care (8, 18, 19).

Interventions aimed at the prevention of DFU have been found to have contrasting benefits and risks (18, 19), varying levels of evidence to support their benefits and risks (18, 19), and global differences in their feasibility and clinical uptake (20-22). In order to interpret the balance between the benefits and risks, the quality of the supporting evidence, and the acceptability and feasibility of these interventions, evidence-based prevention guidelines have been developed to guide optimal care (8, 23).

The 2011 Australian evidence-based guidelines for the treatment of people with diabetes-related foot disease (DFD) are currently outdated (22, 23), which may be reflective of the high costs (~\$AU1 million) associated with the development of new high-quality guidelines (24). There is now a compelling need for the Australian DFD guidelines to be updated to provide contemporary evidence-based recommendations to health professionals to help prevent the large national DFU burden (22). A more cost-effective, yet still robust, alternative to the creation of new guidelines from scratch, is to adapt existing international guidelines; following rigorous assessment by experts in the field to ensure that they meet a high-quality standard (25). In recent years, there have been several international evidence-based DFD guidelines published (8, 26-28). Given the uncertainty and unlikelihood of securing substantial funding for the development of new Australian DFD guidelines in the foreseeable future, the aim was to systematically identify and adapt suitable international guidelines to the Australian context. This paper presents the new Australian evidence-based guidelines on prevention of first-ever and/or recurrent DFU.



Key risk factors contributing to the development of DFU include peripheral neuropathy, peripheral arterial disease (PAD) and foot deformity



METHODS

Key steps

The methodology for this guideline has been described in detail in an accompanying guidelines development paper authored by the Australian DFD Guidelines working group (29). The National Health and Medical Research Council (NHMRC) procedures for adapting source guidelines were followed (25, 30, 31), using eight overarching steps: (i) defining the scope (population and problem); (ii) identifying potential source guidelines; (iii) assessing the suitability of source guidelines; (iv) assessing and deciding which source guideline recommendations to adopt, adapt or exclude in the new context; (v) drafting new recommendations and rationale for the context; (vi) collating recommendations and rationale into new guidelines; (vii) developing clinical pathway(s) to aide implementation; and (viii) consultation and endorsement of the final guidelines (29). The development paper reports the findings of the initial three steps, including that the 2019 International Working Group on the Diabetic Foot (IWGDF) Guidelines (8) were identified and assessed as suitable international source guidelines to adapt for this new Australian guideline (29). The subsequent steps are the subject of this manuscript and are outlined below.

Prevention guideline panel

A national expert panel ('the authors') was established by the Australian DFD Guidelines working group to develop this prevention guideline, including recognised multi-disciplinary (inter)national clinical or research experts in the prevention of DFU, along with consumer, end-user and Aboriginal and Torres Strait Islander DFD experts (29). The panel was provided all prevention recommendations (and all supporting rationale and evidence) from the IWGDF guidelines and systematic reviews (8, 18, 19) to consider as the basis for developing this guideline (29).

Population of interest

The IWGDF identified the population of interest for their systematic reviews (18, 19) and subsequent guideline (8) as people at-risk of DFU (IWGDF risk stratification system: risk 1 [low], risk 2 [moderate], risk 3 [high]), defined as "people with diabetes mellitus and peripheral neuropathy", including "people with or without foot deformities, PAD or lower- extremity amputation, and both people in remission from foot ulceration (i.e. foot ulcer history) and those with no foot ulcer history" (pp. 3) (18, 19).

Initial screening with ADAPTE

Clinical and research panel members were assigned into pairs to independently screen each IWGDF prevention recommendation (and rationale) for their quality of evidence, strength of recommendation and the acceptability and applicability in the Australian context, using a customised 7-item ADAPTE evaluation form (29, 31).

The panel rated the *quality of evidence* in alignment with the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) system as: high, if the panel was very confident that the findings were from studies reporting consistent effects with low risk of bias and further research was unlikely to change that confidence; moderate, if moderate confidence in the consistency of effects or risk of bias and further research was likely to impact that confidence; low, if limited confidence in the risk of bias or had inconsistency of effects and further research was very likely to impact confidence; and very low, if very little confidence in the available supporting evidence (30, 32, 33). The panel also rated the strength of recommendation based on the GRADE system by weighing up the balance of effects, quality of evidence, values, applicability and acceptability (32, 33) in the Australian context (29) as: strong, if there was clearly a moderate-to-large difference in the balance of effects between the intervention compared with the control; and weak, if there was an uncertain and/or mild-to-moderate difference (32, 33).

The panel also rated the *strength of recommendation* based on the GRADE system by weighing up the balance of effects, quality of evidence, values, applicability and acceptability (32, 33) in the Australian context (29) as: strong, if there was clearly a moderate-to-large difference in the balance of effects between the intervention compared with the control; and weak, if there was an uncertain and/or mild-to-moderate difference (32, 33). Any disagreements between the two panel members on any ratings were discussed until consensus was reached. If consensus was not possible, a third member was involved in the adjudication. Finally, the full panel met to discuss and gain consensus on all item ratings for all recommendations. Any recommendations in which the panel unanimously agreed with all items relating to the quality of evidence and strength of recommendation made by IWGDF, and acceptability and applicability in the Australian context, were adopted. Whereas any recommendations where the panel did not agree or were unsure on any item progressed to full assessment (29, 31).



Full assessment with GRADE Evidence to Decision

Recommendations requiring full assessment were assessed using a customised GRADE Evidence to Decision (EtD) tool (29, 30, 32, 33). This involved one panel member extracting and populating the EtD tool with all relevant supporting evidence text for the recommendation from the IWGDF prevention guideline and systematic reviews (8, 18, 19). Eight important EtD criteria were specifically populated: the problem, desirable effects, undesirable effects, quality (or certainty) of evidence, values (of importance of outcomes), balance of effects, acceptability and applicability (29, 30, 32, 33). Once populated, the EtD tool was checked by a second member for accuracy and any disagreements were discussed until a consensus was reached. This assessment involved the member(s) reading all populated text, adding any additional Australian literature or expert opinion considerations not included in the extracted IWGDF text, and making judgements for each criterion. The panel met to discuss and gain consensus on their summary judgements for the eight criteria (30, 32, 33) and compared their judgements with that of the IWGDF judgements (29, 30).

Decision to Adopt, Adapt or Exclude

Based on the level of agreement between the panel and IWGDF summary judgements, the panel then made a consensus decision on adopting, adapting or excluding the recommendation concerned for the Australian context (29, 30). These decisions were defined as follows: adopted, if there were no substantial differences between the panel and IWGDF summary judgements; adapted, if there were substantial differences; and excluded, if there were substantial differences and/or the panel concluded the recommendation was not acceptable or applicable in Australia (29, 30). Any disagreements within the panel were discussed until consensus was reached or, if that was not possible, by discussing with the Australian DFD Guideline working group until consensus was reached.

The panel then re-wrote any adapted recommendation to be clear, specific, and unambiguous as per the GRADE system (34, 35). For each recommendation, the panel then drafted decision rationale, summary justifications for their judgements, detailed justifications for the important EtD criteria (if the recommendation was fully assessed), and considerations for implementation, special subgroups (including for geographically remote and Aboriginal and Torres Strait Islander populations), monitoring and future research priorities (30, 32, 33) in the Australian context (29). The panel collated all recommendations (and rationale) into a consultation draft manuscript for the Australian evidence-based prevention guideline ready for public consultation (29).

Clinical pathway development

Finalised recommendations were used to develop a DFU prevention clinical pathway (29). The pathway aimed to optimise the implementation of prevention recommendations by the multiple health professionals and disciplines caring for Australians with DFU in secondary and tertiary health care settings in Australia. The pathway development methodology followed the 10-step process for developing and implementing clinical pathways as recommended by Flores et al (36) and has also been outlined in detail in the accompanying Guideline development paper (29).

Public consultation and peak body endorsement

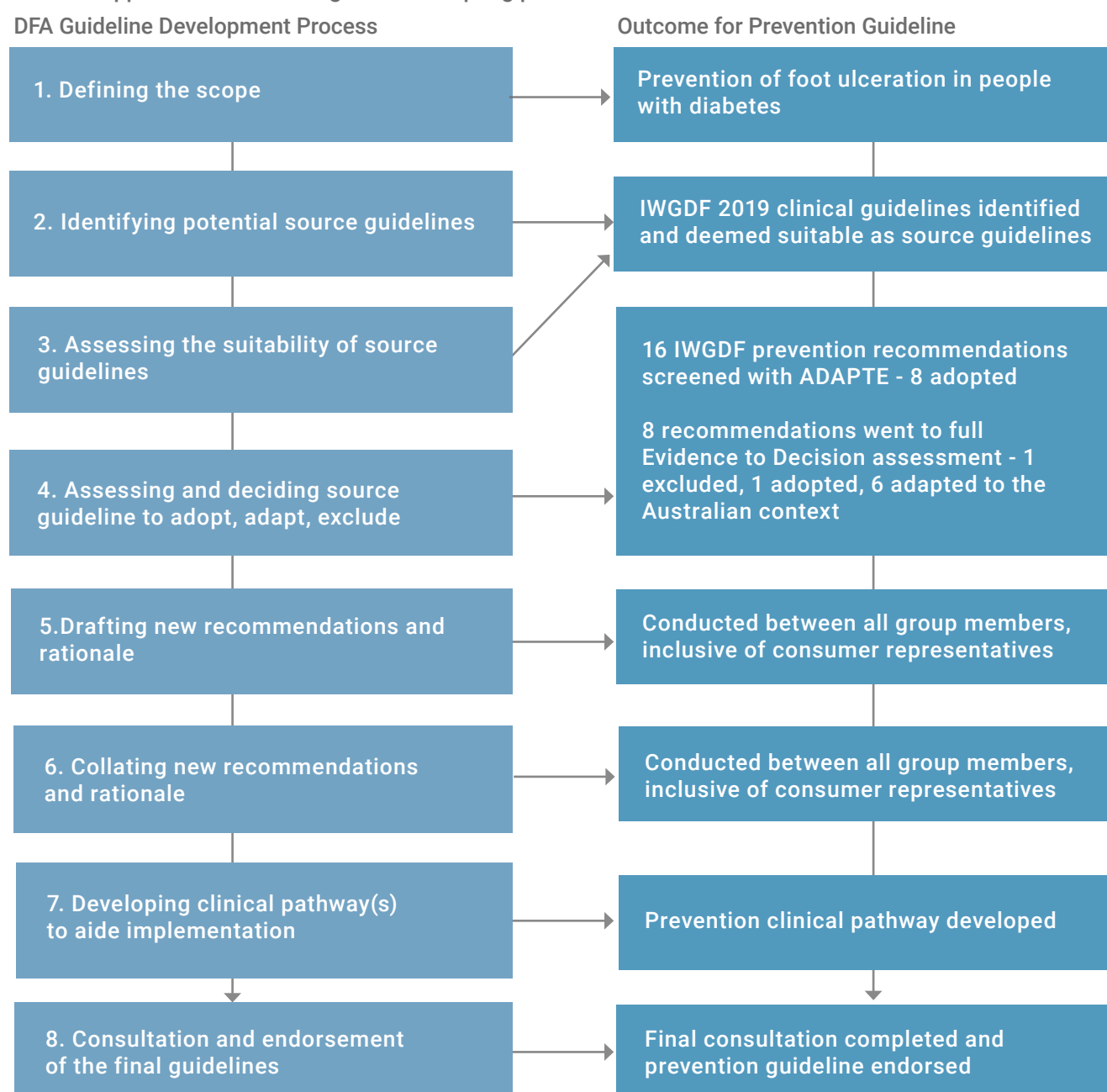
The consultation draft manuscript of the prevention guideline underwent a formal six-week public consultation period using a 23-item customised consultation survey from ADAPTE (29, 31). All relevant survey and written feedback data from the consultation period were collated, analysed and the manuscript was revised accordingly by the authors (29, 31). Finally, the authors sought endorsement from the Australian DFD Guidelines working group and other relevant peak national bodies for the final guideline to be released (29). The results and recommendations in this guideline should be read in conjunction with the respective source documents from the IWGDF Prevention Working Group, where full descriptions of the findings and rationale are provided (8, 18, 19).



RESULTS

Figure 1 displays a diagrammatic summary of the guideline development process and key outcomes. Table 1 shows that after screening, eight recommendations required further full assessment and eight were adopted without further assessment. Table 2 shows that of the eight recommendations that underwent full assessment, one was adopted, one was excluded and six were adapted in order to be considered acceptable and applicable in the Australian context. The main reasons for adapting, included two recommendations that had the quality of evidence rating downgraded, three that had the population or implementation requirements clarified (wordings of recommendations were restructured in an attempt to retain the same meaning but improve clarity) and one that had the intervention modified. The reasons for excluding (Recommendation 14 of the IWGDF Prevention Guideline) were due to the panel having substantial differences in judgements to the IWGDF for the desirable effects, balance of effects, and the quality of evidence, resulting in the panel concluding that the recommendation was not acceptable in the Australian context. Table 3 summarises the wording differences between each of the original 16 IWGDF recommendations and the new 15 Australian recommendations. Overall, nine were adopted (Recommendations 3-5, 7-10, 13 and 16), six were adapted (Recommendations 1-2, 6, 11-12 and 15) and one was excluded (Recommendation 14).

FIGURE 1: Application of the DFD guideline adapting process to the Prevention Guideline





PREVENTION

For each of the 15 Australian prevention recommendations, the question the recommendation addressed; the recommendation(s); the panel's decision and rationale to adopt, adapt or exclude; a summary justification for the recommendation(s); and considerations for the Australian context (including for geographically remote and Aboriginal and Torres Strait Islander peoples) are outlined. As the panel agreed with the IWGDF for the majority of the summary judgements for EtD criteria across 15 (out of 16) of the original IWGDF recommendations, the differences in agreement to the IWGDF recommendations will be the focus of the results presented.

The recommendations are displayed in order according to their prevention category:

- A. Identifying the at-risk foot;
- B. Regularly inspecting and examining the at-risk foot;
- C. Instructions on foot self-care;
- D. Providing structured education about foot self-care;
- E. Instructions about foot self-management;
- F. Ensuring routine wearing of appropriate footwear;
- G. Treatment of risk factors or pre-ulcerative signs on the foot;
- H. Surgical interventions;
- I. Foot-related exercises and weight-bearing activity;
- J. Integrated foot care.

Figure 2 (referred to on page 40) incorporates all 15 recommendations in a one-page Australian clinical pathway to guide evidence-based prevention of DFU. Finally, a glossary of terms used in the guideline and aligned with the IWGDF Guideline can be found in Supplementary File 1.

Nineteen responses (13 individuals and six organisations) to the public consultation survey were received, with 18 completing the survey in its entirety. The collated public consultation responses are displayed in Table 4. No respondents (0%) disagreed with the statements that there was a need for a new prevention guideline, the methodology used for these guidelines was appropriate, the recommendations were clear, when applied the recommendations should produce more benefits than harms, and they would be comfortable if people with DFU received these recommendations. In implementing the prevention guideline, some respondents agreed that to apply the recommendations this may pose challenges around the need for reorganisation of services (50%), technical application (44%) and expense (22%). A large proportion of respondents (83%) agreed the guidelines are likely to be acceptable to people living with DFU. Overall, 78% of the respondents agreed (with none disagreeing) that the guideline should be approved as the new Australian prevention guideline. No respondents (0%) disagreed with the statements that the guideline would be supported by the majority of their colleagues and would encourage its use in practice. All de-identified feedback comments received during public consultation and the panel's responses to each comment were collated and posted on the Diabetes Feet Australia website. Based on the collated public consultation feedback, the guideline was revised, approved by the panel and Australian DFD Guidelines working group, and endorsed as the new *Australian guideline on prevention of foot ulceration* by ten peak national bodies listed below.

GUIDELINE ENDORSEMENT

The prevention guideline has been endorsed by the following Australian peak bodies and national organisations

- Aboriginal and Torres Strait Islander Diabetes-related Foot Complications Program (SAHMRI)
- Advanced Practising Podiatrists - High Risk Foot Group
- Australian and New Zealand Society for Vascular Surgery
- Australian Diabetes Society
- Australian Orthotic Prosthetic Association
- Australian Podiatry Association
- Australasian Society for Infectious Diseases
- Diabetes Feet Australia
- Podiatric Association of Australia
- Wounds Australia





A: IDENTIFYING THE AT-RISK FOOT

Recommendation 1

Examine a person with diabetes at very low risk of foot ulceration (IWGDF risk 0) annually for signs or symptoms of loss of protective sensation and peripheral artery disease, to determine if they are at increased risk for foot ulceration. (GRADE strength of recommendation: Strong; Quality of evidence: Low)

DECISION: ADAPTED

Rationale

The panel decided to adapt this original IWGDF recommendation, based on having a differing judgement to the IWGDF on the quality of evidence rating. Therefore, we downgraded the quality of evidence from high to low (Table 2).

Summary of justification

Although the panel agreed with the IWGDF that the strength of this recommendation is strong, we disagreed that the quality of evidence supporting this is high (8). The reason for our divergent judgement is that in our assessment while evidence exists supporting loss of protective sensation and PAD as risk factors for foot ulceration (16), no direct evidence, or a very low quality of supporting evidence, was available affirming the degree to which screening for these risk factors translates into prevention of DFU (8). Furthermore, in our expert opinion, there are several scenarios whereby detection of ulcer risk upon screening might not result in DFU prevention, such as non-adherence to ulcer prevention strategies or deterioration in ulcer risk status between screenings. The panel therefore deemed that further research is required before a quality of evidence rating above low can be considered for this recommendation.

Otherwise, on all other EtD criteria judgements that led to the strength of recommendation rating, the panel were closely aligned with the IWGDF. There was strong agreement that identification of foot ulcer risk was, on face value and in our expert opinion, highly important for appropriate and targeted DFU preventative treatment and most probably offered at least moderate additional desirable effects (benefit) compared with not examining for foot ulcer risk. The panel, including consumer representatives, acknowledged that fast and effective approaches to identifying DFU risk were also of great value to persons with diabetes, and essential to receiving the right support and care. Conversely, undesirable effects from the possibility of the individual sustaining harm from screening was considered very unlikely, or trivial at best compared to not screening, given its non-invasive, inexpensive, and fast administration. Thus, the balance of effects favoured screening for increased risk compared to not screening, based on the difference between at least moderate likely desirable effects and trivial likely undesirable effects.

The panel also agreed that costs on a societal level, for example, across large publicly funded health services, may be a challenge to address. Arguably, the monetary costs of screening, however, are probably significantly outweighed by its benefits, although empirical data to inform this debate is not currently available. Optimal time periods for re-screening also need to be determined when considering costs versus benefits. The panel agreed that yearly screenings were likely to be acceptable and feasible for most people with diabetes at very low risk of DFU. Thus, overall, we agree with the IWGDF that the strength of the recommendation is strong, based on a clear balance of effects, acceptability and feasibility for screening for increased risk compared to not screening.

Considerations for the Australian context

Refer to Recommendation 2 that outlines the considerations for both Recommendation 1 and 2.

The IWGDF risk stratification system referred to throughout is detailed in Table 5.



B: REGULARLY INSPECTING AND EXAMINING THE AT-RISK FOOT

Recommendation 2

Screen a person with diabetes at risk of foot ulceration (IWGDF risk 1-3) for: a history of foot ulceration or lower-extremity amputation; diagnosis of end-stage renal disease; presence or progression of foot deformity; limited joint mobility; abundant callus; and any pre-ulcerative sign on the foot. Repeat this screening once every 6-12 months for those classified as IWGDF risk 1, once every 3-6 months for IWGDF risk 2, and once every 1-3 months for IWGDF risk 3. (Strong; Low)

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation as we had differing judgements for the quality of evidence rating. Therefore, we downgraded the quality of evidence rating from high to low (Table 2).

Summary of justification

As for recommendation 1, the panel agreed with the IWGDF that the strength of recommendation 2 is also strong, however disagreed that the quality of evidence is high with similar justification (8). While the key factors which are predictive of re-ulceration have a high quality of supporting evidence (1, 16, 17, 37), the degree to which screening for these factors is effective for prevention of DFU, and the optimal intervals for screening, have no evidence to our knowledge, or a very low quality of supporting evidence. The panel therefore also deemed that further research is required before a collective quality of evidence rating above low can be considered for this recommendation as well.

Otherwise, again the panel agreed with all other EtD criteria judgements that led to a strong strength of recommendation, including supporting the judgement that timely and targeted screening of people at risk of DFU, for the aforementioned risk factors, is pertinent for good care and offered at least a moderate additional desirable effect compared to not screening. It makes good intuitive sense that more frequent screening may result in early identification of risk factors, earlier intervention and, based on expert opinion, better prognosis in people who are already at risk. We agree that customised preventative treatment following screening is likely to outweigh possible harms, if treatment is provided by a suitably trained health care professional following evidence-based practice. The panel note that such screening may be anxiety provoking for some people, however agreed that it conversely offers additional opportunity for education and psychological support that individuals may value in addressing fears around developing a DFU and thus trivial undesirable effects. Therefore, similarly to recommendation 1, the balance of effects favoured screening for these risk factors compared with not screening, and screening was deemed acceptable, inexpensive, and thus feasible to most individuals. Although, costs at a societal level may be challenging to assess with the available evidence. Optimal time periods for re-screening also need to be determined when considering costs versus benefits. Taken together, the panel agrees that the strength of recommendation is strong for foot screening according to recommendations 1 and 2.

Considerations for the Australian context for recommendations 1 and 2

We have summarised suggestions for health professionals to consider for implementing screening in Table 6 (for recommendation 1) and Table 7 (for recommendation 2), and otherwise we refer readers to the IWGDF Prevention Guidelines (8) for full details on screening considerations (pp. 3-5). It is the panel's view that these screening tests and protocols are already widely used in current practice and there are few additional considerations for translation into the Australian context. Given the geographical size and diversity of Australia, and the sometimes-limited availability of health services or services with sufficient training (see glossary for definition), some individuals may not be able to access timely screening as recommended. For example, Aboriginal and Torres Strait Islander populations in rural and remote areas of Australia may not be able to access such screening routinely due to a lack of services or factors such as seasonal movement. Of note, screening should be performed by an adequately trained health care professional (such as a general practitioner, podiatrist, diabetes educator), which may add an additional barrier to its availability. However, the panel considers that to adequately train health professionals to competently perform foot risk screening is not a complex activity and there are a number of training programs or tools available to address this activity (such as the Indigenous Diabetic Foot Program (38) and the Foot Forward Train the Trainer Program (39)). Care should be taken to monitor a person's risk status over time and adjust the screening interval according to any changes in risk status (see Table 5). For example, risk status would be increased if foot complications occurred. Therefore, due to potential limited access, movement (e.g. cultural practices), greater severity of diabetes, and greater risk of complications of some Aboriginal and Torres Strait Islander people, health professionals may also consider opportunistic screening and/or more frequent screening (e.g. every 6 months).



C. INSTRUCTIONS ON FOOT SELF-CARE

'Foot self-care' and 'foot self-management' (also see glossary for definitions) are two closely related interventions that both aim to reduce the risk of DFU and its associated complications. Foot self-care interventions (e.g. foot inspection, using emollients to lubricate dry skin, footwear inspection, etc) can be performed independently by the patient at home, whereas foot self-management involves more advanced assistive interventions, such as home monitoring systems (e.g. foot skin temperatures), lifestyle interventions, and telehealth (8, 40, 41). The uptake of education and tasks relevant to foot self-care and foot self-management will be dependent on the individual's unique physical and psychosocial circumstances and capacity to meet their particular requirements. Therefore, patients are encouraged to seek further support, or supports be arranged with the appropriate consents, if a patient is unable to perform these tasks themselves.

Foot self-care

Foot care interventions the patient can do at home, consisting of but not limited to: foot inspection, washing of feet, careful drying between the toes, nail cutting, using emollients to lubricate skin, footwear inspection, avoidance of using chemical agents or plasters to remove callus, avoidance of walking barefoot or on socks only or in thin-soled slippers, avoidance of wearing tight socks, and avoiding exposure to excessive cold and heat.

Foot self-management

Advanced assistive interventions the patient can use at home, consisting of but not limited to: home monitoring systems, lifestyle interventions, telehealth, technological applications, peer support programs.





C: INSTRUCTIONS ON FOOT SELF-CARE

Recommendation 3

Instruct a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3) to protect their feet by not walking barefoot, in socks without shoes, or in thin-soled slippers, whether indoors or outdoors. (Strong; Low)

DECISION: ADOPTED

Rationale

The panel adopted this recommendation as there was full agreement with the IWGDF regarding the strength of the recommendation and quality of evidence ratings and its applicability in the Australian context (Table 2).

Summary of justification

The panel agreed with the IWGDF that there is low-quality supporting evidence for this recommendation. However, given that walking unprotected could be harmful and result in foot ulceration or external/mechanical trauma to the foot (8, 26, 42, 43), there was strong agreement with the IWGDF that education pertaining to the protection of the feet is a highly important DFU prevention strategy (8). While some patients may prefer not to adhere to this recommendation, particularly when inside the home, the panel suggests that the benefits outweigh any potential harms or burden to the patient. On all other points of assessment for recommendation 3, the panel were closely aligned to the rationale of the IWGDF. The panel, including consumer representatives, agreed that education in how to protect the feet is likely to be acceptable and feasible for most people with diabetes.

Protecting the feet from high mechanical stress and external physical trauma is essential for reducing the risk of ulceration in a person with diabetes at risk of foot ulceration (8, 44). This is also an important consideration in the Australian context; walking barefoot (e.g. on the beach) or with open type footwear is common, particularly in parts of Australia with hot climates. While this recommendation focuses on the protection of the feet both indoors or outdoors by not walking barefoot, in socks without shoes, or in thin-soled slippers, the panel agreed with the IWGDF that the use of any open type footwear increases the risk for direct damage to the skin by a foreign object (8, 44), but may also increase the risk of sunburn to the feet in the Australian context. While there is little empirical evidence to support the avoidance of open type of footwear in reducing the risk of ulceration, the panel suggests that closed-toe footwear is recommended as it protects the feet from mechanical impact, as well as reduces the risk of trauma and the collection of foreign objects.

In exceptional circumstances (e.g. if the patient refuses to wear closed-toe footwear), sandals that can be properly fastened and have plantar pressure offloading ability that has been verified in each individual case, may be considered in preference to the patient walking barefoot, in socks, or in slip-on footwear. Although there is no evidence to support that wearing socks when in footwear reduces friction/shearing forces, based on expert opinion, the panel recommends that socks should be worn as this may reduce the risk of blistering, rubbing, or ulceration (44). In addition, wearing clean socks when in shoes may also reduce the incidence of skin and nail infections (e.g. fungal infections) (45).

Considerations for the Australian context

Refer to Recommendation 5 that outlines the considerations for Recommendations 3, 4 and 5.



C: INSTRUCTIONS ON FOOT SELF-CARE

Recommendation 4

Instruct, and after that encourage and remind, a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3) to: inspect daily the entire surface of both feet and the inside of the shoes that will be worn; wash the feet daily (with careful drying, particularly between the toes); use emollients to lubricate dry skin; cut toe nails straight across; and, avoid using chemical agents or plasters or any other technique to remove callus or corns. (Strong; Low)

DECISION: ADOPTED

Rationale

The panel adopted this recommendation as there was full agreement with the IWGDF regarding the strength of the recommendation and quality of evidence ratings and its applicability in the Australian context (Table 2).

Summary of justification

The panel agreed with the IWGDF that although there is low-quality supporting evidence for this recommendation, the strength of the recommendation should be considered 'strong' based on the balance of effects favouring foot self-care for the prevention of a first-ever or recurrent DFU (by detecting early signs of DFU and contributing to basic foot hygiene) (8). On all other points of assessment for recommendation 4, the panel were closely aligned to the rationale of the IWGDF. The panel, including consumer representatives, agreed that education in performing good foot self-care practices is likely to be acceptable and feasible for most people with diabetes.

Considerations for the Australian context

Refer to Recommendation 5 that outlines the considerations for Recommendations 3, 4 and 5.



D: PROVIDING STRUCTURED EDUCATION ABOUT FOOT SELF-CARE

Recommendation 5

Provide structured education to a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3) about appropriate foot self-care for preventing a foot ulcer. (Strong; Low)

DECISION: ADOPTED

Rationale

The panel adopted this recommendation as there was full agreement with the IWGDF regarding the strength of the recommendation and quality of evidence ratings and its applicability in the Australian context (Table 2).

Summary of justification

When considering the balance of effects favouring structured foot self-care education over no education for the prevention of a first-ever or recurrent DFU, the panel were in agreement with the IWGDF that although there is low-quality supporting evidence for this recommendation, the strength of the recommendation should be considered 'strong' (8). Despite education potentially resulting in a fear of complications for the patient, there was strong agreement with the IWGDF that structured education pertaining to: foot ulcers and their consequences; positive foot self-care behaviours; wearing protective footwear; undergoing regular foot checks; performing proper foot hygiene; and seeking professional help in a timely manner when a foot problem is discovered are all important DFU prevention strategies (8). Providing structured education may also serve as a forum for patients to clarify any questions or uncertainties they have regarding their foot health management. On all other points of assessment for recommendation 5, the panel were closely aligned to the rationale of the IWGDF. Given the potential consequences and clinical sequelae of DFU, the panel and consumer representatives agreed that receiving structured education aimed at preventing DFU is likely to be acceptable and feasible for most people with diabetes at risk of ulceration.

Considerations for the Australian context for recommendations 3, 4 and 5

Structured education on foot self-care practises is an essential component of foot ulcer prevention in an at-risk person with diabetes (8). Specific examples of patient education include, but are not limited to, explaining the need for daily inspection of all surfaces of the feet including between the toes, ensuring the patient knows when and how to contact the appropriate health professional if signs of inflammation or pre-ulcerative signs are present or if there is a breach to the skin such as an ulcer, and specific foot practices such as using emollients to lubricate the skin (but not between the toes). Refer to the IWGDF Practical Guidelines (26) for further details. Furthermore, the education provided should be appropriate to the person's culture, level of health literacy and preferred learning style (e.g. visual, verbal, written, illustrated).

From an Australian perspective, those living in geographically remote locations, where Aboriginal and Torres Strait Islander people account for a higher proportion of this population, may have limited availability of health services and adequately trained health professionals to provide such education. Likewise, these individuals may also have infrequent access or limited ability to attend for medical care to receive this foot care education; all of which may act as potential barriers for implementing these recommendations. However, national programs such as the 'Foot Forward Train the Trainer Program' (39) may aid in developing widespread competencies in foot screening, providing appropriate foot self-care education, and appropriate escalation of clinical care.

Performing foot self-care practises is particularly important for those living in rural or remote areas of Australia with hot climates; as this may precipitate perspiration and increased risk of blistering and/or ulceration. And similarly, for dry and dusty environments, people may need to wash their feet more regularly and check for any abrasions, sunburn, or injuries from foreign objects, particularly if people are wearing open type footwear or walking barefoot.

The panel suggest that special considerations may need to be made for the delivery of educational programs for those living in rural or remote areas of Australia. Telehealth services may play an important role in addressing this issue, however, further research into its effectiveness is required (46). Other examples of delivery may include high-risk foot service teams visiting communities to facilitate education, drop-in foot clinics or education through other multimedia platforms. In both cases, equipment and resources would need to be made available to health care services and patients, which may not always be feasible. It is likely that some services may be better resourced than others to support such programs.



Considerations for the Australian context for recommendations 3, 4 and 5 (cont.)

Health disparities between Aboriginal and Torres Strait Islander peoples and non-Indigenous Australians have been well documented (47-50). Poorer health outcomes for Aboriginal and Torres Strait Islander populations are in part due to a higher prevalence of chronic diseases such as diabetes, but is further accentuated by geographical isolation (51). The panel suggest that structured education should be culturally appropriate and address certain provisions for Aboriginal and Torres Strait Islander peoples. To provide some context, Aboriginal and Torres Strait Islander peoples do not just form one group of people, but there are hundreds of discrete groups; all with distinct languages, social structures, cultural and social traditions, important sites and landmarks, and passing on of traditions, beliefs and customs with storytelling (51). There should be thought and consultation of whether face-to-face, individual or group approaches would be preferred, and whether educational handouts are culturally appropriate. The inclusion of Aboriginal and Torres Strait Islander artwork and/or flags on educational material may assist in promoting culturally sensitive education. The location of education sessions should also be considered. For example, cultural safety of presenting education “on Country” or in an Aboriginal Community Controlled Organisation. Holding sessions outdoors may also be considered, weather permitting (52).

While more Aboriginal and Torres Strait Islander peoples are progressing through schooling (i.e. achieving national minimum standards for literacy and numeracy), completing year 12, and enrolling in university (47), there may still be reduced health literacy among some Aboriginal and Torres Strait Islander communities. Therefore, foot self-care education should not rely on handouts alone. The panel agreed with the IWGDF that structured education should also account for gender differences and align with the patient’s health literacy and personal circumstances (8). There must also be consideration of language barriers in consultation, especially where English may be a second, third or fourth language. In these situations, a professional interpreter should be considered.

Health professionals are encouraged to have discussions regarding whether there is regular sharing of shoes and socks within the community. The panel suggests that this should be avoided as to reduce spreading of infections (e.g. fungal infections), and to reduce risk of trauma to the feet related to poor shoe fit or excessively worn footwear. Consideration must be given to the financial cost of footwear, and where possible, more affordable suggestions or recommendations should be made. The panel acknowledge that, in some communities, perhaps many communities, people wear shoes infrequently, or not at all, and this may be for cultural reasons. We recommend health professionals adhere to this prevention guideline wherever possible but may also consider other non-conventional treatment options (e.g. supportive thongs). Health professionals should also have an understanding of Aboriginal and Torres Strait Islander cultural practises (e.g. traditional dance will be performed barefoot to be connected to the land). Perhaps education and consultation with family on how to apply dressings to any cuts or wounds on the sole of the feet prior to cultural activities, and cleaning and redressing any wounds afterwards may be considered.

Most importantly, developing partnerships and engaging with local Aboriginal and Torres Strait Islander health care workers, Liaison Officers and/or community members, such as family and Elders, may assist in promoting these recommendations by determining the best approach for providing education and to ensure it is culturally sensitive. This may optimise understanding and in turn the patient’s outcomes.



E: INSTRUCTIONS ABOUT FOOT SELF-MANAGEMENT

Recommendation 6

Consider instructing a person with diabetes who is at moderate or high risk of foot ulceration (IWGDF risk 2-3) to self-monitor foot skin temperatures once per day to identify any early signs of foot inflammation and help prevent a first or recurrent plantar foot ulcer. The implementation of this recommendation is contingent on validated, user-friendly and affordable systems becoming approved and available in Australia. If the temperature difference is above-threshold between similar regions in the two feet on two consecutive days, instruct the patient to reduce ambulatory activity and consult an adequately trained health care professional for further diagnosis and treatment. (Weak; Moderate)

DECISION: ADAPTED

Rationale

The panel adapted this recommendation by adding a statement regarding the current lack of availability and approval of this validated, user-friendly technology in Australia (Table 2).

Summary of justification

The panel agreed with the IWGDF that the strength of the recommendation is 'weak' and the quality of evidence is 'moderate' based on the findings from four randomised clinical trials (53-56) and a meta-analysis (41) that support the value of home temperature monitoring and offloading of 'hot spots' (i.e. localised areas of inflammation) for the prevention of DFU (8, 41). The decision not to increase the quality of evidence and strength of recommendation ratings was based on the existing trials having small sample sizes and three of the four trials were conducted in the United States (US); therefore, generalisability outside of the US is unknown. A recent meta-analysis suggested home foot temperature monitoring and reducing of physical activity in response to hot spots halved the risk of foot ulcers in moderate or high risk patients. The significance of findings were however lost in some of the leave one out sensitivity analyses (41).

The panel, including consumer and Aboriginal and Torres Strait Islander representatives, had concerns regarding the acceptability and feasibility of foot temperature monitoring in the Australian context. Currently, there are no validated, user-friendly, and affordable foot skin temperature monitoring devices that have received Therapeutic Goods Administration (TGA) approval in Australia. The TempTouch device (Xilas Medical, San Antonio, TX) was used in all clinical trials (53-56). It is appropriately calibrated for skin temperatures and is relatively affordable (~\$150 USD). Production of this device has however been discontinued and no other validated, user-friendly devices are currently approved or available in Australia. Other infrared dermal thermometers can be purchased in Australia but have not currently been validated for home foot temperature monitoring. For example, DermaTemp (Exergen Corporation, Watertown, MA) is a commonly used device in High-Risk Foot Services (HRFS), however it is not designed for self-monitoring and is significantly more expensive (>\$1,000 AUD). Another concern with handheld thermometers, like TempTouch, is that the user has to hold the device at 6 different anatomical sites on the sole of each foot and then record and interpret the temperatures at those sites daily (53-56). This requires substantial time commitment from users and the flexibility to carry out this task daily. At least two more user-friendly foot temperature measuring mats have been designed and are in use in the US (40). Currently, these are not available in Australia and since they were not included in the randomised trials, it is rather uncertain what effect they may have on ulcer prevention. Hence, the implementation of this recommendation is contingent on validated, user-friendly and affordable systems becoming approved and available in Australia.

While the existing trials (53-56) demonstrated good adherence, it is unclear whether the target Australian population would be accepting of this strategy. To the panel's knowledge, there has been no evaluation of patient preferences or values for foot temperature monitoring, however, if validated, user-friendly devices become available, people may be willing to devote the extra time to perform the assessment. It is important to note that the existing trials (53-56) demonstrating good adherence may have been affected by selection bias (i.e. participants were likely to have been more motivated individuals).



E: INSTRUCTIONS ABOUT FOOT SELF-MANAGEMENT

Recommendation 6

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DECISION: ADAPTED

Summary of justification (cont.)

If it were possible to implement this recommendation in Australia, it would be important to re-evaluate its effectiveness in the real-world setting. For this recommendation to be successfully and equitably implemented in Australia, substantial funding would be required, and as this particular device would be unfamiliar to HRFS clinicians, training would also be necessary. There is also uncertainty regarding the acceptability and use of this device by Aboriginal and Torres Strait Islander peoples. Therefore, further research and consultation with Aboriginal and Torres Strait Islander peoples and health professionals would be needed before home foot temperature monitoring could be recommended to this population.

Despite the above concerns, the panel's decision to include this recommendation in the Australian prevention guideline was to ensure that clinicians had some guidance for home temperature monitoring should suitable devices be made available in the near future. The panel agreed that home temperature monitoring of the feet could play an important role in the prevention of foot ulceration, and also provide an opportunity for patients to be actively involved in prevention. However, as validated, user-friendly technology is not yet approved or available in Australia, clinicians should be mindful when explaining this intervention and providing advice to their patients.

Considerations for the Australian context

Foot self-management, which in this case includes monitoring of foot skin temperatures, is a more advanced assistive intervention that requires a person to have ready access to the ability to use an infrared dermal thermometer and be in close communication with an adequately trained health care professional (8). At the time of writing of this guideline, validated, user-friendly and affordable foot skin temperature monitoring devices were not available in Australia. However, should it gain approval for use by the TGA, we suggest the following should be considered by health professionals who are considering using this recommendation: (i) adequate training of healthcare professionals so that they may educate patients on the use of skin temperature monitoring at home; (ii) assessment of patient ability to perform foot skin temperature monitoring at home (e.g. ability to reach the feet, eyesight, cognition, home environment, support networks, etc); (iii) ensuring that there is adequate support for patients experiencing difficulties in performing the skin temperature monitoring at home or if they have concerns with the results; providing patients with written information and contact details for the health service and/or health professional would be beneficial; (iv) adherence to measuring foot temperatures is an important factor in its effectiveness (54), therefore, this intervention may not suit all patient preferences and lifestyles; (v) people without history of foot ulceration may find daily skin temperature assessments an unnecessary burden (8); (vi) consideration of costs to the health service and/or patients in procuring this device; (vii) false-positives and false-negatives may unnecessarily concern people and affect their confidence and trust in their assessment results (8, 57, 58); (viii) there is uncertainty regarding the acceptability for use of this device by the Australian population, including Aboriginal and Torres Strait Islander peoples and those living in rural and remote areas of Australia.



F: ENSURING ROUTINE WEARING OF APPROPRIATE FOOTWEAR

Recommendation 7

Instruct a person with diabetes who is at moderate risk for foot ulceration (IWGDF risk 2) or who has healed from a non-plantar foot ulcer (IWGDF risk 3) to wear medical grade footwear that accommodates the shape of the feet and that fits properly, to reduce plantar pressure and help prevent a foot ulcer. When a foot deformity or a pre-ulcerative sign is present, consider prescribing custom-made footwear, custom-made foot orthoses, or toe orthoses. (Strong; Low)

DECISION: ADOPTED

Rationale

The panel adopted this recommendation as there was full agreement with the IWGDF regarding the strength of the recommendation and quality of evidence ratings and its acceptability and applicability in the Australian context (Table 2). Similar to recommendation 7, the terms 'therapeutic footwear' and 'custom-made insoles' were replaced with 'medical grade footwear' and 'custom-made foot orthoses', respectively so that the terminology remained applicable to the Australian context (i.e. would be easier to interpret for an Australian audience) (44).

Summary of justification

The panel agreed with the IWGDF that while the quality of evidence for this recommendation is low, the strength of the recommendation is strong (8). The panel agreed that because people with diabetes at moderate to high risk for DFU (IWGDF risk 2 to 3) have commonly lost the capacity to accurately sense pain or pressure, their ability to judge a tight fit of footwear which may cause damaging tissue trauma, a key risk factor for the development of DFU, is likely to be impaired. We therefore concurred that people at moderate risk of DFU, or those who have healed from a non-plantar DFU, should wear footwear which protects and accommodates the shape of their feet (including adequate length, width, and depth) and focuses on plantar pressure reduction. Footwear should be fitted by appropriately trained professionals, who are able to safely and effectively assess the suitability of a shoe to protect the feet across a whole range of clinical presentations (i.e. mild to severe foot deformity, various gait anomalies), and reduce plantar pressure. Custom-made footwear, custom-made foot orthoses, or toe orthoses should be considered when required to accommodate foot deformity and to help reduce pressure on pre-ulcerative sites or areas prone to tissue trauma. The likelihood of undesirable effects is low; however, the panel acknowledge a degree of wearing in and adjustment is quite often required in the initial period. Visual inspection of the footwear and feet before and after each usage is required during the wear-in period to monitor for any pre-ulcerative signs, injuries or inflammation. Furthermore, routine visual inspection of footwear and orthoses for poor fit or degradation is important. In addition, while for some people footwear selection may be motivated by appearance and/or cost, rather than health-based reasons, the panel agree that avoiding foot ulceration for most people will ultimately override other factors. Put together, the panel agreed this is a strong recommendation when the vital provision of protection from mechanical and thermal trauma was considered alongside the evidence.

Q6

In people with diabetes at risk for foot ulceration, is any one specific orthotic intervention, including therapeutic footwear (e.g. shoes, insoles or orthoses) and walking aid, compared with no intervention or another type of orthotic, effective for preventing a first-ever or recurrent DFU?



PREVENTION

F: ENSURING ROUTINE WEARING OF APPROPRIATE FOOTWEAR

Recommendation 8

Consider prescribing orthotic interventions, such as toe silicone or (semi-)rigid orthotic devices, to help reduce abundant callus in a person with diabetes who is at risk for foot ulceration (IWGDF risk 1-3). (Weak; Low)

DECISION: ADOPTED

Rationale

The panel adopted this recommendation as there was full agreement with the IWGDF regarding the strength of the recommendation and quality of evidence ratings and its acceptability and applicability in the Australian context (Table 2).

Summary of justification

The panel agreed with IWGDF that the strength of this recommendation is weak, and the quality of evidence is low (8). Based on the small number of low-quality trials reviewed by the IWGDF, the panel agreed that there may be some small likely desirable effects on preventing a future DFU in considering the use of toe silicone and (semi-) rigid orthoses or felted foam in addition to medical grade footwear, to help reduce abundant callus. The undesirable effects of these interventions are judged to be low in comparison to possible gains, therefore the desirable effects (benefits) of this intervention are deemed to probably outweigh the undesirable effects (risks). There is no published data on patient values regarding these interventions, however, they are frequently used clinically and thus we deem them likely to have reasonable patient acceptability, particularly if they improve comfort, cosmesis and reduce frequency of health care visits for callus reduction.

WOUND CLASSIFICATION

PERIPHERAL ARTERY DISEASE

INFECTION

OFFLOADING

WOUND HEALING INTERVENTIONS



F: ENSURING ROUTINE WEARING OF APPROPRIATE FOOTWEAR

Recommendation 9

In a person with diabetes who has a healed plantar foot ulcer (IWGDF risk 3), prescribe medical grade footwear that has a demonstrated plantar pressure relieving effect during walking, to help prevent a recurrent plantar foot ulcer; furthermore, encourage the patient to consistently wear this footwear. (Strong; Moderate).

DECISION: ADOPTED

Rationale

The panel adopted this recommendation as there was full agreement with the IWGDF regarding the strength of the recommendation, the quality of evidence ratings and its acceptability and applicability in the Australian context (Table 2). The term 'therapeutic footwear' was replaced with 'medical grade footwear', so that the terminology remained applicable to the Australian context (i.e. would be easier to interpret for an Australian audience) (44).

Summary of justification

The panel agreed with IWGDF that the strength of recommendation was strong and the quality of supporting evidence was moderate (8), as medical grade footwear may reduce the risk of a first-ever foot ulcer in a person at moderate risk for foot ulceration (IWGDF risk 2) (59-61). As high plantar pressures pose an independent risk factor for the development of DFU (1, 62), and such medical grade footwear (63, 64) has the ability to reduce plantar pressures during walking, its use clinically as a preventative strategy was deemed likely to offer significant benefit. The reduction of elevated plantar pressures at high risk sites in particular, including past ulcer sites and locations of high pressure in the presence of loss of protective sensation, was endorsed. The panel strongly supported the requirement that plantar pressure reduction must be demonstrable (i.e. evidenced) in medical grade footwear prescribed to align with the plantar pressure-guided medical grade footwear protocol adhered to by the RCTs demonstrating a reduction in DFU incidence compared with non-plantar pressure-guided footwear (65, 66). The panel interpret 'a demonstrated plantar pressure relieving effect during walking' as meaning a clinically important reduction in plantar pressure quantified via a valid and reliable, in-shoe plantar pressure measurement system. This may be undertaken, for example, preferably in a footwear prescription/issue consultation in real time by taking plantar pressure measures, or if not possible, to be guided by published, peer-reviewed scientific evidence utilising comparable footwear and/or orthoses. The panel agreed with the IWGDF that $\geq 30\%$ reduction in peak pressure during walking compared with the current (medical grade) footwear, or a reduction of peak pressures to < 200 kPa (measured with a validated and calibrated pressure measuring system with sensor size of 2 cm^2) at high-pressure locations should be demonstrated by applying state-of-the-art knowledge of offloading with footwear (44, 65, 66).

Following on, the panel agreed that it is important to encourage consistent wear of the issued footwear whenever weight-bearing, to educate patients on the need for vigilance regarding protection from mechanical trauma. The panel agreed with the IWGDF that the benefits of wearing such medical grade footwear outweigh the risks, while footwear which is an inadequate length or width (i.e. too short or narrow) is likely to increase DFU risk. This emphasises the dual need for sufficient offloading properties and adequate fit. Contrasting preferences around the appearance of footwear are probable undesirable effects of this recommendation for some patients. With the increased availability of visually appealing footwear styles however, and the importance of adequate footwear towards the prevention of chronic and serious DFU, this recommendation is also deemed to be in alignment with what we anticipate a significant proportion of patients' value. We agreed that cost and availability of both medical grade footwear and pressure measuring technology may limit the applicability of this recommendation in some situations, for example, lack of government funding, however agree that it should remain as an aspirational practice given trials in this area suggest significant ulcer risk reduction may be achievable (8, 67). Overall, therefore, the panel were closely aligned with all points of the IWGDF on this recommendation.



F: ENSURING ROUTINE WEARING OF APPROPRIATE FOOTWEAR

Considerations for the Australian context for recommendations 7, 8 & 9

Before prescribing or issuing any offloading device(s), the panel recommends that the benefits, risks and contraindications are always carefully discussed with the patient. It is also important to ensure that patients have an opportunity to discuss and consider their personal circumstances, in order to gain their full informed consent (44, 68). Providing suitable protection from mechanical trauma in the form of reducing high plantar pressure and/or accommodating foot deformity(s), thereby reducing abundant callus and pre-ulcerative signs, whilst doing no harm, forms a fundamental component of ulcer prevention. Several contextual issues are likely to be pertinent to contemplate in the translation of recommendations 7, 8 and 9 into practice, which individuals should consider in light of their own unique personal situations or circumstances.

From the patient perspective, factors such as level and type of physical activity, job requirements and other functional requirements of footwear are likely to come into play. Whilst important for all people with diabetes, these recommendations may be particularly critical for those living in geographically remote areas or where services are limited, as management of mechanical stress using techniques such as medical grade footwear may offer protection from DFU formation. In some, particularly warm places it may be customary to wear footwear such as thongs or slides that are inexpensive, accessible, and easy to put on as compared to closed footwear which is more protective and is fastened to the foot. Alternatively, in other settings, such as in Aboriginal and Torres Strait Islander communities who reside in remote areas, it may be practice to share footwear or to walk barefoot. Clinicians using these prevention guidelines are therefore encouraged to be innovative and flexible in their application to suit the setting, while aiming to uphold the primary principle of minimising damaging trauma as much as possible. To the panel's knowledge, while there is no evidence that mobility aids may assist in preventing trauma to the feet, this could also be considered following mobility assessment by an adequately trained health professional (if appropriate).

From the perspective of clinical expertise and available resources, there will also be diversity around the country regarding access to suitably trained health professionals at frequent enough intervals, and the availability and funding to pay for devices such as medical grade/custom-made footwear, custom-made foot orthoses, or silicone orthoses.

There are a number of funding bodies and equipment schemes available in Australia (e.g. National Disability Insurance Scheme) and clinicians should become familiar with those that apply in their locality. In addition, differing access to validated plantar pressure measurement equipment or measurement services, or lack of high-quality research reporting plantar pressure data in footwear available in these areas, may be a limiting factor. There is also uncertainty regarding the acceptability and utility of the recommended devices for use by Aboriginal and Torres Strait Islander peoples and further consultation with an Aboriginal and Torres Strait Islander health care workers or representatives may be required before they are recommended. In situations where Aboriginal and Torres Strait Islander peoples are not in agreement to use these offloading devices, or prefer a different approach, we suggest consultation and engagement with the patient of what they may consider as more culturally appropriate options. We refer the reader to the Australian Diabetes Footwear Guidelines (44) or the Australian Offloading Guidelines (68) in these circumstances.

In summary, while there will be practical limitations, costs and contextual considerations that must be reconciled for recommendations 7, 8 and 9 to be applied effectively in practice, we agree with the IWGDF that the strong benefits of protection against mechanical and thermal trauma to reducing ulcer risk justifies grading these as strong recommendations. We therefore encourage ongoing and future investment to support the provision of these important recommendations broadly. In regions and settings where these recommendations cannot be applied currently, we suggest continuing to work towards meeting them as aspirational guidelines, particularly as the recommendation for those with a history of DFU are supported by at least moderate quality of evidence, drawing on all locally available innovations and knowledge to meet the guiding principles of minimising damaging trauma.



G: TREATMENT OF RISK FACTORS OR PRE-ULCERATIVE SIGNS ON THE FOOT

Recommendation 10

Treat any pre-ulcerative sign or abundant callus on the foot, ingrown toenail, and fungal infection on the foot, to help prevent a foot ulcer in a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3). (Strong; Low)

DECISION: ADOPTED

Rationale

The panel adopted this recommendation as there was full agreement with the IWGDF regarding the strength of the recommendation and quality of evidence ratings and its acceptability and applicability in the Australian context (Table 2).

Summary of justification

The panel agreed with the IWGDF that the strength of recommendation was strong and the quality of supporting evidence was low (8). While the panel acknowledged that there was no available evidence supporting the treatment of pre-ulcerative signs, abundant callus on the foot, ingrown toenail, and fungal infection for the prevention of DFU, there was agreement with the IWGDF that the benefit-harm ratio will likely favour the intervention and come at a relatively low cost. We agreed that treatment of presentations including callus, blisters, fissures, ingrown or thickened toenails, cutaneous haemorrhage, and skin and nail fungal infections should be administered by appropriately trained foot care professionals, using current evidence-based methods where available (26) and the level of risk should be considered when selecting treatments and in particular severity of PAD. We refer the reader to the accompanying Australian DFD Guidelines for PAD (69) for further details. The costs associated with this recommendation are likely low and we anticipate that individuals are more likely to value having these minor presentations managed quickly and effectively, over developing secondary, potentially serious, complications such as DFU. Accessibility and applicability of the recommendation is likely to be good. Overall, therefore, the panel were closely aligned with all points of the IWGDF and support this as a strong recommendation.

Considerations for the Australian context

As the treatments in this recommendation are relatively common and broadly used, there are not many special considerations for the Australian context. As with all recommendations, their application should be evidence-based, where possible, but also locally contextualised (8, 26). For example, the appropriate treatment of blisters in metropolitan settings, where closed footwear is worn and the weather is cool, may differ compared to rural and remote settings where open shoes are worn, the weather is hot and humid and adhering dressings may be challenging. Options and rationale for management should be fully discussed with the individual and others (i.e. family, carers, traditional healers) as is culturally appropriate, in order to obtain informed consent. We agree with the IWGDF that as these treatments have the potential to lead to harm in people with diabetes if not properly performed, they should only be done by an appropriately trained health care professional (see glossary for definition). Individuals should therefore be educated on how to recognise these issues as part of their home self-checking, and to seek professional treatment if they identify any of these signs rather than trying to treat these issues themselves.



H: SURGICAL INTERVENTIONS

Recommendation 11

In a person with diabetes and abundant callus consider digital flexor tendon tenotomy for preventing a first foot ulcer. Where there is an ulcer on the apex or distal part of a non-rigid hammertoe that has failed to heal with evidence-based non-surgical treatment, consider this procedure to help prevent future ulcer recurrence. (Weak; Low)

DECISION: ADAPTED

Rationale

The panel adapted this recommendation as considered the wording of the original IWGDF recommendation to be confusing, and therefore, restructured the wording to retain the same meaning but improve clarity (see Table 3 for comparative wording).

Summary of justification

The panel agreed with IWGDF that while this recommendation is supported by low quality evidence and is a weak recommendation (8), there may be some situations where digital flexor tenotomy could offer a promising option to help prevent or delay future ulceration (70-76). For example, in an individual who has pre-ulcerative signs, or an ulcer on a toe where there has been a poor response to evidence-based non-surgical treatment due to a deformity. Risk of ulcer development may also be reduced with flexor tenotomy where there is abundant callus or thickened toenails (72, 74, 76). Few complications have been reported with flexor tenotomy (70-76), however this finding must be interpreted in light of the low volume and quality of evidence that exists investigating this procedure for the prevention of DFU. Conversely, it is possible that the benefits of flexor tenotomy may outweigh the risks, particularly in people with recurrent ulceration despite best attempts at appropriate, evidence-based, non-surgical intervention.

The panel noted the IWGDF's perspective that the procedure may be easily performed in an outpatient setting, however questioned availability, costs, and procedural options in the Australian context. It may be that flexor tenotomy is not widely available across Australia, depending on access to health care services and funding models, however the procedure is accessible to some. It was noted that flexor tenotomy should only be performed by appropriately trained, suitably qualified professionals who are able to demonstrate competence in the procedure and registered with the appropriate regulatory body. The panel further agreed with the IWGDF that, taken together, this recommendation is weak.



H: SURGICAL INTERVENTIONS

Recommendation 12

In a person with diabetes and a plantar forefoot ulcer that has failed to heal with evidence-based non-surgical treatment, consider Achilles tendon lengthening, single or pan metatarsal head resection, metatarsophalangeal joint arthroplasty or osteotomy, to help prevent future ulcer recurrence. (Weak; Low)

DECISION: ADAPTED

Rationale

The panel adapted this recommendation as considered the wording of the original IWGDF recommendation to be confusing, and therefore, restructured the wording to retain the same meaning but improve clarity (see Table 3 for comparative wording).

Summary of justification

Similarly to recommendation 11, while the panel concurred with the IWGDF that the quality of supporting evidence is low and the strength of the recommendation is weak, Achilles tendon lengthening, single or pan metatarsal head resection, and metatarsophalangeal joint arthroplasty may reduce risk of recurrent plantar foot ulceration in some circumstances (77-96).

The panel agreed with the IWGDF, based on their interpretation of the research, that this recommendation applies where a plantar ulcer is not healing in response to evidence-based conservative care, is likely to re-occur due to underlying structural anomalies, has established elevated forefoot plantar pressures, and for Achilles tendon lengthening, ankle joint range of motion is limited, not passing neutral. Importantly though, it is not clear whether the benefits of these procedures outweigh the not inconsequential risks (e.g. new deformities, post-operative infection and transfer ulcers) (80, 96-99), due to the limited quality and quantity of available evidence. Therefore, a clear clinical rationale should be evident before exploring the use of these procedures for DFU prevention, such as to heal a DFU which has not responded to non-invasive evidence-based management and is expected to re-occur if the foot structure is not changed.

Further, the surgeon must have adequate training and experience in performing the specific procedure. The panel noted the IWGDF's point that patient values and preferences for these approaches are unknown and add that this is the case within the Australian context also. It is important therefore that any individuals considering this recommendation fully understand the range of risks and benefits in order for them to personally gauge acceptability for their unique situation and health care preferences. It was noted that these surgical procedures should only be performed by appropriately trained, suitably qualified professionals who are able to demonstrate competence in the procedure and registered with the appropriate regulatory body. The panel further agreed with the IWGDF that this is a weak recommendation.



H: SURGICAL INTERVENTIONS

Recommendation 13

We suggest not to use a nerve decompression procedure, in preference to accepted standards of good quality care, to help prevent a foot ulcer in a person with diabetes who is at moderate or high risk of foot ulceration (IWGDF risk 2-3) and who is experiencing neuropathic pain. (Weak; Low)

DECISION: ADOPTED

Rationale

The panel adopted this recommendation as there was full agreement with the IWGDF regarding the strength of the recommendation and quality of evidence ratings and its acceptability and applicability in the Australian context (Table 1).

Summary of justification

Unrecognised nerve entrapment may coexist in patients with diabetes-related sensorimotor peripheral neuropathy (100). While nerve decompression procedures have demonstrated low incidence rates for new and recurrent ulcers in observational studies with prolonged follow-up periods (100-104), there is no available high-quality evidence from controlled studies or trials that this procedure has an ulcer prevention effect (8). Although this type of procedure may be considered in certain clinical scenarios, the panel agreed with the IWGDF that the strength of the recommendation is weak and the quality of the evidence is low, particularly as there have been no studies that have compared nerve decompression to standards of good quality care (8). Similar to recommendations 11 and 12, it is also not clear whether the potential benefits of this particular procedure outweigh the not inconsequential risks of such a surgical procedure (e.g. post-operative infection, delayed wound healing, permanent nerve damage) due to the limited quality and quantity of available evidence. The panel agreed with the IWGDF that the balance of effects most likely favoured good quality care, rather than the surgical intervention, particularly considering the acceptability and feasibility (e.g. cost and inconvenience) of the intervention. Patient values and preferences for this surgical approach are also unknown due to a lack of evidence, and this is also the case within the Australian context. On all other points of assessment for recommendation 13, the panel were closely aligned to the rationale of the IWGDF.

Considerations for the Australian context for recommendations 11, 12 and 13

For any surgical intervention it is of utmost importance that an individual be fully informed about what the procedure involves including the likely benefits (desirable effects) versus risks (undesirable effects) compared to good quality of care or other treatment options, to support their autonomy and informed decision making. Full disclosure is important for surgical procedures given it is a permanent, invasive intervention which may have important physical but also psychosocial implications for some individuals (e.g. managing expectations, illness anxiety, potential for reduced functional capacity, ability to work, etc). Health professionals should very carefully assess, and discuss with the patient, adverse events in the context of their unique situation and the procedure(s) being considered, in particular where there is PAD (please see the accompanying Australian DFD guidelines for PAD (69)), increased potential for non-healing of the wound/surgical site or any other situation which may result in poor post-operative outcomes. Access to these procedures may be limited in the Australian context, depending on the level of surgical intervention available at local health services. We suggest that when discussing the above benefits, risks, contraindications, and personal circumstances for these surgical procedures with people living in rural and remote areas of Australia, that they should be carefully considered in light of potential for limited access to follow-up appointments for close monitoring of progress and for potential complications. It is likely that these people would need to travel to large metropolitan tertiary hospitals to receive these procedures and post-operative care; all of which should be discussed as part of the informed consent process. In addition to the above, similar considerations for Aboriginal and Torres Strait Islander peoples apply. All discussions with Aboriginal and Torres Strait Islander peoples should be preferably performed in conjunction with family and/or an Aboriginal and Torres Strait Islander health care worker. It is also important to allow adequate time to discuss, understand and consider the benefits, risks, contraindications, personal circumstances, and travel requirements of such procedures; to enable the person and their family to make an informed decision. To the panel's knowledge, we are unaware of any guidelines that focus on culturally appropriate discussions surrounding surgery with Aboriginal and Torres Strait Islander peoples. The development of such guidelines would be most useful. Otherwise, for considerations of these same surgical procedures for people with foot ulcers, please refer to the accompanying Australian DFD Guidelines for offloading treatment (68).

I. FOOT-RELATED EXERCISES AND WEIGHT-BEARING ACTIVITY

Original IWGDF Recommendation

Consider advising a person with diabetes who is at low or moderate risk for foot ulceration (IWGDF risk 1 or 2) to perform foot and mobility-related exercises with the aim of reducing risk factors of ulceration, that is, decreasing peak pressure and increasing foot and ankle range of motion, and with the aim of improving neuropathy symptoms. (Weak; Moderate)

DECISION: EXCLUDED

Rationale

The panel excluded this recommendation based on having substantially differing judgements to the IWGDF for desirable effects, balance of effects and the quality of supporting evidence, resulting in the panel concluding that the recommendation should be excluded as high quality clinical trials specifically investigating the effectiveness of foot and mobility-related exercises on ulcer prevention are non-existent (Table 1) (8).

Summary of justification

Exercise is widely accepted as being valuable for maintaining or improving physical and mental health in the general population (105). There is also good evidence that exercise training can improve balance and gait, reduce falls risk and improve other functional markers in people with diabetes at risk of foot ulceration (106). While there is some evidence to suggest that foot and mobility-related exercises may improve modifiable risk factors for foot ulceration, such as plantar pressures, foot and ankle joint range of motion and neuropathy symptoms (107-116), there is no current convincing evidence that foot and mobility exercises have a preventative effect on foot ulceration. Therefore, the panel disagreed with the IWGDF regarding the inclusion of this recommendation in the Australian prevention guidelines (8).

The panel's decision to exclude this recommendation from the Australian prevention guideline was based on the following: (i) recommendation is based on very low quality of supporting evidence (small studies with inconsistent findings for surrogate outcomes only); (ii) our judgement of "don't know" based on the absence of direct evidence for the desirable effect (benefit) of foot and mobility-related exercises for the prevention of foot ulceration is non-existent; (iii) foot and mobility-related exercises are likely to be time consuming, adherence challenging, and patients may already feel overwhelmed by their general diabetes management. Therefore, advising patients to routinely perform foot and mobility-related exercises without any evidence of clinically important benefit, may be considered inappropriate and an unnecessary burden on the patient. The panel were also unclear on what the patient values and preferences would be for performing these exercises, as this was ambiguous in existing studies. Although some individuals are not keen to do exercises overall, there is no reason to suspect that exercises would not be acceptable or valuable to individuals. Adverse events related to performing such exercises are also unknown, however, the panel suggested that any new weight-bearing exercise regime could increase the risk of ulceration, particularly if there was a sudden increase in activity. In cases where foot or mobility-related exercises are indicated (e.g. for treatment of a musculoskeletal pathology), the panel recommends that patients undergo a thorough foot assessment to establish risk of ulceration by a trained health care professional prior to prescribing an exercise program. The panel agreed with the IWGDF that prescribed foot-related exercises that mechanically load the foot are contraindicated in people with pre-ulcerative signs or an active foot ulcer (8).

Considerations for the Australian context

Although it is currently unknown, there is no reason to expect that foot and mobility-related exercises would not be acceptable to the overall Australian population. However, as mentioned previously, as there is no direct evidence for the benefit of these exercises on the prevention of foot ulceration, the panel does not recommend the prescription of foot and mobility-related exercises for the purpose of foot ulcer prevention within Australia. Therefore, the panel excluded this recommendation from the Australian prevention guideline..

Q10 In people with diabetes who are at risk for foot ulceration, can the level of weight-bearing daily activities be safely increased without increasing first-ever or recurrent DFU risk?



I. FOOT-RELATED EXERCISES AND WEIGHT-BEARING ACTIVITY

Recommendation 14

Consider communicating to a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3) that any increase in weight-bearing activity should be gradual, ensuring appropriate footwear and/or prescribed offloading device(s) are worn, and that the skin is frequently monitored for pre-ulcerative signs or injury. (Weak; Low)

DECISION: ADAPTED

Rationale

The panel adapted this recommendation by restructuring the IWGDF wording to focus on a gradual increase in weight-bearing activity as the panel considered there was limited evidence to specifically prescribe moderate increase in the level of walking-related weight-bearing activity (i.e. an extra 1,000 steps/day), but broadly considered a gradual increase under certain conditions (such as when appropriate footwear and/or prescribed offloading device(s) for the patient were worn during the activity) could be supported. Thus, the wording was also amended to improve clarity of the recommendation (Table 1).

Summary of justification

Exercise is known to have important benefits for cardiovascular and metabolic health (105, 117, 118). However, the ideal approach to increasing exercise, particularly with respect to weight-bearing, is unclear. It makes logical sense that any attempt to increase exercise should be graduated, preferencing activity that limits plantar pressure and shear on the feet. Activities involving limited weight-bearing, such as recumbent bike or pool-based exercise, may be considered where suitable for the individual. Additional precautions, based on expert opinion (8), such as checking skin integrity before and after any exercise, wearing of socks and well-fitting/appropriate footwear, and regular podiatry review may help to reduce risk. While the panel agreed with the IWGDF that the quality of evidence is low and the strength of the recommendation is weak, the panel disagreed with the IWGDF, based on our interpretation of the research, that there is sufficient evidence to provide a specific recommendation on the level of weight-bearing activity increase that is likely to be safe or harmful (8). Of the two RCTs (118, 119) evaluating the effects of weight-bearing exercise in people with diabetes and peripheral neuropathy, the study populations were small in size ($n = 79$ and $n = 29$, respectively) and with relatively short periods of follow-up (12 months and 12 weeks, respectively). It seems reasonable to suggest that any increase in physical activity should be gradual, however it is the expert opinion of the panel that it is not possible to advise on precise step figures based on the existing evidence. Generally, gradual increases in weight-bearing activity would most likely be acceptable and feasible to patients and providers within Australia, including Aboriginal and Torres Strait Islander peoples. However, with respect to the values, this would vary, and care should be taken to explain what gradual increase of exercise would be for each individual.

Exclusion of this recommendation was initially considered by the panel due to a lack of empirical evidence, however, the panel believed that some expert guidance around weight-bearing physical activity would be of great clinical importance for two main reasons. First, there is sound evidence regarding the benefit of physical activity in the general population and in people with diabetes, particularly with respect to cardiovascular benefit (105, 117). Second, some guidance to patients planning to increase physical activity may help to prevent avoidable ulceration; as rapidly increased weight-bearing may result in cumulative plantar tissue stress (120). Therefore, the panel decided to adapt this recommendation based on the above rationale.



I. FOOT-RELATED EXERCISES AND WEIGHT-BEARING ACTIVITY

Recommendation 14

Consider communicating to a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3) that any increase in weight-bearing activity should be gradual, ensuring appropriate footwear and/or prescribed offloading device(s) are worn, and that the skin is frequently monitored for pre-ulcerative signs or injury. (Weak; Low)

DECISION: ADAPTED

Considerations for the Australian context

All things considered, people with diabetes at-risk of foot ulceration should not be discouraged from carefully increasing exercise. This is based on the potential health benefits and evidence being equivocal as to whether weight-bearing activity exposes the individual to any greater ulceration risk (121). The relative importance of functional outcomes, potential cardiovascular/metabolic benefits, and risk of injury (both ulceration and musculoskeletal) would vary on an individual level. Therefore, this recommendation should be individualised and implemented according to the person's unique situation. For example, in those at high risk of foot ulceration, activities involving limited weight-bearing (such as recumbent bike or pool-based exercise) may be considered more appropriate.

Considerations on how to implement this recommendation would depend on: (i) appropriate advice being given to persons with diabetes by an adequately trained health care professional, including a prior foot assessment to establish risk status and monitoring of skin for pre-ulcerative signs; (ii) appropriate support of individuals attempting to increase weight-bearing activity (e.g. exercise physiology, rapid access to advice in case of injury); and (iii) appropriate equipment, especially footwear, being available with particular reference to reasonable options for Aboriginal and Torres Strait Islander peoples. When weight-bearing activities are performed in geographically rural or remote areas of Australia with hot climates, this may precipitate excess perspiration and increased risk of blistering and/or ulceration in patients residing in these areas. Therefore, these individuals would most likely benefit from more regular monitoring of their feet from a health professional, for the early identification and management of pre-ulcerative signs and injuries. Telehealth services may assist in these regions of Australia, and particularly where there is limited scope for patients to attend face-to-face appointments for advice on gradual increase in activity, appropriate footwear and how to monitor the feet for pre-ulcerative lesions (40, 46). The panel suggests that any advice on increasing weight-bearing activity provided to Aboriginal and Torres Strait Islander peoples should be performed in collaboration with local Aboriginal and Torres Strait Islander health care workers and/or with input from family and Elders.



J. INTEGRATED FOOT CARE

Recommendation 15

Provide integrated foot care for a person with diabetes who is at high risk of foot ulceration (IWGDF risk 3) to help prevent a recurrent foot ulcer. This integrated foot care includes professional foot care, adequate footwear, and structured education about self-care. Repeat this foot care or re-evaluate the need for it once every one to three months, as necessary. (Strong; Low)

DECISION: ADOPTED

Rationale

The panel adopted this recommendation as there was full agreement with the IWGDF regarding the strength of the recommendation and quality of evidence ratings and its acceptability and applicability in the Australian context (Table 2).

Summary of justification

The panel agreed with IWGDF that there is a low quality of supporting evidence for this recommendation (8). However, given that the provision of integrated foot care provides an opportunity for screening of the feet for any pre-ulcerative signs or problems, early intervention, and an opportunity for foot health counselling and education, all of which are earlier individual recommendations for prevention (see Recommendations 3,4,5,10 and 14), the panel supports the IWGDF's 'strong' recommendation rating (8). This was based on the panel agreeing with IWGDF that the combined benefits of these recommendations are likely to increase the magnitude of the overall desirable effects on DFU prevention and hence the balance of effects are likely to clearly favour the integrated foot care intervention over standard care. While there may be some perceived inconvenience for some patients to attend a health service for regular foot care (particularly for those with multiple health care needs and appointments), the panel suggests that the desirable effects (benefits) outweigh any potential undesirable effects of harms or burden to the patient. Otherwise, the panel concluded that the intervention is applicable, affordable for most patients, and the resources and expertise are available via most organisations that would provide such integrated foot care in Australia. On all other points of assessment for recommendation 15, the panel were closely aligned to the rationale of the IWGDF.

Considerations for the Australian context

Similar to the considerations for the Australian context outlined in recommendation 4, integrated foot care is particularly important for those living in geographically rural and remote areas of Australia with hot climates that may precipitate perspiration and increased risk of blistering and/or ulceration. Due to the often dry and dusty environments in rural and remote regions of Australia, patients residing in these areas would most likely benefit from regular monitoring of their feet from a health professional for the early identification and management of injuries, such as abrasions from foreign objects, or pre-ulcerative signs. Telehealth services may assist in these regions of Australia, and particularly where there is limited scope for patients to attend face-to-face appointments.

Similar to people living in geographically remote locations, the panel also considers that this recommendation is particularly important for Aboriginal and Torres Strait Islander peoples, given the increased risk of foot ulceration and access to medical care may not be as frequent. As per recommendation 4, the panel suggests that structured education (a component of integrated foot care) should be performed in collaboration with local Aboriginal and Torres Strait Islander health care workers and/or with input from family and Elders to optimise understanding and individual outcomes. It may also be beneficial for service providers to promote consistency of staff who are providing integrated foot care to Aboriginal and Torres Strait Islander peoples; as this may assist in expedited rapport building and trust between the person and health professional, which may result in a more enriched clinical experience for the patient. Telehealth services for the structured education component of integrated foot care may also be considered for Aboriginal and Torres Strait Islander peoples, however, the views and experiences, acceptability and appropriateness of using telehealth services in this population requires further investigation (122).



DISCUSSION

Key findings and recommendations

This is a long overdue new Australian guideline on prevention of DFU, produced by systematically adapting all IWGDF prevention recommendations to the Australian context. Overall, we adopted nine, adapted six and excluded one of the 16 original IWGDF recommendations. For the prevention of DFU in Australia, the panel recommends the following: (i) screening all people with diabetes at increased risk of foot ulceration at intervals corresponding to the IWGDF risk ratings; (ii) providing structured education about foot protection, inspection, footwear, weight-bearing activities and foot self-care (and potentially self-monitoring of foot skin temperatures contingent on device approval and availability in Australia); (iii) prescription of orthotic interventions and/or medical grade footwear; (iv) providing integrated foot care. If the above recommended non-surgical treatment fails, the use of various surgical interventions for the prevention of DFU can be considered. This guideline should serve as the new national evidence-based prevention guideline and the best practice standard for implementing prevention strategies in people at-risk for DFU in Australia.

Clinical implementation and considerations for the Australian context

To optimise and promote the uptake of these new prevention recommendations into national clinical practice, we provided a comprehensive range of implementation considerations for health professionals, and for the first time, have included considerations for people residing in geographically remote areas of Australia and people who identify as an Aboriginal and Torres Strait Islander person. In addition, all prevention recommendations were incorporated into a one-page user-friendly clinical pathway to try and maximise uptake and implementation of these recommendations and considerations by busy multi-disciplinary clinicians in Australia (Figure 2 referred to on page 40).

Before implementing any of the prevention recommendations outlined in this guideline, the panel suggests that health professionals consider them in light of their health service policies and resources, clinical expertise, and the needs of their individual clients. Given these recommendations have been assessed and written in accordance with the Australian context, the implementation should be applicable and feasible to most health service providers across the country. However, prior to the implementation of these guidelines, it is important for health professionals to understand and reflect on the health disparities that still exist between geographically remote and metropolitan populations and importantly between Aboriginal and Torres Strait Islander peoples and non-Indigenous Australians (48-50, 123). These health disparities are most likely associated with government policy and a complex historical legacy of social determinants of health affecting the Aboriginal and Torres Strait Islander population (122, 123). Further, there are still challenges that exist in the delivery of effective, equitable, culturally sensitive and responsive health care for this group of individuals (122, 123). This is particularly evident within rural and remote regions of Australia, where Aboriginal and Torres Strait Islander people account for a higher proportion of the population (51, 122). With all of these factors combined, it is not unexpected that there is higher incidence of DFU and poorer outcomes observed in Aboriginal and Torres Strait Islander populations (5, 13).

Health services and clinicians should continue to strive for effective, equitable and culturally appropriate clinical environments to all Australians at-risk of DFU, but particularly for those most vulnerable such as Aboriginal and Torres Strait Islander peoples and those living in rural and remote regions of Australia. As mentioned previously, Aboriginal and Torres Strait Islander peoples are from numerous discrete groups (51). Therefore, an important first step for health professionals is to determine the best approach to provide culturally sensitive education and treatment, and how best to meet the needs of their patients (124). One way to achieve this, is to work in partnership and to foster meaningful relationships with representatives from the community, for example, Aboriginal and Torres Strait Islander health care workers, family members and/or Elders. Providing culturally responsive health care through the provision of a safe and welcoming clinical environment that is professional, humble, inclusive, transparent, respectful, empathetic, non-judgemental, and that gives a 'voice' which encourages client choice and informed consent, may result in improved health outcomes in the Aboriginal and Torres Strait Islander population (124). Structured education should also account for gender differences and align with the patient's health literacy, preferences and values, and personal circumstances (8). Finally, due to potential limited access, movement (e.g. cultural practices), greater severity of diabetes and risk of complications of some Aboriginal and Torres Strait Islander peoples, health professionals may also consider opportunistic screening and/or more frequent screening intervals.



Special considerations should also be made for the delivery of these prevention recommendations for those residing in rural or remote areas of Australia. New national initiatives in the use of telehealth, multi-media platforms and/or HRFS teams visiting communities may prove to be invaluable in improving health access and equity for these individuals, and overall health outcomes. Equipment and resources for this approach would need to be made available to the health care services and patients, which may not always be feasible in some locations. Resourcing of outreach programs in association with secondary and tertiary health care organisations may be a tangible and effective solution.

Limitations

While the recommendations presented in this Australian prevention guideline were adapted from the high-quality IWGDF prevention guideline (8), the panel followed a robust protocol to systematically assess each of the 16 IWGDF recommendations for their quality of evidence, strength of recommendation and acceptability and applicability to the Australian context (29). Although updated systematic reviews were not performed since the 2019 IWGDF systematic reviews and no new systematic reviews for different questions were available in this process, it is unlikely that new evidence would have substantially impacted the Australian recommendations; particularly as the IWGDF prevention guidelines were published so recently (8). As a measure to ensure all relevant literature was included in the current Australian guideline, any Australian literature related to the prevention of DFU published after the IWGDF guideline, was eligible for inclusion (29). For the most part, despite the widespread clinical application of prevention interventions, the empirical evidence underlying these recommendations is lacking and is often based on expert opinion. In Australia, there is particularly limited research on the prevention of DFU, and research within the Aboriginal and Torres Strait Islander population is essentially non-existent. The limited available evidence does not imply that these prevention interventions are not effective for Australians, but rather more research is required to provide a stronger evidence base. The clinical implementation of the recommendations outlined in this prevention guideline also requires further investigation, particularly encompassing Aboriginal and Torres Strait Islander peoples and those living in rural and remote regions of Australia. Finally, as the recommendations within this guideline centre around the IWGDF risk stratification ratings, this may limit the scope and applicability of the guideline in terms of catering for all individual needs and personal circumstances. For example, the guideline may not always provide the right treatment, for the right person, at the right time (8).

Strengths

This new Australian evidence-based prevention guideline used a rigorous methodological approach to systematically assess all of the recommendations outlined in the IWGDF prevention guideline and outlined considerations specific to the Australian context (29). The panel consisted of a multi-disciplinary team of (inter) national experts in the field of preventing DFU including Vascular Surgery, Endocrinology, Podiatry and Pedorthics. A point of difference to the IWGDF, was that the Australian panel also included consumer representatives (patient with history of DFU and an Aboriginal and Torres Strait Islander person/health care worker). This was to ensure that the Australian guideline was pragmatic, clinically relevant, considered patient values and preferences, and was applicable to the Australian context. Another strength specifically related to the Australian guideline, was that an evidence-based clinical pathway was developed for health professionals in order to assist implementation and accessibility of the recommendations.

We anticipate that the broad implementation of these guidelines throughout Australia will lead to improved health outcomes in those at-risk of DFU. There are several benefits for the use of this new guideline in clinical practice. First, it should encourage evidence-based consistency of care among health services and health professionals, which may in turn improve clinical pathways of care and reduce any confusion for health professionals and their patients at-risk of DFU. Second, it should help guide and give confidence to clinicians providing evidence-based DFU prevention strategies. Third, as the guideline has been designed to be evidence-based, yet pragmatic, it is likely that these best practice recommendations can be implemented by all health professionals involved in DFU prevention in Australia, providing that they are adequately trained. Finally, health professionals following these recommendations should achieve better prevention and overall outcomes for their patients with DFU in Australia.



Future research directions summary

The panel acknowledges that prevention of DFU is under-studied and there is a need to improve the evidence-base in this area. The panel identified the following future research priorities:

1. The effectiveness of screening for ulcer prevention, including what factors to screen for, validity of screening tools/techniques and combinations, and optimal duration matched to patient presentation (physical, psychological, social), assessment intervals, etc
2. Well-designed trials for preventative surgical procedures with longer follow up periods
3. Well-designed trials to investigate whether foot and mobility-related exercises reduce DFU incidence/modify risk factors (e.g. plantar pressure) and which types and combinations of exercise are most effective
4. User-friendly, accessible, accurate, reliable, and cost effective methods to monitor foot temperatures at home, and evaluation of patient preferences or values
5. The associated costs and cost effectiveness of prevention interventions at both an individual and societal level compared with usual care
6. Integrated foot care approach combining all the recommendations outlined in this guideline on preventing DFU
7. Research on the prevention of DFU within the Aboriginal and Torres Strait Islander population broadly
8. Structured education approaches within the Aboriginal and Torres Strait Islander population and those in rural and remote areas, including use of Telehealth services, etc.
9. Psychological interventions to support adherence and psychosocial management in relation to DFU prevention
10. Optimal medication management on prevention of DFU
11. More effective ways to implement preventative care
12. Risk and benefit of exercise programs typically recommended to improve cardiovascular health in people at risk of DFU, and whether specific modalities minimise risk of ulceration (e.g. walking, bike, rowing, swimming)

CONCLUSION

The effective prevention of DFU is critical to reducing this serious and costly health problem. These new Australian guidelines provide evidence-based recommendations for DFU prevention and have been developed to suit the needs of consumers and health professionals in the context of the unique geography, diversity, cultures, and health care settings in Australia. This guideline includes specific considerations and simplified clinical pathways for Australian health professionals to follow, which may help to optimise implementation of these prevention recommendations in clinical practice. Health professionals following these recommendations should achieve better DFU prevention outcomes and help to reduce the large national burden of DFU in Australia.



DECLARATIONS

Ethical approvals

Not applicable

Consent for publication

Not applicable

Availability of data and materials

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Competing interests

The funding/supporting bodies below provided oversight and final approval for this guideline, however, did not have any input into the decisions on recommendations and rationale contained in these guidelines or in the writing of these guidelines. JChe is employed by Diabetes Victoria and her role is fully funded by the National Diabetes Services Scheme. AR was an author of the IWGDF Prevention Guidelines and Systematic Reviews in which this manuscript is based. AR was specifically centrally involved with the development and drafting of (4 to 6, 14 and 15) in the IWGDF Prevention Guideline and addressed this conflict by not screening, assessing, deciding on or drafting any of these specific recommendations as part of this Australian Guideline project. All other authors declare that they have no relevant competing interests.

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Authors' contributions

MRK screened and assessed allocated IWGDF prevention recommendations, populated the EtD templates for all recommendations requiring full assessment, and drafted the initial manuscript and clinical pathways document. AR screened and assessed allocated IWGDF prevention recommendations and drafted the initial manuscript. MRK and AR critically reviewed and revised versions of the manuscript. JG, JL and KH screened and assessed allocated prevention recommendations and critically revised the manuscript. JCha provided Aboriginal and Torres Strait Islander and end-user intellectual input and content into the screening, assessment and drafting of all recommendations and rationale, and critically reviewed the manuscript. JChe provided lived experience and consumer intellectual input and content into the screening, assessment and drafting of all recommendations and rationale, and critically reviewed the manuscript. PAL provided DFD intellectual input and content into the overall process and peer-reviewed the manuscript and clinical pathways. MRK acted as the secretary and AR as the chair of the author/chapter group. MRK and AR take full responsibility for the content of the manuscript and all authors approved the manuscript for submission.

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FIGURES

Figure 1. Application of the DFD guideline Adapting Process to the Prevention Guideline

Figure 2. Australian clinical pathway to guide evidence-based prevention of foot ulcers in people at-risk of diabetes-related foot ulceration

TABLES

Table 1. Summary of screening ratings for acceptability and applicability in the Australian context for all IWGDF Prevention Recommendations (ADAPTE ratings)

Table 2. Summary of final panel judgements compared with IWGDF judgements for all IWGDF prevention recommendations

Table 3. Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for prevention

Table 4. Summary public consultation survey responses

Table 5. The IWGDF Risk Stratification System

Table 6. Summary of IWGDF screening suggestions for Recommendation 1

Table 7. Summary of IWGDF screening suggestions for Recommendation 2

SUPPLEMENTARY FILES

Supplementary File 1. Glossary of terms used in the prevention guideline

**FIGURE 1**

Application of the DFD guideline adapting process to the Prevention Guideline

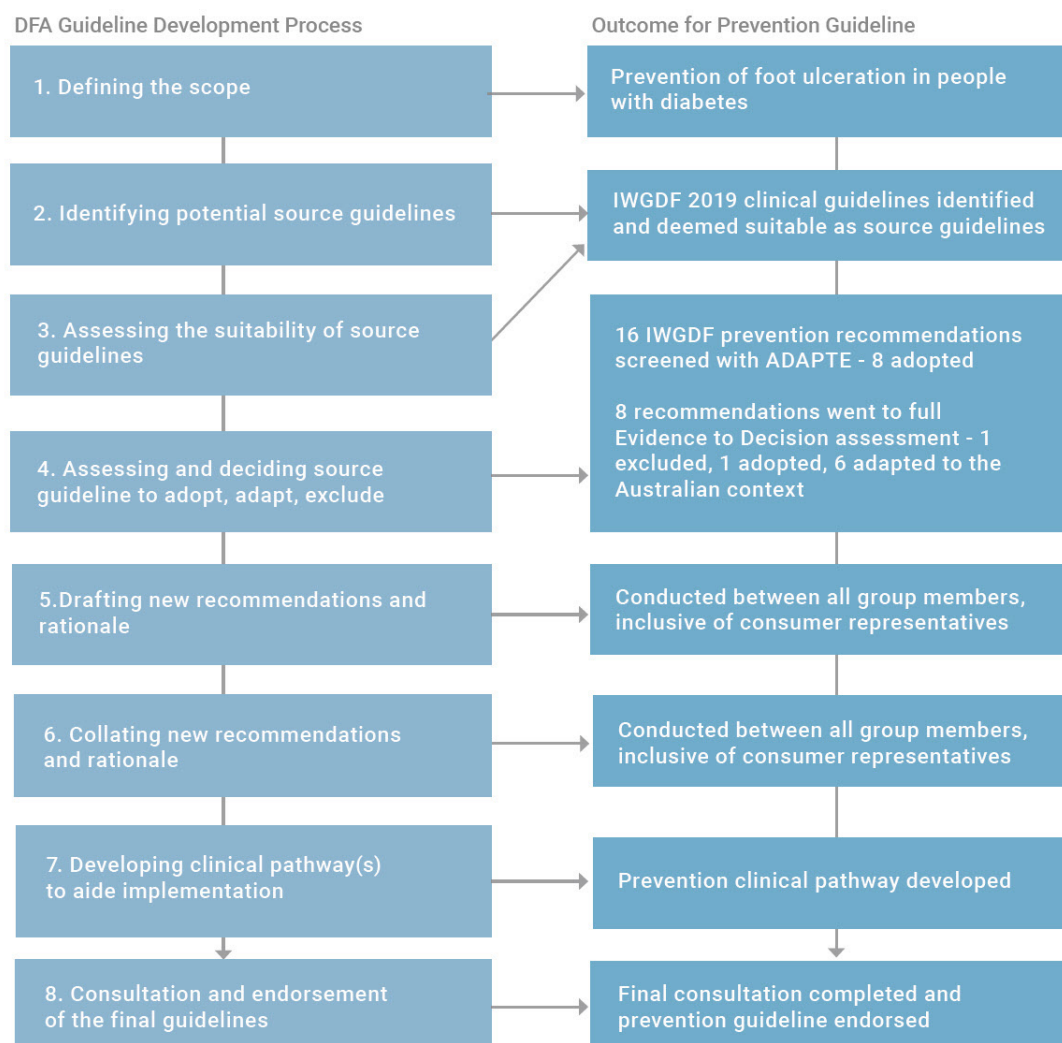


Figure 2. Australian evidence-based clinical pathway on prevention of foot ulcers for people with diabetes

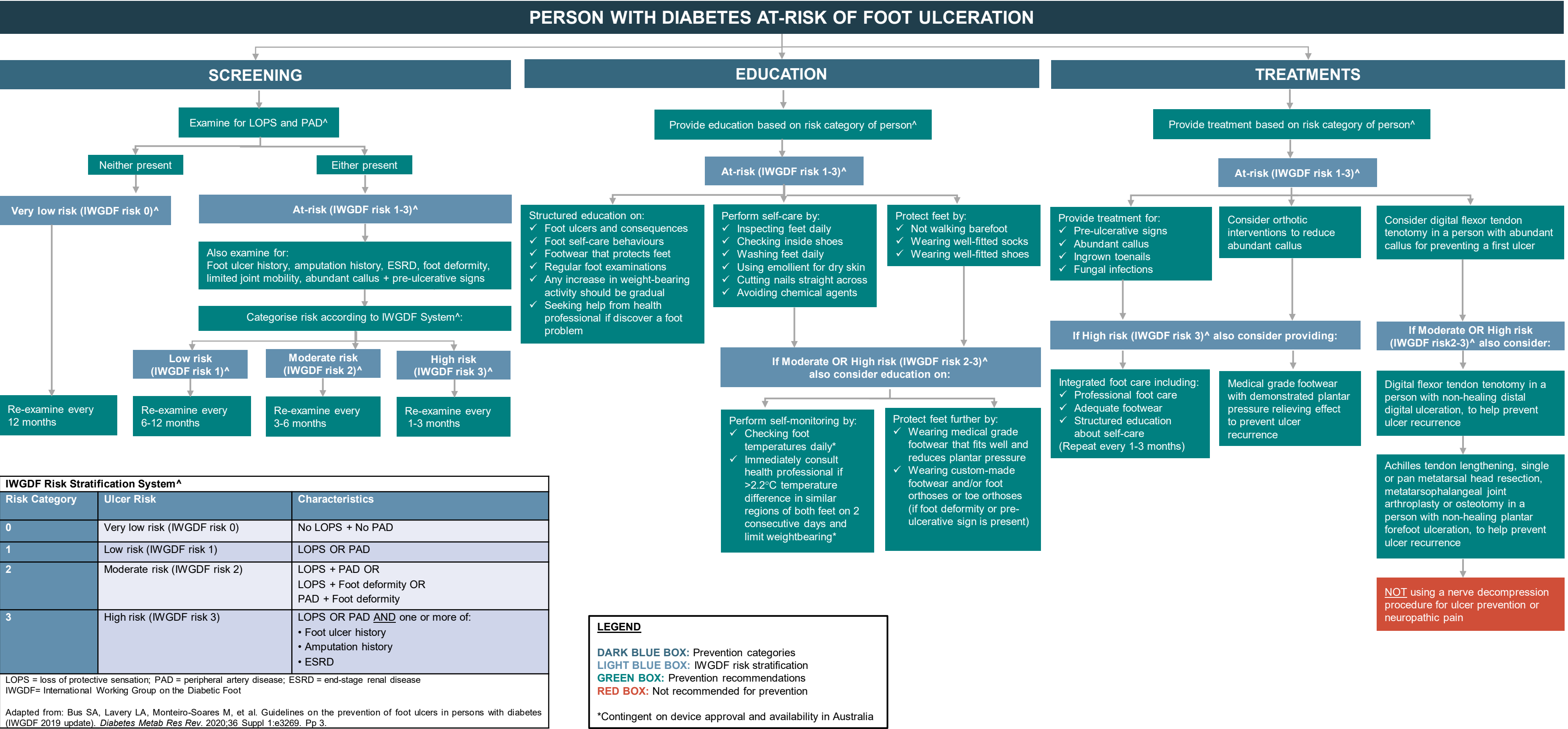




TABLE 1

Summary of screening ratings for acceptability and applicability in the Australian context for all IWGDF Prevention recommendations (ADAPTE ratings)

RECOMMENDATION	ACCEPTABILITY			APPLICABILITY				FULL ASSESSMENT	COMMENTS
	1	2	3	4	5	6	7		
1	?	+	+	+	+	+	+	Yes	Assess quality of evidence
2	?	+	+	+	+	+	+	Yes	Assess quality of evidence
3	+	+	+	+	+	+	+	No	
4	+	+	+	+	+	+	+	No	
5	+	+	+	+	+	+	+	No	
6	+	+	?	-	-	-	-	Yes	Assess compatibility with culture & values, applicability to patient context, availability of intervention / equipment / expertise & other constraints (legal, policy, resources)
7	+	+	+	+	+	+	+	No	
8	+	+	+	+	+	+	+	No	
9	+	+	+	+	+	+	+	No	
10	+	+	+	+	+	+	+	No	
11	+	?	?	+	+	+	+	Yes	Assess strength of recommendation and compatibility with culture & values, applicability to patient context
12	?	+	?	+	+	?	+	Yes	Assess quality of evidence & compatibility with culture & values
13	+	+	+	+	+	+	+	No	
14	?	?	?	+	+	+	+	Yes	Assess quality of evidence, strength of recommendation and compatibility with cultures & values
15	+	-	+	?	+	+	+	Yes	Assess strength of recommendation & applicability to patient context
16	+	?	+	+	+	+	+	Yes	Assess strength of recommendation
TOTAL	12	12	12	14	13	14	15	8	
%	75	75	75	88	81	88	94	50	
Note: +, yes item is met; -, no item is not met; ? unsure if item is met									



TABLE 2

Summary of final panel judgements compared with IWGDF judgements for all IWGDF prevention recommendations

No.	Problem	Desirable effects	Undesirable effects	Quality of evidence	Values	Balance of effects	Acceptability	Applicability/feasibility	Decision	Comment
1	+ Yes	+ Moderate	+ Trivial	- Low	? Probably no important uncertainty	+ Favours the intervention	+ Yes	+ Yes	Adapt	Adapted QoE
2	+ Yes	+ Moderate	+ Trivial	- Low	? Probably no important uncertainty	+ Favours the intervention	+ Yes	+ Yes	Adapt	Adapted QoE
3	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
4	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
5	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
6	+ Yes	+ Moderate	- Moderate	+ Moderate	+ Possibly important uncertainty	? Probably favours the intervention	? Probably yes	- No	Adapt	Adapted wording to reflect that the technology is not yet available in Australia
7	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
8	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
9	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
10	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
11	+ Yes	+ Moderate	+ Small	+ Low	+ Probably no important uncertainty	+ Probably favours the intervention	+ Varies	+ Varies	Adapt	Adapted wording to retain meaning, but improve clarity



TABLE 2

Summary of final panel judgements compared with IWGDF judgements for all IWGDF prevention recommendations

No.	Problem	Desirable effects	Undesirable effects	Quality of evidence	Values	Balance of effects	Acceptability	Applicability/feasibility	Decision	Comment
12	+ Yes	+ Moderate	+ Moderate	+ Low	+ Probably no important uncertainty	+ Probably favours the intervention	+ Probably yes	+ Probably yes	Adapt	Adapted wording to retain meaning, but improve clarity
13	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
14	+ Yes	- Don't know	+ Trivial	- Very low	+ No important uncertainty	- Does not favour either the intervention or comparison	+ Probably yes	+ Yes	Exclude	Excluded due to low-quality supporting evidence
15	+ Yes	+ Small	? Small	+ Low	+ Probably no important uncertainty	? Probably favours the intervention	+ Probably yes	+ Probably yes	Adapt	Adapted intervention
16	+ Yes	+ Large	+ Small	+ Low	+ Probably no important uncertainty	+ Probably favours the intervention	+ Yes	+ Probably yes	Adopt	Adopted in EtD assessment

NOTE: +, panel agreed with original IWGDF judgement; -, panel disagreed with original IWGDF judgement; ?, panel unsure if agreed with original IWGDF judgement due to lack of IWGDF information on judgement; =, panel agreed with original IWGDF judgements during screening (see Table 1); QoE: Quality of evidence.



TABLE 3

Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for prevention

No.	Original IWGDF Recommendation	Decision	No.	New Australian Recommendation
1	Examine a person with diabetes at very low risk of foot ulceration (IWGDF risk 0) annually for signs or symptoms of loss of protective sensation and peripheral artery disease, to determine if they are at increased risk for foot ulceration. (GRADE recommendation: Strong; Quality of evidence: High)	<u>Adapt</u>	1	Examine a person with diabetes at very low risk of foot ulceration (IWGDF risk 0) annually for signs or symptoms of loss of protective sensation and peripheral artery disease, to determine if they are at increased risk for foot ulceration. (GRADE strength of recommendation: Strong; Quality of evidence: <u>Low</u>)
2	Screen a person with diabetes at risk of foot ulceration (IWGD risk 1-3) for: a history of foot ulceration or lower-extremity amputation; diagnosis of end-stage renal disease; presence or progression of foot deformity; limited joint mobility; abundant callus; and any pre-ulcerative sign on the foot. Repeat this screening once every 6-12 months for those classified as IWGDF risk 1, once every 3-6 months for IWGDF risk 2, and once every 1-3 months for IWGDF risk 3. (Strong; High)	<u>Adapt</u>	2	Screen a person with diabetes at risk of foot ulceration (IWGDF risk 1-3) for: a history of foot ulceration or lower-extremity amputation; diagnosis of end-stage renal disease; presence or progression of foot deformity; limited joint mobility; abundant callus; and any pre-ulcerative sign on the foot. Repeat this screening once every 6-12 months for those classified as IWGDF risk 1, once every 3-6 months for IWGDF risk 2, and once every 1-3 months for IWGDF risk 3. (Strong; <u>Low</u>)
3	Instruct a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3) to protect their feet by not walking barefoot, in socks without shoes, or in thin-soled slippers, whether indoors or outdoors. (Strong; Low)	Adopt	3	As stated in original IWGDF recommendation
4	Instruct, and after that encourage and remind, a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3) to: inspect daily the entire surface of both feet and the inside of the shoes that will be worn; wash the feet daily (with careful drying, particularly between the toes); use emollients to lubricate dry skin; cut toe nails straight across; and, avoid using chemical agents or plasters or any other technique to remove callus or corns. (Strong; Low)	Adopt	4	As stated in original IWGDF recommendation
5	Provide structured education to a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3) about appropriate foot self-care for preventing a foot ulcer. (Strong; Low)	Adopt	5	As stated in original IWGDF recommendation

NOTE: underlined wording indicates the specific adaptations to the original IWGDF recommendation.



TABLE 3

Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for prevention

No.	Original IWGDF Recommendation	Decision	No.	New Australian Recommendation
6	Consider instructing a person with diabetes who is at moderate or high risk of foot ulceration (IWGDF risk 2-3) to self-monitor foot skin temperatures once per day to identify any early signs of foot inflammation and help prevent a first or recurrent plantar foot ulcer. If the temperature difference is above-threshold between similar regions in the two feet on two consecutive days, instruct the patient to reduce ambulatory activity and consult an adequately trained health care professional for further diagnosis and treatment. (Weak; Moderate)	<u>Adapt</u>	6	Consider instructing a person with diabetes who is at moderate or high risk of foot ulceration (IWGDF risk 2-3) to self-monitor foot skin temperatures once per day to identify any early signs of foot inflammation and help prevent a first or recurrent plantar foot ulcer. <u>The implementation of this recommendation is contingent on validated, user-friendly and affordable systems becoming approved and available in Australia.</u> If the temperature difference is above-threshold between similar regions in the two feet on two consecutive days, instruct the patient to reduce ambulatory activity and consult an adequately trained health care professional for further diagnosis and treatment. (Weak; Moderate)
7	Instruct a person with diabetes who is at moderate risk for foot ulceration (IWGDF risk 2) or who has healed from a non-plantar foot ulcer (IWGDF risk 3) to wear therapeutic footwear that accommodates the shape of the feet and that fits properly, to reduce plantar pressure and help prevent a foot ulcer. When a foot deformity or a pre-ulcerative sign is present, consider prescribing custom-made footwear, custom-made insoles, or toe orthoses. (Strong; Low)	Adopt	7	As stated in original IWGDF recommendation, except 'therapeutic footwear' has been replaced with 'medical grade footwear' and 'custom-made insoles' has been replaced with 'custom-made foot orthoses', so that the terminology was applicable to the Australian context. Instruct a person with diabetes who is at moderate risk for foot ulceration (IWGDF risk 2) or who has healed from a non-plantar foot ulcer (IWGDF risk 3) to wear <u>medical grade</u> footwear that accommodates the shape of the feet and that fits properly, to reduce plantar pressure and help prevent a foot ulcer. When a foot deformity or a pre-ulcerative sign is present, consider prescribing custom-made footwear, custom-made <u>foot orthoses</u> , or toe orthoses. (Strong; Low)
8	Consider prescribing orthotic interventions, such as toe silicone or (semi-)rigid orthotic devices, to help reduce abundant callus in a person with diabetes who is at risk for foot ulceration (IWGDF risk 1-3). (Weak; Low)	Adopt	8	As stated in original IWGDF recommendation
9	In a person with diabetes who has a healed plantar foot ulcer (IWGDF risk 3), prescribe therapeutic footwear that has a demonstrated plantar pressure relieving effect during walking, to help prevent a recurrent plantar foot ulcer; furthermore, encourage the patient to consistently wear this footwear. (Strong; Moderate).	Adopt	9	As stated in original IWGDF recommendation, except 'therapeutic footwear' has been replaced with 'medical grade footwear', so that the terminology was applicable to the Australian context. In a person with diabetes who has a healed plantar foot ulcer (IWGDF risk 3), prescribe <u>medical grade</u> footwear that has a demonstrated plantar pressure relieving effect during walking, to help prevent a recurrent plantar foot ulcer; furthermore, encourage the patient to consistently wear this footwear. (Strong; Moderate).

NOTE: underlined wording indicates the specific adaptations to the original IWGDF recommendation.



TABLE 3

Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for prevention

No.	Original IWGDF Recommendation	Decision	No.	New Australian Recommendation
10	Treat any pre-ulcerative sign or abundant callus on the foot, ingrown toe nail, and fungal infection on the foot, to help prevent a foot ulcer in a person with diabetes who is at risk of foot ulceration (IWGDF risk 1-3). (Strong; Low)	Adopt	10	As stated in original IWGDF recommendation
11	In a person with diabetes and abundant callus or an ulcer on the apex or distal part of a non-rigid hammertoe that has failed to heal with non-surgical treatment, consider digital flexor tendon tenotomy for preventing a first foot ulcer or recurrent foot ulcer once the active ulcer has healed (Weak; Low).	Adapt	11	In a person with diabetes and abundant callus <u>consider digital flexor tendon tenotomy for preventing a first foot ulcer. Where there is</u> an ulcer on the apex or distal part of a non-rigid hammertoe that has failed to heal with <u>evidence-based</u> non-surgical treatment, consider <u>this procedure to help prevent future ulcer recurrence.</u> (Weak; Low)
12	In a person with diabetes and a plantar forefoot ulcer that has failed to heal with non-surgical treatment, consider Achilles tendon lengthening, single or pan metatarsal head resection, metatarsophalangeal joint arthroplasty or osteotomy, to help prevent a recurrent plantar forefoot ulcer once the active ulcer has healed. (Weak; Low)	Adapt	12	In a person with diabetes and a plantar forefoot ulcer that has failed to heal with <u>evidence-based</u> non-surgical treatment, consider Achilles tendon lengthening, single or pan metatarsal head resection, metatarsophalangeal joint arthroplasty or osteotomy, to help prevent <u>future ulcer recurrence.</u> (Weak; Low)
13	We suggest not to use a nerve decompression procedure, in preference to accepted standards of good quality care, to help prevent a foot ulcer in a person with diabetes who is at moderate or high risk of foot ulceration (IWGDF risk 2-3) and who is experiencing neuropathic pain. (Weak; Low)	Adopt	13	As stated in original IWGDF recommendation
14	Consider advising a person with diabetes who is at low or moderate risk for foot ulceration (IWGDF risk 1 or 2) to perform foot and mobility-related exercises with the aim of reducing risk factors of ulceration, that is, decreasing peak pressure and increasing foot and ankle range of motion, and with the aim of improving neuropathy symptoms. (Weak; Moderate)	Exclude	–	Recommendation excluded from the Australian guideline
15	Consider communicating to a person with diabetes who is at low or moderate risk for foot ulceration (IWGDF risk 1 or 2) that a moderate increase in the level of walking-related weight-bearing activity (ie, an extra 1.000 steps/day) is likely to be safe. Advise this person to wear appropriate footwear when undertaking weight-bearing activities, and to frequently monitor the skin for pre-ulcerative signs or breakdown. (Weak; Low)	Adapt	14	Consider communicating to a person with diabetes who is at <u>risk of</u> foot ulceration (IWGDF risk 1-3) that any increase in weight-bearing activity should be gradual, ensuring appropriate footwear <u>and/or prescribed offloading device(s) are worn, and that the skin is frequently monitored for pre-ulcerative signs or injury.</u> (Weak; Low)
16	Provide integrated foot care for a person with diabetes who is at high risk of foot ulceration (IWGDF risk 3) to help prevent a recurrent foot ulcer. This integrated foot care includes professional foot care, adequate footwear and structured education about self-care. Repeat this foot care or re-evaluate the need for it once every one to three months, as necessary. (Strong; Low)	Adopt	15	As stated in original IWGDF recommendation



TABLE 4

Summary of public consultation survey responses (n=19)

No.	Item	n	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
Background							
1	You are involved with the care of patients for whom this draft Australian offloading guideline is relevant.	19	12 (63.2%)	4 (21.0%)	3 (15.8%)	0	0
2	There is a need for a new Australian offloading guideline in this population.	19	9 (47.4%)	9 (47.4%)	1 (5.2%)	0	0
3	The rationale for developing a new Australian offloading guideline on this topic is clear in this draft guideline.	19	12 (63.2%)	6 (31.6%)	1 (5.2%)	0	0
Methodology							
4	I agree with the overall methodology used to develop this draft Australian offloading guideline.	19	7 (36.8%)	10 (52.6%)	2 (10.5%)	0	0
5	The search strategy used to identify international guidelines on which this draft Australian offloading guideline was based is relevant and complete	19	7 (36.8%)	10 (52.6%)	2 (10.5%)	0	0
6	The methods used to determine the suitability of identified international source guidelines upon which this draft Australian offloading guideline were based were robust.	19	8 (42.1%)	8 (42.1%)	3 (15.8%)	0	0
7	I agree with the methods used within this draft Australian offloading guideline to interpret the available evidence on this topic.	19	6 (31.6%)	11 (57.9%)	2 (10.5%)	0	0
8	The methods used to decide which recommendations to adopt, adapt or exclude for the Australian context were objective and transparent.	19	5 (26.3%)	12 (63.2%)	2 (10.2%)	0	0
Recommendations							
9	The recommendations in this draft Australian offloading guideline are clear.	18	7 (38.9%)	10 (55.6%)	1 (5.6%)	0	0
10	I agree with the recommendations in this draft Australian offloading guideline as stated.	18	3 (16.7%)	13 (68.4%)	1 (5.6%)	1 (5.6%)	0
11	The recommendations are suitable for people living with diabetes-related foot disease.	18	4 (22.2%)	13 (68.4%)	1 (5.6%)	0	0
12	The recommendations are too rigid to apply for people living with diabetes-related foot disease.	18	1 (5.6%)	1 (5.6%)	4 (22.2%)	11 (61.1%)	1 (5.6%)
13	The recommendations reflect a more effective approach to improving patient outcomes than is current practice.	18	2 (11.1%)	7 (38.9%)	8 (44.4%)	1 (5.6%)	0
14	When applied, the recommendations should produce more benefits than harms for people living with diabetes-related foot disease.	18	8 (44.4%)	9 (50.0%)	1 (5.6%)	0	0
15	When applied, the recommendations should result in better use of resources than current practice allows.	18	6 (33.3%)	5 (27.8%)	6 (33.3%)	1 (5.6%)	0
16	I would feel comfortable if people living with diabetes-related foot disease received the care recommended in this draft Australian offloading guideline.	18	7 (38.9%)	9 (50.0%)	2 (11.1%)	0	0



TABLE 4

Summary of public consultation survey responses (n=19)

No.	Item	n	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
Implementation of recommendations							
17	To apply the draft Australian offloading guideline may require reorganisation of services/care.	18	3 (16.7%)	6 (33.3%)	7 (38.9%)	2 (11.1%)	0
18	To apply the draft Australian offloading guideline may be technically challenging.	18	0	8 (44.4%)	7 (38.9%)	2 (11.1%)	1 (5.6%)
19	The draft Australian offloading guideline may be too expensive to apply.	18	2 (11.1%)	2 (11.1%)	7 (38.9%)	7 (38.9%)	0
20	The draft Australian offloading guideline presents options that will likely be acceptable to people living with diabetes-related foot disease.	18	3 (16.7%)	12 (66.7%)	1 (5.6%)	2 (11.1%)	0
Final thoughts							
21	This draft guideline should be approved as the new Australian offloading guideline.	18	6 (33.3%)	8 (44.4%)	4 (22.2%)	0	0
22	This draft Australian offloading guideline would be supported by the majority of my colleagues.	18	7 (38.9%)	8 (44.4%)	3 (16.7%)	0	0
23	If this draft guideline was to be approved as the new Australian offloading guideline, I would use or encourage their use in practice.	18	8 (44.4%)	8 (44.4%)	2 (11.1%)	0	0

**TABLE 5**

The IWGDF Risk Stratification System*

RISK CATEGORY	ULCER RISK	CHARACTERISTICS
0	Very low	No LOPS and no PAD
1	Low	LOPS or PAD
2	Moderate	LOPS + PAD, or LOPS + foot deformity or PAD + foot deformity
3	High	LOPS or PAD, and one or more of the following • history of a foot ulcer • a lower-extremity amputation (minor or major) • end-stage renal disease
NOTE: LOPS = loss of protective sensation; PAD = peripheral artery disease; IWGDF = International working group on the diabetic foot		

*Adapted from: Bus SA, Lavery LA, Monteiro-Soares M, et al. Guidelines on the prevention of foot ulcers in persons with diabetes (IWGDF 2019 update). Diabetes Metab Res Rev. 2020;36 Suppl 1:e3269. Pp 3.

TABLE 6

Summary of IWGDF screening suggestions for Recommendation 1*

FOOT SCREENING
Aims to identify those at risk of DFU.
Should specifically include screening for LOPS caused by peripheral neuropathy and for signs or symptoms of PAD.
Should be performed by an adequately trained health care professional (see glossary for definition) who is also aware of the evidence on screening validity and is competent to undertake further assessment / intervention and/or referral to a suitably trained health care practitioner to ensure individuals receive suitable care.
The examination should include (but is not limited to): • screening for LOPS with a 10-g Semmes Weinstein monofilament (26), or if unavailable, use of the Ipswich Touch Test (125) and screening of vibratory sensation with a tuning fork or biothesiometer/neurothesiometer, if the monofilament testing is negative; • screening for PAD as per the IWGDF Guidelines on PAD (126) and/or the Australian DFD Guidelines on PAD (69) by taking a cardiovascular history, palpating for foot pulses, obtaining pedal Doppler arterial waveforms and blood pressure measurements; • although evidence for a screening interval is non-existent, we recommend an annual screening for a person with diabetes in whom LOPS or PAD have not yet been identified; • further assessment / intervention and/or referral for follow-up if any areas of concern are identified.

*Adapted from: Bus SA, Lavery LA, Monteiro-Soares M, et al. Guidelines on the prevention of foot ulcers in persons with diabetes (IWGDF 2019 update). Diabetes Metab Res Rev. 2020;36 Suppl 1:e3269. Pps 4-5 .

**TABLE 7**

Summary of IWGDF screening suggestions for Recommendation 2*

WHEN A PERSON WITH DIABETES IS IDENTIFIED AS BEING AT-RISK OF FOOT ULCERATION (I.E. IWGDF RISK 1-3)

More extensive and more frequent foot examination is needed, as the ulcer risk is higher.

The examination should include (but is not limited to):

- taking a detailed history of foot ulceration, lower-extremity amputation, and determining a diagnosis of end-stage renal disease;
- physical examination of the foot for presence of deformities or progression thereof; abundant callus and pre-ulcerative signs, such as blisters, fissures and haemorrhage; and limited joint mobility;
- history of other factors (suggested based more on expert opinion), including social isolation, poor access to health care, financial constraints, foot pain (with walking or at rest), and numbness or claudication;
- examining the presence of ill-fitting, inadequate, or lack of footwear, abnormal skin colour, temperature or oedema; poor foot hygiene (e.g. improperly cut toenails, unwashed feet, superficial fungal infection, or unclean socks), physical limitations that may hinder foot self-care (e.g. visual acuity, obesity); and foot care knowledge are also suggested;

Any foot ulcer identified during screening should be treated according to the principles outlined in the suite of IWGDF Guidelines (26, 126-130) and/or the Australian DFD Guidelines (68, 69, 131-133).

*Adapted from: Bus SA, Lavery LA, Monteiro-Soares M, et al. Guidelines on the prevention of foot ulcers in persons with diabetes (IWGDF 2019 update). Diabetes Metab Res Rev. 2020;36 Suppl 1:e3269. Pps 4-5



SUPPLEMENTARY FILE 1

GLOSSARY OF TERMS*

Abundant callus: Callus that, as assessed by an appropriately trained health care professional, requires debridement to reduce risk for ulceration.

Adherence: The extent to which a person's behaviour corresponds with agreed recommendations for treatment from a health care provider, expressed as quantitatively as possible; eg, the proportion of time, steps or instances that the prescribed intervention (or comparator) is used (134).

Adequately trained health care professional: a person who according to national or regional standards has the knowledge, expertise, and skills to perform a specified task in screening, examining, or managing a person with diabetes who is at risk of foot ulceration.

Custom-made foot orthoses: An insole that is custom-made to the individual's foot using a 2D or 3D impression of the foot, and that is often built-up in a multi-layer construction. This may also incorporate other features, such as a metatarsal pad or metatarsal bar. The insole is designed to conform to the shape of the foot, providing cushioning and redistribution of plantar pressure. The term "insole" is also known as "insert" or "liner" or "orthotic".

Custom-made (medical grade) footwear: Footwear uniquely manufactured for one person, when this person cannot be safely accommodated in pre-fabricated (medical grade) footwear. It is made to accommodate deformity and relieve pressure over at-risk sites on the plantar and dorsal surfaces of the foot. In-depth assessment, multiple measurements, impressions or a mould, and a positive model of a person's foot and ankle are generally required for manufacture. This footwear includes a custom-made insole. Also known as "bespoke footwear", "therapeutic footwear" or "orthopaedic footwear".

Extra-depth footwear: Pre-fabricated footwear constructed with additional depth and volume in order to accommodate deformity such as claw/hammer toes and/or to allow for space for a thick insole. Usually a minimum of 5 mm (~3/1600) depth is added compared with off-the-shelf footwear. Even greater depth is sometimes provided in footwear that is referred to as double depth or super extra-depth.

Foot deformity: See IWGDF definitions and criteria document (135).

Foot-related exercises: Any physical exercise specifically targeting the foot or lower-extremity with the aim of changing foot function. These exercises can include stretching and strengthening of the foot and ankle musculature and functional exercises such as balance and gait training. These exercises are provided and/or supervised by a physical therapist or a similarly adequately trained health care professional.

Foot self-care: Foot care interventions the patient can do at home, consisting of but not limited to: foot inspection, washing of feet, careful drying between the toes, nail cutting, using emollients to lubricate skin, footwear inspection, avoidance of using chemical agents or plasters to remove callus, avoidance of walking barefoot or on socks only or in thin-soled slippers, avoidance of wearing tight socks, and avoiding exposure to excessive cold and heat.

Foot self-management: Advanced assistive interventions the patient can use at home, consisting of but not limited to: home monitoring systems, lifestyle interventions, telehealth, technological applications, peer support programs.

Footwear: defined broadly as any shoe-gear and including insoles.

Footwear modification: Modification to existing footwear with an intended therapeutic effect, for example, pressure relief.

Hosiery: Stockings or socks of any kind. See further Stockings or Socks.



SUPPLEMENTARY FILE 1

GLOSSARY OF TERMS

In-shoe (semi-)rigid orthosis: Term used for device put inside the shoe to achieve pressure reduction or alteration in the function of the foot. Can be pre-fabricated or custom-made.

Limited joint mobility: See IWGDF definitions and criteria document (135).

Medical grade footwear: Footwear that meets the specific needs of a person. Can be either pre-fabricated (see "Pre-fabricated medical grade footwear") or custom-made (see "Custom-made medical grade footwear"). Also known as pedorthic footwear.

Off-the-shelf footwear: Readily available footwear that has not been modified and has no intended therapeutic functions. Preferred term is pre-fabricated footwear.

Pre-fabricated insole: An "off-the-shelf" flat or contoured insole made without reference to the shape of the individual patient's foot.

Pre-fabricated medical grade footwear: Pre-fabricated footwear that meets the specific needs of a person, on the basis of footwear that provides extra depth, multiple width fittings and features designed to accommodate a broader range of foot types. Other features may include modified soles, fastenings and smooth internal linings. This type of footwear is usually available at specialty shoe shops.

Shoe last: Last used to make footwear. The upper of the footwear is moulded or pulled over the last. The last shape defines the footwear shape including the outsole, heel pitch and toe spring. For off-the-shelf or pre-fabricated footwear generically generated lasts in different sizes are used.

Slipper: Low-cut, open type footwear that is easily slipped onto the foot. Includes thin-soled slippers and flip-flops (thongs).

Socks: Garment for the foot and lower part of the leg, typically knitted from wool, cotton, or nylon.

Stockings: Garment that fits closely over the foot and lower leg, typically elastic. Includes compression stockings for medical purposes.

Structured education: Any educational modality that is provided in a structured way. This can take many forms, such as one-to-one verbal education, motivational interviewing, educational group sessions, video education, booklets, software, quizzes, and pictorial education via animated drawing or descriptive images.

Therapeutic footwear: Generic term for footwear designed to have some therapeutic effect that cannot be provided by or in off-the-shelf footwear. Custom-made shoes or sandals, custom-made foot orthoses, extra-depth shoes, and custom-made or prefabricated medical grade footwear are examples of therapeutic footwear.

Toe orthosis: an in-shoe orthosis to achieve some alteration in the function of the toe.

Weight-bearing activity: Activity during which the foot is loaded by supporting the body weight of the person, and expressed as quantitatively as possible. Includes walking and standing.

*Adapted from: Bus SA, Lavery LA, Monteiro-Soares M, et al. Guidelines on the prevention of foot ulcers in persons with diabetes (IWGDF 2019 update). Diabetes Metab Res Rev. 2020;36 Suppl 1:e3269. Pp 13-14.



REFERENCES

1. Armstrong DG, Boulton AJM, Bus SA. Diabetic Foot Ulcers and Their Recurrence. *New England Journal of Medicine*. 2017;376(24):2367-75.
2. Boulton AJ, Vileikyte L, Ragnarson-Tennvall G, Apelqvist J. The global burden of diabetic foot disease. *Lancet*. 2005;366(9498):1719-24.
3. Lazzarini PA, Hurn SE, Fernando ME, Jen SD, Kuys SS, Kamp MC, et al. Prevalence of foot disease and risk factors in general inpatient populations: a systematic review and meta-analysis. *BMJ Open*. 2015;5(11):e008544.
4. Van Netten JJ, Lazzarini PA, Fitridge R, Kinnear EM, Griffiths I, Malone M, et al. Australian diabetes-related foot disease strategy 2018-2022: The first step towards ending avoidable amputations within a generation. Brisbane: Wound Management CRC; 2017.
5. Lazzarini PA, Van Netten JJ, Fitridge R, Griffiths I, Kinnear EM, Malone M, et al. Pathway to ending avoidable diabetes-related amputations in Australia. *The Medical Journal Of Australia*. 2018;209(7):288-90.
6. Zhang Y, Lazzarini PA, McPhail SM, van Netten JJ, Armstrong DG, Pacella RE. Global Disability Burdens of Diabetes-Related Lower-Extremity Complications in 1990 and 2016. *Diabetes Care*. 2020;43(5):964-74.
7. Kerr M, Barron E, Chadwick P, Evans T, Kong WM, Rayman G, et al. The cost of diabetic foot ulcers and amputations to the National Health Service in England. *Diabetic Medicine*. 2019;36(8):995-1002.
8. Bus SA, Lavery LA, Monteiro-Soares M, Rasmussen A, Raspovic A, Sacco ICN, et al. Guidelines on the prevention of foot ulcers in persons with diabetes (IWGDF 2019 update). *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3269.
9. Zhang Y, van Netten JJ, Baba M, Cheng Q, Pacella R, McPhail SM, et al. Diabetes-related foot disease in Australia: a systematic review of the prevalence and incidence of risk factors, disease and amputation in Australian populations. *J Foot Ankle Res*. 2021;14(1):8.
10. Lazzarini PA, Hurn SE, Kuys SS, Kamp MC, Ng V, Thomas C, et al. Direct inpatient burden caused by foot-related conditions: a multisite point-prevalence study. *BMJ Open*. 2016;6(6):e010811-e.
11. Lazzarini PA, Hurn SE, Kuys SS, Kamp MC, Ng V, Thomas C, et al. The silent overall burden of foot disease in a representative hospitalised population. *Int Wound J*. 2017;14(4):716-28.
12. Lazzarini PA, Gurr JM, Rogers JR, Schox A, Bergin SM. Diabetes foot disease: the Cinderella of Australian diabetes management? *J Foot Ankle Res*. 2012;5(1):24.
13. West M, Chuter V, Munteanu S, Hawke F. Defining the gap: a systematic review of the difference in rates of diabetes-related foot complications in Aboriginal and Torres Strait Islander Australians and non-Indigenous Australians. *Journal of Foot and Ankle Research*. 2017;10(1):48.
14. Singh TP, Moxon JV, Meehan MT, Jones R, Cadet-James Y, Golledge J. Major amputation rates and outcomes for Aboriginal and Torres Strait Islander and non-Indigenous people in North Queensland Australia between 2000 and 2015. *BMC Endocr Disord*. 2021;21(1):101.
15. Coalition of Aboriginal and Torres Strait Islander Peak Organisations. National agreement on closing the gap. 2020.
16. Crawford F, Cezard G, Chappell FM, Murray GD, Price JF, Sheikh A, et al. A systematic review and individual patient data meta-analysis of prognostic factors for foot ulceration in people with diabetes: the international research collaboration for the prediction of diabetic foot ulcerations (PODUS). *Health Technol Assess*. 2015;19(57):1-210.
17. Monteiro-Soares M, Boyko EJ, Ribeiro J, Ribeiro I, Dinis-Ribeiro M. Predictive factors for diabetic foot ulceration: a systematic review. *Diabetes Metab Res Rev*. 2012;28(7):574-600.
18. van Netten JJ, Raspovic A, Lavery LA, Monteiro-Soares M, Rasmussen A, Sacco ICN, et al. Prevention of foot ulcers in the at-risk patient with diabetes: a systematic review. *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3270.
19. van Netten JJ, Sacco ICN, Lavery LA, Monteiro-Soares M, Rasmussen A, Raspovic A, et al. Treatment of modifiable risk factors for foot ulceration in persons with diabetes: a systematic review. *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3271.
20. Quinton T, Lazzarini P, Boyle F, Russell A, Armstrong D. How do Australian podiatrists manage patients with diabetes? The Australian diabetic foot management survey. *Journal of Foot and Ankle Research*. 2015;8(1):16.
21. Formosa C, Chockalingam N, Gatt A. Diabetes foot screening: Challenges and future strategies. *Foot (Edinb)*. 2019;38:8-11.
22. Parker CN, Van Netten JJ, Parker TJ, Jia L, Corcoran H, Garrett M, et al. Differences between national and international guidelines for the management of diabetic foot disease. *Diabetes Metab Res Rev*. 2019;35(2):e3101.
23. Baker IDI Heart and Diabetes Institute. National evidence-based guideline on prevention, identification and management of foot complications in diabetes (Part of the National Health & Medical Research Council Approved Guidelines on Management of Type 2 Diabetes). Melbourne: Baker IDI Heart & Diabetes Institute; 2011.



REFERENCES

24. National Health & Medical Research Council (NHMRC). Guidelines for Guidelines: Project planning - Version 5.0; Last updated 5 September 2019. In: NHMRC, editor. Canberra, Australia 2019.
25. National Health & Medical Research Council (NHMRC). Guidelines for Guidelines: Adopt, adapt or start from scratch - Version 5.2; Last updated 22 November 2018. In: NHMRC, editor. Canberra, Australia 2018 <https://www.nhmrc.gov.au/guidelinesforguidelines/plan/adopt-adapt-or-start-scratch>.
26. Schaper NC, Van Netten JJ, Apelqvist J, Bus SA, Hinchliffe RJ, Lipsky BA, et al. Practical guidelines on the prevention and management of diabetic foot disease (IWGDF 2019 update). *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3266.
27. Conte MS, Bradbury AW, Kolh P, White JV, Dick F, Fitridge R, et al. Global vascular guidelines on the management of chronic limb-threatening ischemia. *Journal of vascular surgery*. 2019;69(6s):3S-12S.e40.
28. International Diabetes Federation. Clinical Practice Recommendation on the Diabetic Foot: A guide for health care professionals. Brussels, Belgium: International Diabetes Federation; 2017.
29. Lazzarini PA, Rasovic A, Prentice J, Commons RJ, Fitridge RA, Charles J, et al. Guidelines development protocol and findings: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
30. Schünemann HJ, Wiercioch W, Brozek J, Etzeandía-Ikobaltzeta I, Mustafa RA, Manja V, et al. GRADE Evidence to Decision (EtD) frameworks for adoption, adaptation, and de novo development of trustworthy recommendations: GRADE-ADOLOPMENT. *J Clin Epidemiol*. 2017;81:101-10.
31. The ADAPTE Collaboration. The ADAPTE Process: Resource Toolkit for Guideline Adaptation - Version 2.0. Perthshire, Scotland: Guideline International Network; 2009 <https://g-i-n.net/library/tools>.
32. Alonso-Coello P, Schünemann HJ, Moher J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 1: Introduction. *Bmj*. 2016;353:i2016.
33. Alonso-Coello P, Oxman AD, Moher J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 2: Clinical practice guidelines. *Bmj*. 2016;353:i2089.
34. Andrews J, Guyatt G, Oxman AD, Alderson P, Dahm P, Falck-Ytter Y, et al. GRADE guidelines: 14. Going from evidence to recommendations: the significance and presentation of recommendations. *J Clin Epidemiol*. 2013;66(7):719-25.
35. Andrews JC, Schünemann HJ, Oxman AD, Pottie K, Meerpohl JJ, Coello PA, et al. GRADE guidelines: 15. Going from evidence to recommendation-determinants of a recommendation's direction and strength. *J Clin Epidemiol*. 2013;66(7):726-35.
36. Flores EJ, Mull NK, Lavenberg JG, Mitchell MD, Leas BF, Williams A, et al. Using a 10-step framework to support the implementation of an evidence-based clinical pathways programme. *BMJ Qual Saf*. 2019;28(6):476-85.
37. Waaijman R, de Haart M, Arts ML, Wever D, Verlouw AJ, Nollé F, et al. Risk factors for plantar foot ulcer recurrence in neuropathic diabetic patients. *Diabetes Care*. 2014;37(6):1697-705.
38. Warnock J. Indigenous diabetic foot program. 2008. <https://healthinfor.net.ecu.edu.au/key-resources/resources/14604/?title=Indigenous%20diabetic%20foot%20program>. Accessed 31 May 2021.
39. Foot Forward. Train the trainer program. 2021. <https://nadc.net.au/footforward/fftpilot/>. Accessed 31 May 2021.
40. Golledge J, Fernando M, Lazzarini P, Najafi B, D GA. The Potential Role of Sensors, Wearables and Telehealth in the Remote Management of Diabetes-Related Foot Disease. *Sensors (Basel)*. 2020;20(16).
41. Alahakoon C, Fernando M, Galappaththy C, Matthews EO, Lazzarini P, Moxon JV, et al. Meta-analyses of randomized controlled trials reporting the effect of home foot temperature monitoring, patient education or offloading footwear on the incidence of diabetes-related foot ulcers. *Diabet Med*. 2020;37(8):1266-79.
42. Fernando ME, Crowther RG, Pappas E, Lazzarini PA, Cunningham M, Sangla KS, et al. Plantar pressure in diabetic peripheral neuropathy patients with active foot ulceration, previous ulceration and no history of ulceration: a meta-analysis of observational studies. *Plos One*. 2014;9(6):e99050.
43. Fernando M, Crowther R, Lazzarini P, Sangla K, Cunningham M, Buttner P, et al. Biomechanical characteristics of peripheral diabetic neuropathy: A systematic review and meta-analysis of findings from the gait cycle, muscle activity and dynamic barefoot plantar pressure. *Clin Biomech (Bristol, Avon)*. 2013;28(8):831-45.
44. van Netten JJ, Lazzarini PA, Armstrong DG, Bus SA, Fitridge R, Harding K, et al. Diabetic Foot Australia guideline on footwear for people with diabetes. *J Foot Ankle Res*. 2018;11:2.



REFERENCES

45. Gupta AK, Versteeg SG. The Role of Shoe and Sock Sanitization in the Management of Superficial Fungal Infections of the Feet. *J Am Podiatr Med Assoc.* 2019;109(2):141-9.
46. Drovandi A, Wong S, Seng L, Crowley B, Alahakoon C, Banwait J, et al. Remotely Delivered Monitoring and Management of Diabetes-Related Foot Disease: An Overview of Systematic Reviews. *J Diabetes Sci Technol.* 2021;19322968211012456.
47. © Commonwealth of Australia, Department of the Prime Minister and Cabinet, Closing the Gap Report 2020.
48. Australian Institute of Health and Welfare 2015. The health and welfare of Australia's Aboriginal and Torres Strait Islander peoples 2015. Cat. no. IHW 147. Canberra: AIHW.
49. Australian Bureau of Statistics (2019a) National Aboriginal and Torres Strait Islander Health Survey, 2018–19, Cat. No. 4715.0.
50. Australian Bureau of Statistics (2019b) Causes of Death, Australia, 2018, Cat. No. 3303.0.
51. Rheault H, Coyer F, Jones L, Bonner A. Health literacy in Indigenous people with chronic disease living in remote Australia. *BMC Health Serv Res.* 2019;19(1):523.
52. Charles J. An investigation into the foot health of Aboriginal and Torres Strait Islander peoples: a literature review. *Australian Indigenous Health Bulletin.* 2015;15(3).
53. Lavery LA, Higgins KR, Lanctot DR, Constantinides GP, Zamorano RG, Armstrong DG, et al. Home monitoring of foot skin temperatures to prevent ulceration. *Diabetes Care.* 2004;27(11):2642-7.
54. Lavery LA, Higgins KR, Lanctot DR, Constantinides GP, Zamorano RG, Athanasiou KA, et al. Preventing diabetic foot ulcer recurrence in high-risk patients: use of temperature monitoring as a self-assessment tool. *Diabetes Care.* 2007;30(1):14-20.
55. Armstrong DG, Holtz-Neiderer K, Wendel C, Mohler MJ, Kimbriel HR, Lavery LA. Skin temperature monitoring reduces the risk for diabetic foot ulceration in high-risk patients. *Am J Med.* 2007;120(12):1042-6.
56. Skafjeld A, Iversen MM, Holme I, Ribu L, Hvaal K, Kilhovd BK. A pilot study testing the feasibility of skin temperature monitoring to reduce recurrent foot ulcers in patients with diabetes—a randomized controlled trial. *BMC Endocr Disord.* 2015;15:55.
57. Wijlens AM, Holloway S, Bus SA, van Netten JJ. An explorative study on the validity of various definitions of a 2.2°C temperature threshold as warning signal for impending diabetic foot ulceration. *Int Wound J.* 2017;14(6):1346-51.
58. van Netten JJ, Pijls M, van Baal JG, Liu C, van der Heijden F, Bus SA. Diagnostic values for skin temperature assessment to detect diabetes-related foot complications. *Diabetes Technol Ther.* 2014;16(11):714-21.
59. Reiber GE, Smith DG, Wallace C, Sullivan K, Hayes S, Vath C, et al. Effect of therapeutic footwear on foot reulceration in patients with diabetes: a randomized controlled trial. *Jama.* 2002;287(19):2552-8.
60. Uccioli L, Faglia E, Monticone G, Favales F, Durola L, Aldeghi A, et al. Manufactured shoes in the prevention of diabetic foot ulcers. *Diabetes Care.* 1995;18(10):1376-8.
61. Viswanathan V, Madhavan S, Gnanasundaram S, Gopalakrishna G, Das BN, Rajasekar S, et al. Effectiveness of different types of footwear insoles for the diabetic neuropathic foot: a follow-up study. *Diabetes Care.* 2004;27(2):474-7.
62. Chantelau E, Kushner T, Spraul M. How effective is cushioned therapeutic footwear in protecting diabetic feet? A clinical study. *Diabet Med.* 1990;7(4):355-9.
63. Busch K, Chantelau E. Effectiveness of a new brand of stock 'diabetic' shoes to protect against diabetic foot ulcer relapse. A prospective cohort study. *Diabet Med.* 2003;20(8):665-9.
64. Reike H, Bruning A, Rischbieter E, Vogler F, Angelkort B. Recurrence of foot lesions in patients with diabetic foot syndrome: influence of custom-molded orthotic device. *Diabetes Stoffwechsel.* 1997;6:107-13.
65. Bus SA, Waaijman R, Arts M, de Haart M, Busch-Westbroek T, van Baal J, et al. Effect of custom-made footwear on foot ulcer recurrence in diabetes: a multicenter randomized controlled trial. *Diabetes Care.* 2013;36(12):4109-16.
66. Ulbrecht JS, Hurley T, Mauger DT, Cavanagh PR. Prevention of recurrent foot ulcers with plantar pressure-based in-shoe orthoses: the CareFUL prevention multicenter randomized controlled trial. *Diabetes Care.* 2014;37(7):1982-9.
67. Bus SA, van Netten JJ. A shift in priority in diabetic foot care and research: 75% of foot ulcers are preventable. *Diabetes Metab Res Rev.* 2016;32 Suppl 1:195-200.
68. Fernando ME, Horsley MW, Jones S, Martin B, Nube VL, Charles J, et al. Australian guideline on offloading treatment for foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.



REFERENCES

69. Chuter VH, Quigley F, Tosenovsky P, Ritter JC, Charles J, Cheney J, et al. Australian guideline on diagnosis and management of peripheral artery disease: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
70. Kearney TP, Hunt NA, Lavery LA. Safety and effectiveness of flexor tenotomies to heal toe ulcers in persons with diabetes. *Diabetes Res Clin Pract.* 2010;89(3):224-6.
71. Laborde JM. Neuropathic toe ulcers treated with toe flexor tenotomies. *Foot Ankle Int.* 2007;28(11):1160-4.
72. Rasmussen A, Bjerre-Christensen U, Almdal TP, Holstein P. Percutaneous flexor tenotomy for preventing and treating toe ulcers in people with diabetes mellitus. *J Tissue Viability.* 2013;22(3):68-73.
73. Schepers T, Berendsen HA, Oei IH, Koning J. Functional outcome and patient satisfaction after flexor tenotomy for plantar ulcers of the toes. *J Foot Ankle Surg.* 2010;49(2):119-22.
74. Tamir E, McLaren AM, Gadgil A, Daniels TR. Outpatient percutaneous flexor tenotomies for management of diabetic claw toe deformities with ulcers: a preliminary report. *Can J Surg.* 2008;51(1):41-4.
75. Tamir E, Vigler M, Avisar E, Finestone AS. Percutaneous tenotomy for the treatment of diabetic toe ulcers. *Foot Ankle Int.* 2014;35(1):38-43.
76. van Netten JJ, Bril A, van Baal JG. The effect of flexor tenotomy on healing and prevention of neuropathic diabetic foot ulcers on the distal end of the toe. *J Foot Ankle Res.* 2013;6(1):3.
77. Mueller MJ, Sinacore DR, Hastings MK, Strube MJ, Johnson JE. Effect of Achilles tendon lengthening on neuropathic plantar ulcers. A randomized clinical trial. *J Bone Joint Surg Am.* 2003;85(8):1436-45.
78. Colen LB, Kim CJ, Grant WP, Yeh JT, Hind B. Achilles tendon lengthening: friend or foe in the diabetic foot? *Plast Reconstr Surg.* 2013;131(1):37e-43e.
79. Cunha M, Faul J, Steinberg J, Attinger C. Forefoot ulcer recurrence following partial first ray amputation: the role of tendo-achilles lengthening. *J Am Podiatr Med Assoc.* 2010;100(1):80-2.
80. Holstein P, Lohmann M, Bitsch M, Jørgensen B. Achilles tendon lengthening, the panacea for plantar forefoot ulceration? *Diabetes Metab Res Rev.* 2004;20 Suppl 1:S37-40.
81. Lin SS, Lee TH, Wapner KL. Plantar forefoot ulceration with equinus deformity of the ankle in diabetic patients: the effect of tendo-Achilles lengthening and total contact casting. *Orthopedics.* 1996;19(5):465-75.
82. Laborde JM. Treatment of diabetic foot ulcers with tendon lengthening. *Am Fam Physician.* 2009;80(12):1351; author reply
83. Laborde JM. Midfoot ulcers treated with gastrocnemius-soleus recession. *Foot Ankle Int.* 2009;30(9):842-6.
84. Piaggese A, Schipani E, Campi F, Romanelli M, Baccetti F, Arvia C, et al. Conservative surgical approach versus non-surgical management for diabetic neuropathic foot ulcers: a randomized trial. *Diabet Med.* 1998;15(5):412-7.
85. Armstrong DG, Rosales MA, Gashi A. Efficacy of fifth metatarsal head resection for treatment of chronic diabetic foot ulceration. *J Am Podiatr Med Assoc.* 2005;95(4):353-6.
86. Faglia E, Clerici G, Caminiti M, Curci V, Somalvico F. Feasibility and effectiveness of internal pedal amputation of phalanx or metatarsal head in diabetic patients with forefoot osteomyelitis. *J Foot Ankle Surg.* 2012;51(5):593-8.
87. Giurini JM, Basile P, Chrzan JS, Habershaw GM, Rosenblum BI. Panmetatarsal head resection. A viable alternative to the transmetatarsal amputation. *J Am Podiatr Med Assoc.* 1993;83(2):101-7.
88. Hamilton GA, Ford LA, Perez H, Rush SM. Salvage of the neuropathic foot by using bone resection and tendon balancing: a retrospective review of 10 patients. *J Foot Ankle Surg.* 2005;44(1):37-43.
89. Petrov O, Pfeifer M, Flood M, Chagares W, Daniele C. Recurrent plantar ulceration following pan metatarsal head resection. *J Foot Ankle Surg.* 1996;35(6):573-7; discussion 602.
90. Molines-Barroso RJ, Lázaro-Martínez JL, Aragón-Sánchez J, García-Morales E, Beneit-Montesinos JV, Álvaro-Afonso FJ. Analysis of transfer lesions in patients who underwent surgery for diabetic foot ulcers located on the plantar aspect of the metatarsal heads. *Diabet Med.* 2013;30(8):973-6.
91. Griffiths GD, Wieman TJ. Metatarsal head resection for diabetic foot ulcers. *Arch Surg.* 1990;125(7):832-5.
92. Vanlerberghe B, Devemy F, Duhamel A, Guerreschi P, Torabi D. [Conservative surgical treatment for diabetic foot ulcers under the metatarsal heads. A retrospective case-control study]. *Ann Chir Plast Esthet.* 2014;59(3):161-9.
93. Armstrong DG, Lavery LA, Vazquez JR, Short B, Kimbriel HR, Nixon BP, et al. Clinical efficacy of the first metatarsophalangeal joint arthroplasty as a curative procedure for hallux interphalangeal joint wounds in patients with diabetes. *Diabetes Care.* 2003;26(12):3284-7.
94. Lin SS, Bono CM, Lee TH. Total contact casting and Keller arthroplasty for diabetic great toe ulceration under the interphalangeal joint. *Foot Ankle Int.* 2000;21(7):588-93.
95. Downs DM, Jacobs RL. Treatment of resistant ulcers on the plantar surface of the great toe in diabetics. *J Bone Joint Surg Am.* 1982;64(6):930-3.



REFERENCES

96. Fleischli JE, Anderson RB, Davis WH. Dorsiflexion metatarsal osteotomy for treatment of recalcitrant diabetic neuropathic ulcers. *Foot Ankle Int.* 1999;20(2):80-5.
97. Mueller MJ, Sinacore DR, Hastings MK, Lott DJ, Strube MJ, Johnson JE. Impact of achilles tendon lengthening on functional limitations and perceived disability in people with a neuropathic plantar ulcer. *Diabetes Care.* 2004;27(7):1559-64.
98. Salsich GB, Mueller MJ, Hastings MK, Sinacore DR, Strube MJ, Johnson JE. Effect of Achilles tendon lengthening on ankle muscle performance in people with diabetes mellitus and a neuropathic plantar ulcer. *Phys Ther.* 2005;85(1):34-43.
99. Hastings MK, Mueller MJ, Sinacore DR, Salsich GB, Engsberg JR, Johnson JE. Effects of a tendo-Achilles lengthening procedure on muscle function and gait characteristics in a patient with diabetes mellitus. *J Orthop Sports Phys Ther.* 2000;30(2):85-90.
100. Nickerson DS. Low recurrence rate of diabetic foot ulcer after nerve decompression. *J Am Podiatr Med Assoc.* 2010;100(2):111-5.
101. Dellon AL, Muse VL, Nickerson DS, Akre T, Anderson SR, Barrett SL, et al. Prevention of ulceration, amputation, and reduction of hospitalization: outcomes of a prospective multicenter trial of tibial neurolysis in patients with diabetic neuropathy. *J Reconstr Microsurg.* 2012;28(4):241-6.
102. Nickerson DS, Rader AJ. Low long-term risk of foot ulcer recurrence after nerve decompression in a diabetes neuropathy cohort. *J Am Podiatr Med Assoc.* 2013;103(5):380-6.
103. Nickerson DS, Rader AJ. Nerve decompression after diabetic foot ulceration may protect against recurrence: a 3-year controlled, prospective analysis. *J Am Podiatr Med Assoc.* 2014;104(1):66-70.
104. Aszmann O, Tassler PL, Dellon AL. Changing the natural history of diabetic neuropathy: incidence of ulcer/amputation in the contralateral limb of patients with a unilateral nerve decompression procedure. *Ann Plast Surg.* 2004;53(6):517-22.
105. World Health Organization. *Global Recommendations on Physical Activity for Health*; WHO: Geneva, Switzerland, 2010.
106. Venkataraman K, Tai BC, Khoo EYH, Tavintharan S, Chandran K, Hwang SW, et al. Short-term strength and balance training does not improve quality of life but improves functional status in individuals with diabetic peripheral neuropathy: a randomised controlled trial. *Diabetologia.* 2019;62(12):2200-10.
107. Sartor CD, Hasue RH, Cacciari LP, Butugan MK, Watari R, Pássaro AC, et al. Effects of strengthening, stretching and functional training on foot function in patients with diabetic neuropathy: results of a randomized controlled trial. *BMC Musculoskelet Disord.* 2014;15:137.
108. Melai T, Schaper NC, Ijzerman TH, de Lange TL, Willems PJ, Lima Passos V, et al. Lower leg muscle strengthening does not redistribute plantar load in diabetic polyneuropathy: a randomised controlled trial. *J Foot Ankle Res.* 2013;6(1):41.
109. Pataky Z, de León Rodríguez D, Allet L, Golay A, Assal M, Assal JP, et al. Biofeedback for foot offloading in diabetic patients with peripheral neuropathy. *Diabet Med.* 2010;27(1):61-4.
110. York RM, Perell-Gerson KL, Barr M, Durham J, Roper JM. Motor learning of a gait pattern to reduce forefoot plantar pressures in individuals with diabetic peripheral neuropathy. *Pm r.* 2009;1(5):434-41.
111. De León Rodríguez D, Allet L, Golay A, Philippe J, Assal JP, Hauert CA, et al. Biofeedback can reduce foot pressure to a safe level and without causing new at-risk zones in patients with diabetes and peripheral neuropathy. *Diabetes Metab Res Rev.* 2013;29(2):139-44.
112. Cerrahoglu L, Koşan U, Sirin TC, Ulusoy A. Range of Motion and Plantar Pressure Evaluation for the Effects of Self-Care Foot Exercises on Diabetic Patients with and Without Neuropathy. *J Am Podiatr Med Assoc.* 2016;106(3):189-200.
113. Goldsmith JR, Lidtke RH, Shott S. The effects of range-of-motion therapy on the plantar pressures of patients with diabetes mellitus. *J Am Podiatr Med Assoc.* 2002;92(9):483-90.
114. Kanchanasamut W, Pensri P. Effects of weight-bearing exercise on a mini-trampoline on foot mobility, plantar pressure and sensation of diabetic neuropathic feet; a preliminary study. *Diabet Foot Ankle.* 2017;8(1):1287239.
115. Iunes DH, Rocha CB, Borges NC, Marcon CO, Pereira VM, Carvalho LC. Self-care associated with home exercises in patients with type 2 diabetes mellitus. *PLoS One.* 2014;9(12):e114151.
116. Fayed EE, Badr NM, Mahmoud S, Hakim SA. Exercise therapy improves plantar pressure distribution in patients with diabetic peripheral neuropathy. *International Journal of Pharm Tech Research.* 2016;9(5):151-9.
117. Colberg SR, Sigal RJ, Yardley JE, Riddell MC, Dunstan DW, Dempsey PC, et al. Physical Activity/Exercise and Diabetes: A Position Statement of the American Diabetes Association. *Diabetes Care.* 2016;39(11):2065-79.



REFERENCES

118. Mueller MJ, Tuttle LJ, Lemaster JW, Strube MJ, McGill JB, Hastings MK, et al. Weight-bearing versus nonweight-bearing exercise for persons with diabetes and peripheral neuropathy: a randomized controlled trial. *Arch Phys Med Rehabil.* 2013;94(5):829-38.
119. Lemaster JW, Mueller MJ, Reiber GE, Mehr DR, Madsen RW, Conn VS. Effect of weight-bearing activity on foot ulcer incidence in people with diabetic peripheral neuropathy: feet first randomized controlled trial. *Phys Ther.* 2008;88(11):1385-98.
120. Lazzarini PA, Crews RT, van Netten JJ, Bus SA, Fernando ME, Chadwick PJ, et al. Measuring Plantar Tissue Stress in People With Diabetic Peripheral Neuropathy: A Critical Concept in Diabetic Foot Management. *J Diabetes Sci Technol.* 2019;13(5):869-80.
121. Hulshof CM, van Netten JJ, Pijnappels M, Bus SA. The role of foot-loading factors and their associations with ulcer development and ulcer healing in people with diabetes: A systematic review. *Journal of Clinical Medicine.* 2020;9(11):3591.
122. Schoen DE. Barriers and facilitators to the implementation of evidence-based guidelines for the diabetic foot in rural and remote Western Australia using the World Health Organization network. PhD Thesis. The University of Western Australia, Perth, Australia; 2019.
123. Dawson J, Augoustinos M, Sjoberg D, Canuto K, Glover K, Rumbold A, et al. Closing the gap: Examining how the problem of Aboriginal and Torres Strait Islander disadvantage is represented in policy. *Aust J Soc Issues.* 2020;1-17.
124. Department of Health, Koolin Balit: Victorian Government strategic directions for Aboriginal health 2012–2022, Melbourne, Australia; 2012.
125. Rayman G, Vas PR, Baker N, Taylor CG, Jr., Gooday C, Alder AI, et al. The Ipswich Touch Test: a simple and novel method to identify inpatients with diabetes at risk of foot ulceration. *Diabetes Care.* 2011;34(7):1517-8.
126. Hinchliffe RJ, Forsythe RO, Apelqvist J, Boyko EJ, Fitridge R, Hong JP, et al. Guidelines on diagnosis, prognosis, and management of peripheral artery disease in patients with foot ulcers and diabetes (IWGDF 2019 update). *Diabetes Metab Res Rev.* 2020;36 Suppl 1:e3276.
127. Monteiro-Soares M, Russell D, Boyko EJ, Jeffcoate W, Mills JL, Morbach S, et al. Guidelines on the classification of diabetic foot ulcers (IWGDF 2019). *Diabetes Metab Res Rev.* 2020;36 Suppl 1:e3273.
128. Rayman G, Vas P, Dhatariya K, Driver V, Hartemann A, Londahl M, et al. Guidelines on use of interventions to enhance healing of chronic foot ulcers in diabetes (IWGDF 2019 update). *Diabetes Metab Res Rev.* 2020;36 Suppl 1:e3283.
129. Lipsky BA, Senneville É, Abbas ZG, Aragón-Sánchez J, Diggle M, Embil JM, et al. Guidelines on the diagnosis and treatment of foot infection in persons with diabetes (IWGDF 2019 update). *Diabetes Metab Res Rev.* 2020;36 Suppl 1:e3280.
130. Bus SA, Armstrong DG, Gooday C, Jarl G, Caravaggi C, Viswanathan V, et al. Guidelines on offloading foot ulcers in persons with diabetes (IWGDF 2019 update). *Diabetes/Metabolism Research and Reviews.* 2020;36(S1):e3274.
131. Commons RJ, Charles J, Cheney J, Lynar SA, Malone M, Raby E, et al. Australian guideline on management of diabetes-related foot infection: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
132. Hamilton EJ, Scheepers J, Ryan H, Perrin BM, Charles J, Cheney J, et al. Australian guideline on wound classification of diabetes-related foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
133. Chen P, Carville K, Swanson T, Lazzarini PA, Charles J, Cheney J, et al. Australian guideline on wound healing interventions to enhance healing of foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
134. World Health Organization. Adherence to long-term therapies: evidence for action. 2003.
135. IWGDF Editorial Board. IWGDF Definitions and Criteria. 2019; Available at: <https://iwgdfguidelines.org/definitions-criteria/>. Accessed 27/02, 2021.



WOUND CLASSIFICATION

Australian guideline on wound classification of
diabetes-related foot ulcers

Part of the 2021 Australian
evidence-based guidelines for
diabetes-related foot disease

VERSION 1.0 210921



AUTHORS

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Disclaimer

These Australian Evidence-based Guidelines are a general guide to appropriate practice, to be followed subject to the clinician's judgment and the patient's preference in each individual case. The Guidelines are designed to provide information to assist decision-making and are based on the best evidence available at the time of development.

Diabetes Feet Australia would like to thank and acknowledge Mikaela Cameron who has created the artwork to represent the guidelines. Mikaela Cameron (M. J. Badagarang) is a proud Dharug saltwater woman from the Hawkesbury River in New South Wales, Australia. She's worked the past 4 years as a cultural educator delivering cultural workshops and creating murals. "Worimi, I am a proud Dharug woman. My totem is the Badagarang (Eastern Grey Kangaroo), and Waroo (the brown-eyes crow). I pay my respects to all Elders past, present and emerging, and extend this acknowledgment to you and your people. Welcome, let's walk together."

ABSTRACT

Background

Wound classification systems are useful tools to characterise diabetes-related foot ulcers (DFU) and are utilised for the purpose of clinical assessment, to promote effective communication between health professionals, and to support clinical audit and benchmarking. Australian guidelines regarding wound classification in patients with DFU are outdated. We aimed to adapt existing international guidelines for wound classification to develop new evidence-based Australian guidelines for wound classification in people with diabetes and DFU.

Methods

Recommended NHRMC procedures were followed to adapt suitable International Working Group on the Diabetic Foot (IWGDF) guidelines on wound classification to the Australian health context. Five IWGDF wound classification recommendations were evaluated and assessed according to the ADAPTE and GRADE systems. We compared our judgements with IWGDF judgements to decide if recommendations should be adopted, adapted or excluded in an Australian context. We re-evaluated the quality of evidence and strength of recommendation ratings, provided justifications for the recommendation and outlined any special considerations for implementation, subgroups, monitoring and future research in an Australian setting.

Results

After the five recommendations from the IWGDF 2019 guidelines on the classification of DFU's were evaluated by the panel, two were adopted and three were adapted to be more suitable for Australia. The main reasons for adapting, were to align the recommendations to existing Australian standards of care, especially in specialist settings, to maintain consistency with existing recommendations for documentation, audit and benchmarking and to be more appropriate, acceptable and applicable to an Australian context. In Australia, we recommend the use of the SINBAD system as a minimum standard to document the characteristics of a DFU for the purposes of communication among health professionals and for regional/national/international audit. In contrast to the IWGDF who recommend against usage, in Australia we recommend caution in the use of existing wound classification systems to provide an individual prognosis for a person with diabetes and a foot ulcer.

Conclusions

We have developed new guidelines for wound classification for people with diabetes and a foot ulcer that are appropriate and applicable for use across diverse care settings and geographical locations in Australia.

Keywords

Wound classification, guidelines, adapt, adopt, diabetes-related foot ulcers



WOUND CLASSIFICATION

AUSTRALIAN RECOMMENDATIONS LIST

PREVENTION

WOUND CLASSIFICATION

PERIPHERAL ARTERY
DISEASE

INFECTION

OFFLOADING

WOUND HEALING
INTERVENTIONS

1

In a person with diabetes and a foot ulcer, as a minimum, use the SINBAD wound classification system for communication among health professionals about the characteristics of the ulcer (strength of recommendation: strong; quality of evidence: moderate)

2

Be cautious in the application of any of the currently available classification/scoring systems to offer an individual prognosis for a person with diabetes and a foot ulcer (weak; low)

3

In a person with diabetes and an infected foot ulcer, use the IDSA/IWGDF infection classification to characterise and guide infection management (weak; moderate)

4

In a person with diabetes and a foot ulcer who is being managed in a setting where appropriate expertise in vascular intervention is available, use WIfI scoring to aid decision making in the assessment of perfusion and likelihood of benefit from revascularisation (weak; moderate)

5

As a minimum, use the SINBAD system for any regional/national/international audits to allow comparisons between institutions on the outcomes of patients with diabetes and an ulcer of the foot (strong; high).





BACKGROUND

One Australian loses a limb, or part thereof, every 2 hours as a consequence of diabetes-related foot disease (DFD) (1, 2). DFD is defined as ulceration, infection, ischaemia or neuroarthropathy of the foot in a person with diabetes (3-6). The annual burden of DFD in Australia is high with an estimated 27,600 public hospitalisations, 4,400 lower limb amputations, 1,700 deaths, and health system costs of \$1.6 billion each year (3, 4, 7-9). Management of DFD by interdisciplinary high risk foot services (iHRFS) increases the percentage of healed ulcers, and reduces wound healing times, amputations and hospitalisations (10). Effective assessment, documentation and communication of clinical information and audit of patient outcomes is central to achieving optimal outcomes for patients living with DFD. Aboriginal and Torres Strait Islander Australians have a 38-fold elevated risk of developing DFD, including diabetes-related peripheral neuropathy, DFU and amputation (11, 12).

Foot health complications in Aboriginal and Torres Strait islander communities is historic (13, 14) and this also impacts on social and emotional well-being (15). This relates to outcome 1 in the new 2020 Closing the Gap in Partnership agreement “Aboriginal and Torres Strait Islander people enjoying long and healthy lives” with potential avoidable mortality rates and rates of accessing health services. These recommendations also address outcome 14 “Aboriginal and Torres Strait Islander people enjoying high levels of social and emotional wellbeing” in relation to “psychological distress” caused by hospitalisation due to ulceration and amputation (16). Therefore, implementing strategies for the prevention of DFU is critical to all Australians, and will likely contribute to lowering the national health care burden (17). To a greater extent, addressing health disparities experienced by Aboriginal and Torres Strait Islander people is also paramount (11).

A diabetes-related foot ulcer (DFU) is a break in the skin of the foot in a person with diabetes which does not promptly heal (18). DFUs may vary in regard to precipitant, characteristics such as location, size and depth and there are a number of different factors which may influence DFU outcomes, such as healing time and risk of lower extremity amputation (LEA) (18, 19). Wound classification systems are useful tools to support clinical assessment, aid effective communication between health professionals, assist with timely triage of referrals to specialist services such as iHRFS, and to guide clinical decision making and prognosis in certain settings, as well as support clinical audit and benchmarking (18, 19).

There have been a number of review articles of DFU classification systems, including a recent critical review by the IWGDF (18, 20-23). DFU classification systems vary in their intended purpose and clinical use, may be predominantly descriptive or generate a score or risk level, be simple relying on clinical examination findings, or complex requiring specialised equipment or expertise (18, 19). A DFU classification system intended to provide a risk assessment or prognosis for an individual patient will require more detailed information and evaluation compared with a DFU classification system designed for the comparison of outcomes between populations, the latter which would ideally be simple, quick and require no specialised equipment (19). In total, 37 DFU classification systems were identified by the IWGDF, of which 19 were reviewed in detail, suggesting it is likely no one DFU classification system is ideally suited for all clinical purposes and populations (18, 19).

Based on existing evidence from review of clinical cohorts and consensus expert opinion the IWGDF determined there were eight key factors which were most important for predicting DFU outcomes, namely: patient factors (end-stage renal disease); limb factors (presence of peripheral arterial disease, loss of protective sensation); and ulcer factors (area, depth, location, number of ulcers and presence of infection); however no one DFU classification system currently comprises all of the aforementioned parameters (18, 19, 24-30). In the 2019 IWGDF DFU classification guidelines five key questions or clinical scenarios were identified and considered to be of critical importance regarding the use of wound classification systems in people with a DFU: a) the most appropriate DFU classification system for the purposes of communication among health professionals b) for the purpose of providing a prognosis for DFU outcomes c) for guiding clinical management of DFU complicated by infection d) for guiding decision making regarding benefit from revascularisation in a patient with DFU, and e) for the purpose of regional/national/international audits (18, 19).

National evidence-based Australian guidelines for prevention, identification and management of foot complications in diabetes were last published in 2011 and are now outdated (31). As there are existing international DFD guidelines that were recently updated and suitable for adaptation to an Australian context, here we present the new Australian evidence-based guideline for wound classification in people with DFU, adapted from recent 2019 guidelines from the IWGDF (19, 32, 33).



METHODS

The process for development of these guidelines has been overseen by the Australian DFD guidelines working group and is described in detail in an accompanying guidelines development paper (33). NHMRC recommendations for adapting source guidelines were followed, which recommend an approach using eight steps: i) defining the scope; ii) identifying potential source guidelines; iii) assessing the suitability of source guidelines; iv) assessing and deciding which source guideline recommendations to adopt, adapt, or exclude; v) drafting new recommendations and rationale for the context; vi) collating recommendations and rationale into new guidelines; vii) developing clinical pathway(s) to aid implementation; and viii) consultation and endorsement of the final guidelines (33-36). The Australian DFD guidelines development paper reports the findings of the first three steps and concludes that the 2019 International Working Group on the Diabetic Foot (IWGDF) guidelines were the only suitable international source guidelines to adapt for this new guideline (33). The subsequent steps are described in this manuscript.

A national expert panel was established by the Australian DFD Guidelines working group to develop this wound classification guideline, consisting of recognised multi-disciplinary experts in DFU management and wound classification, along with a consumer representative and Aboriginal and Torres Strait Islander DFD experts (33). The panel members were provided with the recommendations from the 2019 guidelines on the classification of diabetic foot ulcers and supporting critical review from the IWGDF (18, 19, 33).

Two members of the Wound Classification panel independently screened and reviewed each of the five IWGDF DFU classification recommendations (and rationale) for the quality of evidence, strength of recommendation, acceptability and applicability in an Australian context, using a customised 7-item ADAPTE evaluation form (33, 35). The panel subsequently met to review and discuss ratings for all five recommendations until consensus decisions for all recommendations were reached. The panel were empowered to realise a consensus decision for each IWGDF recommendation. If the panel agreed with the quality of evidence and strength of a recommendation made by IWGDF, and found it acceptable and applicable in the Australian context, then the recommendation was adopted. Any recommendations where the panel determined uncertainty or disagreement existed with: the quality of evidence; strength of recommendation; or acceptability or applicability in the Australia context, were referred to be fully assessed in the next stage, of full assessment (33, 35). Recommendations requiring full assessment used a customised GRADE Evidence to Decision (EtD) tool (33, 36-38). One panel member extracted and populated the EtD tool, with relevant supporting evidence text for the recommendation from the IWGDF guidelines on the classification of diabetic foot ulcers, and critical review plus any more recent relevant published material (18, 19). The EtD tool describes eight important criteria: the problem, desirable effects, undesirable effects, quality (or certainty) of evidence, values (of importance of outcomes), balance of effects, acceptability, and applicability (33, 36-38). The populated EtD tool was checked by a second panel member and any disagreements were discussed until consensus was reached. The panel met to discuss and gain consensus on their summary judgements for the eight criteria (37, 38), and compared their judgements with the IWGDF (33, 36).

Based on the level of agreement between the panel and IWGDF summary judgements, the panel then discussed and made a consensus decision on adopting, adapting, or excluding the recommendation concerned for the Australian national context (33, 36). These decisions were defined as follows: adopted, if there were no substantial differences between the panel and IWGDF summary judgements; adapted, if there were substantial differences; and excluded, if there were substantial differences and/or the panel concluded the recommendation was not acceptable or applicable in Australia (33, 36). Any disagreements within the panel were discussed until consensus was reached.

Those recommendations the panel decided to adapt had their quality of evidence, strength of recommendation rating (36, 37, 39) and written recommendations re-evaluated, via consensus based on the panel's summary judgements (33, 36). The panel rated the quality of evidence as per the GRADE system as: high, if the panel was very confident that the findings from the supporting evidence were from studies with low risk of bias that reported consistent effects and further research was unlikely to change that confidence; moderate, if moderate confidence in the risk of bias or consistency of effects and further research was likely to impact that confidence further; low, if limited confidence in the risk of bias and inconsistency of effects and further research was very likely to impact confidence; and very low, if very little confidence in the available supporting evidence (37, 39). The panel rated the strength of recommendations also based on GRADE system by weighing up the balance of effects, quality of evidence, values, applicability and acceptability (37, 39) in the Australian national context (33) as: strong, if there was clearly a moderate-to-large difference in the balance of effects between the intervention compared with the control; and weak, if there was an uncertainty and/or mild-to-moderate difference (37, 39). The panel then re-wrote any adapted recommendation to be clear, specific and unambiguous as per GRADE (40, 41).



WOUND CLASSIFICATION

METHODS

For each recommendation the panel drafted decision rationale, summary justifications for their judgements, detail justifications for important EtD criteria (if the recommendation was fully assessed), and considerations for implementation, special subgroups (including for geographically remote and Aboriginal and Torres Strait Islander populations), monitoring and potential future research priorities (36, 37, 39), in the Australian context (33). The panel collated all recommendations (and rationale) into a consultation draft manuscript of the Australian evidence-based wound classification guideline ready for public consultation (33).

The consultation draft manuscript of the wound classification guideline underwent a formal one-month public consultation period using a customised consultation survey from ADAPTE (33, 35). All relevant survey and written feedback from the consultation period was collated, analysed and the manuscript was revised accordingly by the authors (33, 35). Finally, the authors sought endorsement from the Australian DFD Guidelines working group and other relevant peak national bodies for the final guideline to be released. We refer the reader to the results section below for all final recommendations and rationale contained in the new Australian national evidenced-based guidelines for the wound classification in people with DFU.

RESULTS

The five recommendations from the IWGDF 2019 guidelines on the classification of diabetes-related foot ulcers were evaluated by the panel to determine the quality of evidence, strength of recommendation, acceptability and applicability to the Australian context. After screening, two recommendations were adopted and three recommendations required further full assessment (see Table 1). Following full assessment by the panel, all three of those recommendations were adapted, with the adapted versions determined to be acceptable and applicable to an Australian context (see Table 2). The main reasons for adapting, were to align the recommendations with existing Australian standards of care, especially in specialist settings, such as iHRFS, to maintain consistency with existing recommendations for documentation, audit and benchmarking, and to be more appropriate, acceptable and applicable to an Australian context (42, 43). Wording differences between the original three IWGDF and new Australian recommendations for wound classification in people with DFU are summarized in Table 3. See Supplementary Material for detailed justification for the three recommendations that were adapted.

For each of the five Australian wound classification recommendations, we have outlined below: the question the recommendation addressed; the Australian recommendation; the panel decision and rationale to adopt, adapt or exclude; summary (and detailed if applicable) justification for the recommendation; and considerations for implementation, special subgroups (including for Aboriginal and Torres Strait Islander and geographical remote populations), monitoring; and, potential future research priorities. Following on from the Recommendations determined in this document, a consensus Clinical Pathway was developed for Wound Classification in people with DFUs, as shown in Figure 1. Four responses from four organisations to the public consultation survey were received. All four respondents (strongly) agreed that the guideline should be approved as the new Australian wound classification guideline, that the guideline would be supported by the majority of their colleagues and if approved they would encourage its use in practice. All de-identified feedback comments received during public consultation and the panel's responses to each comment were collated and posted on the Diabetes Feet Australia website. Based on the collated public consultation feedback, the guideline was revised, approved by the panel and Australian DFD Guidelines working group, and endorsed as the new Australian guideline on wound classification of diabetes-related foot ulcers by ten peak national bodies listed below.

WOUND CLASSIFICATION GUIDELINE ENDORSEMENT

- Aboriginal and Torres Strait Islander Diabetes-related Foot Complications Program (SAHMRI)
- Advanced Practicing Podiatrists - High Risk Foot Group
- Australian and New Zealand Society for Vascular Surgery
- Australian Diabetes Society
- Australian Orthotic Prosthetic Association
- Australian Podiatry Association
- Australasian Society for Infectious Diseases
- Diabetes Feet Australia
- Pedorthic Association of Australia
- Wounds Australia





Recommendation 1

In a person with diabetes and a foot ulcer, as a minimum, use the SINBAD wound classification system for communication among health professionals about the characteristics of the ulcer (strength of recommendation: strong; quality of evidence: moderate)

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation after full assessment, based on minor differences in some judgements to the IWGDF, particularly regarding acceptability and feasibility in an Australian context (see Table 2). As a result, wording changes to the original IWGDF recommendation were made, with the insertion of 'as a minimum' to indicate the use of the SINBAD wound classification system as a minimum standard for wound classification for the purposes of communication among health professionals.

Summary justification

The panel agreed with the IWGDF evaluation of the strength of the evidence (moderate) and that health providers would place importance on the effective communication of information to facilitate appropriate referral and patient assessment. Although most patients are probably unaware of specific wound classification systems, it was also agreed that patients would likely place importance on effective communication of clinical information that would facilitate appropriate triage of referrals for DFU assessment and management. There were some minor differences in comparison to the IWGDF judgement for this recommendation, with partial agreement with IWGDF in regard to acceptability and feasibility in an Australian context, due to existing guidelines and recommendations for use of WIfI and/ or University of Texas wound classification systems in specialist settings such as iHRFS, as well as current lack of widespread familiarity with the SINBAD wound classification system in Australia (42, 43). The detailed justifications for our full assessment are described in supplementary information.

Implementation considerations

The panel agreed that the use of the additional text 'as a minimum' in the recommendation for the Australian Guidelines provides two additional strengths. Firstly, it recognises that SINBAD is the minimum acceptable method for wound classification, suitable for communication between health professionals, for example to and from primary care settings. Secondly, it highlights for communication between other health care providers, such as within and between iHRFS, use of an additional, more detailed wound classification system is desirable such as WIfI or University of Texas. Given the simplicity and lack of need for specialised equipment, there should be no significant barriers to implementation of the use of SINBAD in Australia. In agreement with IWGDF, it is important the individual components of SINBAD (rather than the total score) are used for the purposes of communication between health professionals. It is likely in Australia that additional educational measures will be required to support more widespread familiarity and use of SINBAD across diverse clinical settings.

Subgroup considerations

Geographically remote people

The panel agreed with the IWGDF, that SINBAD would be acceptable for use in remote locations, given the simplicity, reliability and no requirement for specialised clinical equipment.

Aboriginal and Torres Strait Islander peoples

The SINBAD wound classification system would likely be well accepted and utilised in health settings where Aboriginal and Torres Strait Islander populations are managed, especially given the simplicity, reliability and no requirement for specialised clinical equipment.

Other subgroup considerations

No other subgroup considerations.



Recommendation 1

In a person with diabetes and a foot ulcer, as a minimum, use the SINBAD wound classification system for communication among health professionals about the characteristics of the ulcer (strength of recommendation: strong; quality of evidence: moderate)

DECISION: ADAPTED

Monitoring considerations

As SINBAD is not currently widely used in Australia the panel determined that it would be useful to monitor use of SINBAD across clinical care settings in the future. This may be possible via updates inclusive of SINBAD, for the DFA minimum dataset reporting, NADC iHRFS data collection, and benchmarking or via individual primary care or hospital audits. Furthermore, the panel felt that it would be helpful to monitor how SINBAD is being used, either as a total score only, or with reporting of individual components. The effectiveness of SINBAD as a communication and triage tool depends on widespread adoption and use by health professionals across the care spectrum, so the panel felt it was important to monitor the use of SINBAD subsequent to the release of these recommendations.

Future research considerations

The critical review of diabetic foot ulcer classification systems recently conducted by the IWGDF identified eight important prognostic features of a DFU, however no existing wound classification system includes all of these variables (18, 19). In agreement with the IWGDF, future research should investigate whether the addition of more complexity to existing wound classification systems can improve clinical and prognostic utility without compromising reliability and/ or simplicity of use (19). Furthermore, there may be uniquely Australian considerations when evaluating prognostic utility of a wound classification system in an Australian setting - Aboriginal and Torres Strait Islander people and people living in rural and remote locations experience a higher rate of LEA (9, 44) however these important patient-related factors are not included in any existing wound classification or scoring system.

As per the panel's recommendations for monitoring of this recommendation, future research should also address the clinical uptake and usage of SINBAD in Australia across the spectrum of care settings. This may include quantitative and qualitative surveys conducted by specialist societies (eg RACGP, AWTRS, APP-HRF), to target groups such as general practitioners, practice nurses, nurse practitioners, orthotists/prosthetists, and podiatrists as well as via accreditation, benchmarking and reporting processes for iHRFS.



Recommendation 2

Be cautious in the application of any of the currently available classification/scoring systems to offer an individual prognosis for a person with diabetes and a foot ulcer (weak; low)

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation after full assessment based on differences in some judgements to the IWGDF, particularly regarding overall balance of effects, acceptability and feasibility in an Australian context (see Table 2). Consequently, wording changes to the original IWGDF recommendation were made, with the insertion of the words 'Be cautious in the application of' instead of 'Do not use' to reflect the panel's determination that prognostic information is important for patients, is useful to support clinical management, and wound classification systems are available which have been validated (albeit, at a cohort rather than individual level) for outcome prediction including DFU healing outcomes and LEA.

Summary justification

The panel agreed with the IWGDF evaluation of the strength of the evidence (low)(19). There are a number of wound classification systems that have been validated in patients with DFU for wound healing and LEA outcomes within cohorts but not at an individual patient level (18, 19). There were some minor differences in comparison to the IWGDF judgement for this recommendation, with disagreement with IWGDF regarding overall balance of effects, acceptability and feasibility in an Australian context. Acknowledging the limitations of the existing evidence, the panel agreed that cautious provision of prognostic information would be important and beneficial for both patient and clinician. As such the panel recommended caution in the use of wound classification systems such as Wifl, which is already accepted and utilised by Australian iHRFS clinicians, as well as SINBAD, as both have been found to be reliable and validated in cohorts including patients with DFU. The panel agreed it is important to consider that the term 'prognosis' relates not to an absolute, definitive determination but enables some determination of the overall likelihood of recovery, for example healing of a DFU by conservative management without the need for amputation. In that context, we contend that wound classification systems such as Wifl and SINBAD do provide some prognostic information for individual patients with DFU. The detailed justifications from our full assessment are described in supplementary information.

Implementation considerations

The panel carefully considered whether they should provide a negative recommendation, no recommendation, or a more limited positive recommendation, recognising that prognosis of diabetes-related foot ulcer healing can only be estimated and partially determined in most cases. In that context, the wording of this recommendation was modified to recognise the limitations of prognostication about a foot ulcer healing outcome at an individual patient and wound level, yet with the recognition that some data does exist (particularly for SINBAD and Wifl) to support the experienced clinician to provide a prognosis regarding DFU outcomes, including wound healing likelihood and LEA risk.

Subgroup considerations

Geographical remote people

The panel determined that this recommendation is applicable to geographically remote populations. People in geographically remote sites are at increased risk of ulcer non-healing by conservative measures and the greater likelihood of the need for LEA compared with those in urban areas. While local service factors can aid in development of data, the opinion of the panel was that overall prognosis for conservative ulcer healing is likely linked to the Wifl classification of an ulcer.

Aboriginal and Torres Strait Islander peoples

The panel determined that this recommendation is applicable to Aboriginal and Torres Strait Islander people, who are at markedly increased risk of ulcer non-healing by conservative measures and the greater likelihood of the need for LEA. It is likely that overall prognosis for conservative ulcer healing and for amputation risk is linked to the Wifl scoring of an ulcer and cautious use of this information would be beneficial to Aboriginal and Torres Strait Islander people with DFU.

Other subgroup considerations

No other subgroup considerations.



Recommendation 2

Be cautious in the application of any of the currently available classification/scoring systems to offer an individual prognosis for a person with diabetes and a foot ulcer (weak; low)

DECISION: ADAPTED

Monitoring considerations

The panel felt that specific monitoring for this recommendation could include clinical practice surveys which could be systematically undertaken to determine if iHRFS in Australia in particular, utilise prognostic wound classification systems for individual patients.

Future research considerations

Future research considerations for recommendation 2 are similar to those for recommendation 1. The critical review of diabetic foot ulcer classification systems recently conducted by the IWGDF identified eight important prognostic features of a DFU, however no existing wound classification system includes all of these variables (18, 19). In agreement with the IWGDF, future research should investigate whether the addition of more complexity to existing wound classification systems can improve clinical and prognostic utility without compromising reliability and/ or simplicity of use (19). Furthermore, there may be uniquely Australian considerations when evaluating prognostic utility of a wound classification system in an Australian setting - Aboriginal and Torres Strait Islander people and people living in rural and remote location experience a higher rate of LEA however these important patient-related factors are not included in any existing wound classification or scoring system (9, 44).

Future research work should explore the utility and reliability of existing wound classification systems such as SINBAD and Wifl for providing an individual prognosis. Furthermore, whether the addition of complexity to existing wound classifications systems via additional parameters or measures improves ability to predict outcomes without compromising reliability or utility should be the subject of further study. Finally, the development of an Australian DFU prognostic tool or score could be considered for further investigation, with the inclusion of parameters that are uniquely important to outcomes in an Australian context, such as a patient being from a geographically remote location, or from an Aboriginal or Torres Strait Islander population. Such an Australian approach would, in time, be expected to help to validate use of a prognostic tool in the domestic context.



Recommendation 3

In a person with diabetes and an infected foot ulcer, use the IDSA/IWGDF infection classification to characterise and guide infection management (weak; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation after initial assessment (ADAPTE), as there was agreement amongst the panel with the IWGDF evaluation of the evidence and judgement. We agreed with the IWGDF that there are only two wound classification systems that provide assessment and stratification that can aid clinical decision making - the IDSA/IWGDF infection classification and Wifl (18, 19). The IDSA/IWGDF infection classification systems describe four grades of DFU infection severity. Although the IDSA/IWGDF infection classification is incorporated into the foot infection component of the Wifl wound classification system, it has also been evaluated as a stand-alone classification system for diabetes-related foot ulcers complicated by infection and is used widely to help guide clinical management decisions for diabetes-related foot infections such as hospitalisation and use of intravenous antibiotics (18, 19). The panel agreed with the IWGDF strength of evidence as 'moderate' given the moderate reliability, strong prediction of hospitalisation (albeit unsurprising given the clinical context of use) and validation for risk of minor and major amputation (18, 19, 45-47). The panel also agreed with the IWGDF strength of recommendation as 'weak', because despite the quality of evidence, the IDSA/IWGDF infection classification is reasonably complex and has not been evaluated in diverse clinical settings (18, 19). Finally, the panel agreed that the IDSA/IWGDF infection classification would be both acceptable and applicable in an Australian context, as there is already familiarity and widespread use in Australian healthcare settings, and no potential barriers to use in primary care or rural locations such as requirement for specialised equipment or expertise (19).

Subgroup considerations

Geographical remote people

This recommendation refers predominantly to specialty practice, however the IDSA/IWGDF infection classification would be applicable and acceptable in geographically remote locations as it is based on assessment of clinical features of infection and requires no specialised equipment.

Aboriginal and Torres Strait Islander peoples

No additional considerations were identified for clinicians implementing this recommendation in regard to Aboriginal and Torres Strait Islander populations, especially as it requires no specialised equipment.

Other subgroup considerations

No other subgroup considerations.

Monitoring considerations

The panel felt there were no specific monitoring implications for this recommendation, however, advise clinicians to consider the general monitoring implications for the chapter when implementing this recommendation.

Future research considerations

The panel felt there were no specific future research considerations for this recommendation, however, advise clinicians to consider the general future research considerations for the chapter when implementing this recommendation.

Q4 In persons with an active DFU, can any classifications/scoring system aid decision-making in specialty areas to improve healing and/or reducing amputation risk?



Recommendation 4

In a person with diabetes and a foot ulcer who is being managed in a setting where appropriate expertise in vascular intervention is available, use Wifl scoring to aid decision making in the assessment of perfusion and likelihood of benefit from revascularisation (weak; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation after initial assessment (ADAPTE), as there was agreement amongst the panel with the IWGDF evaluation of the evidence and judgement. Wifl generates a combined score across three areas- wound (depth of ulcer or gangrene extent), ischaemia (based on evaluation with ankle-brachial index, ankle systolic pressure, toe pressure or transcutaneous oxygen pressure) and foot infection (IDSA/IWGDF infection classification) and can be used to stratify one year risk of amputation and one year benefit from revascularisation, which are both classified as very low, low, moderate or high (6, 18, 19). The panel agreed with the IWGDF evaluation of evidence as 'moderate' given the strong evidence of reliability for outcome prediction, including wound healing, need for revascularisation and LEA in patient cohorts with peripheral arterial disease, but less so specifically in patient cohorts with DFU (48-52). The panel also agreed with the IWGDF strength of recommendation as 'weak', because despite the quality of evidence, the Wifl classification is reasonably complex and has not been evaluated in diverse clinical settings and populations (18, 19). Finally, the panel agreed that the use of Wifl classification system to aid clinical decision making and evaluate benefit from revascularisation in clinical contexts where appropriate vascular surgical expertise is available would be both acceptable and applicable in an Australian context, as there is already familiarity and widespread acceptance of use in Australian guidelines and recommendations, particularly in the setting of iHRFS, in which the presence of Vascular surgical expertise is recommended (42, 43).

Subgroup considerations

Geographical remote people

This recommendation refers predominantly to specialty practice where vascular surgeon expertise is available. As such, this recommendation is not generally applicable to geographically remote locations as it requires specialist expertise and equipment.

Aboriginal and Torres Strait Islander peoples

When assessment is being made, and if revascularisation is being considered, there must be adequate consultation with the patient and engagement with family explaining why the assessment is being conducted and if hospitalisation is needed provide the approximate length of stay required. There must also be consideration of language barriers with consultation, especially where English may be a second, third or fourth language, in these situations a professional interpreter should be considered.

Other subgroup considerations

No other subgroup considerations.

Monitoring considerations

The panel felt there were no specific monitoring implications for this recommendation.

Future research considerations

The panel felt there were no specific future research considerations for this recommendation.



Recommendation 5

As a minimum, use the SINBAD system for any regional/national/international audits to allow comparisons between institutions on the outcomes of patients with diabetes and an ulcer of the foot (strong; high).

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation after full assessment based on minor differences in some judgements to the IWGDF, particularly regarding acceptability and feasibility in an Australian context (see Table 2). As a result, wording changes to the original IWGDF recommendation were made, with the insertion of 'as a minimum' to recommend the use of the SINBAD wound classification system as a minimum standard for regional/national/international audits to allow comparisons between institutions.

Summary justification

The panel agreed with the IWGDF evaluation of the strength of the evidence (strong) and that health providers would place importance on the reliability of wound classification systems used for the purposes of regional, national and international audit and benchmarking but also on the simplicity and ease of use of such a system across diverse populations and care settings. There was some minor differences in comparison to the IWGDF judgement for this recommendation, with partial agreement with IWGDF regarding acceptability and feasibility in an Australian context, due to existing guidelines and recommendations for use of Wlfl and/ or University of Texas wound classification systems for audit and benchmarking in specialist settings such as iHRFS, as well as current lack of widespread familiarity with the SINBAD wound classification system in Australia (42, 43). Use of the additional text 'As a minimum' in the recommendation for the Australian Guidelines provides two additional strengths. Firstly, it recognises that the use of SINBAD for wound classification reporting for the purpose of audit is the minimum acceptable method and would be acceptable and appropriate in settings such as primary care. Secondly, it recognises that in other health care settings such as iHRFS, additional information provided by a more detailed wound classification system such as Wlfl or University of Texas would be desirable, and is recommended in Australian standards of care (42, 43). The additional text does not negate that the SINBAD scoring system is reliable, appropriate and its use for the purpose of audit is supported by evidence, but it does indicate that it may be insufficient in some clinical settings, particularly in specialist iHRFS care. The detailed justifications from our full assessment are provided in supplementary information.

Implementation considerations

The panel agreed that the use of the additional text 'as a minimum' in this recommendation provides two additional strengths. Firstly it recognises that SINBAD is the minimum acceptable standard for wound classification for the purposes of regional/ national/ international audit and should be completed for all patients with DFU. Secondly, it highlights for certain care settings, such as iHRFS, use of an additional, more detailed wound classification system is desirable such as Wlfl or University of Texas to appropriately capture DFU characteristics to enable more accurate audit and benchmarking. Given the simplicity of SINBAD and lack of need for specialised equipment, there should be no significant barriers to implementation of use of SINBAD in Australia. In agreement with IWGDF, it is important the individual components of SINBAD (rather than the total score) are used for the purposes of audit (19). It is likely in Australia that additional educational measures will be required to support more widespread familiarity and use of SINBAD across diverse clinical settings.



Recommendation 5

As a minimum, use the SINBAD system for any regional/national/international audits to allow comparisons between institutions on the outcomes of patients with diabetes and an ulcer of the foot (strong; high).

DECISION: ADAPTED

Subgroup considerations

Geographical remote people

The panel determined that this recommendation is applicable to geographically remote populations. Given the simplicity, reliability and ease of use, the use of SINBAD for audit purposes was thought likely to be accepted and readily utilised in rural and regional health care settings.

Aboriginal and Torres Strait Islander peoples

The panel determined that this recommendation is applicable to Aboriginal and Torres Strait Islander people. The SINBAD wound classification system would likely be well accepted and utilised in health settings where Aboriginal and Torres Strait Islander populations are managed.

Other subgroup considerations

No other subgroup considerations.

Monitoring considerations

SINBAD is not currently widely used in Australia and consequently, the panel determined that it would be useful to monitor the use of SINBAD for audit purposes across clinical care settings in the future. This may be possible via DFA minimum dataset reporting, NADC iHRFS data collection and benchmarking or via individual primary care or hospital audits. Furthermore, the panel felt that it would be helpful to monitor how SINBAD is being used, either as a total score or reporting of individual components. The effectiveness of SINBAD as an audit tool in an Australian context depends on widespread adoption and use by health professionals across the care spectrum, so the panel felt it was important to monitor the use of SINBAD subsequent to the release of these recommendations.

Future research considerations

Future research considerations for recommendation 5 are similar to those for recommendation 1. The critical review of diabetic foot ulcer classification systems recently conducted by the IWGDF identified eight important prognostic features of a DFU, however no existing wound classification system includes all of these variables (18, 19). In agreement with the IWGDF, future research should investigate whether the addition of more complexity to existing wound classification systems can improve clinical and prognostic utility without compromising reliability and/ or simplicity of use (19). Furthermore, there may be uniquely Australian considerations when evaluating prognostic utility of a wound classification system in an Australian setting- Aboriginal and Torres Strait Islander people and people living in rural and remote location experience a higher rate of LEA (9, 44), however these important patient-related factors are not included in any existing wound classification or scoring system.

As per the panel's recommendations for monitoring of this recommendation, future research should also address the clinical uptake and usage of SINBAD for the purpose of audit in Australia across the spectrum of care settings. In addition, it is recognised that reporting of the individual components of SINBAD separately for a foot ulcer in a person with diabetes, adds detailed clinical value compared with the SINBAD score alone. Thus the monitoring systems above and the qualitative research targeting primary care could also determine how often the individual components of SINBAD are reported, in addition to the score out of six. This may include qualitative surveys conducted by specialist societies (e.g. RACGP, AWTRS, APP-HRF) to target groups such as general practitioners, practice nurses, nurse practitioners, and podiatrists as well as via accreditation, benchmarking and reporting processes for iHRFS.

Following on from the Recommendations determined in this document, a consensus Clinical Pathway was developed for Wound Classification in people with DFUs, as shown in Figure 1.



DISCUSSION

Recommendations summary

The classification of DFUs is central to achieving optimal outcomes for people with diabetes and is important to facilitate effective communication among health professionals, timely triage and assessment, to guide management decisions and prognosis, and to support audit and benchmarking activities. After the five recommendations from the IWGDF 2019 guidelines on the classification of diabetic foot ulcers were evaluated by the panel, two were adopted and three were adapted to be more suitable for Australian conditions.

The main reasons for adapting, were to align the recommendations to existing Australian standards of care, especially in specialist settings, to maintain consistency with existing Australian recommendations for documentation, audit and benchmarking and to be more appropriate, acceptable and applicable to an Australian context. In Australia, we recommend the use of the SINBAD system as a minimum standard to document the characteristics of a DFU for the purposes of communication among health professionals and for regional/ national/ international audit.

We have adopted the 2019 IWGDF recommendations for the use of the IDSA/IWGDF infection classification system to characterise and guide management of an infected DFU in a person with diabetes and the Wifl classification system to guide perfusion assessment and benefit from revascularisation in settings where vascular surgical expertise is available. In contrast to the IWGDF who make a recommendation against usage, in Australia we recommend caution in the use of existing wound classification systems to provide a prognosis for a person with diabetes and a foot ulcer.

Justifications summary

There were some minor differences in comparison with the IWGDF judgement for recommendations 1 and 5, with partial agreement with IWGDF in regard to acceptability and feasibility in an Australian context, due to existing guidelines and recommendations for use of Wifl and/ or University of Texas wound classification systems for communication among health professionals and for audit and benchmarking in specialist settings such as iHRFS, as well as current lack of widespread familiarity with the SINBAD wound classification system in Australia (42, 43). Use of the additional text 'As a minimum' in both recommendation 1 and 5 for the Australian Guidelines provides two additional strengths.

Firstly, it recognises that the use of SINBAD for wound classification reporting for the purpose of communication and audit is the minimum standard and would be acceptable and appropriate in settings such as primary care. Secondly, it recognises that in other health care settings such as iHRFS, additional information provided by a more detailed wound classification system such as Wifl or University of Texas would be desirable, and is recommended in Australian standards of care (42, 43).

There were some differences in comparison with the IWGDF judgement for Recommendation 2, with disagreement with IWGDF regarding the overall balance of effects, and acceptability and feasibility in an Australian context. Acknowledging the limitations of the existing evidence, the panel agreed that cautious provision of prognostic information would be important and beneficial for both patient and clinician. As such the panel recommended cautious use of wound classification systems such as Wifl, which is already accepted and utilised by Australian iHRFS clinicians, as well as SINBAD, as both have been found to be reliable and validated in cohorts including patients with DFU.

Subgroup considerations

In general, the new Australian Recommendations for wound classification in people with diabetes and a foot ulcer were not associated with specific concerns or considerations for the management of DFU in Aboriginal and Torres Strait Islander people or for people living in geographically remote locations. In particular, the panel felt that the SINBAD wound classification system would likely be well accepted and utilised in health settings where Aboriginal and Torres Strait Islander populations are managed.

In addition, the panel agreed with the IWGDF, that the SINBAD system would be acceptable for use in remote locations, given the simplicity, reliability and no requirement for specialised clinical equipment. There were no other significant subgroup considerations applicable to the wound classification recommendations.



DISCUSSION

Implementation considerations summary

Given the simplicity and lack of need for specialised equipment, there should be no significant barriers to implementation of use of SINBAD in Australia for the purpose of communication among health professionals and/ or regional/ national/ international audit (recommendations 1 and 5). In agreement with the IWGDF, it is important the individual components of SINBAD (rather than the total score) are used for the purposes of communication between health professionals. It is likely in Australia that additional educational measures will be required to support more widespread familiarity and use of SINBAD across diverse clinical settings. In regard to recommendation 2, there are likely no specific implementation considerations as the use of Wifl is already established in Australian iHRFS care standards (42, 43)

Monitoring considerations

SINBAD is not currently widely used in Australia and as such, the panel determined that it would be useful to monitor adoption of SINBAD across clinical care settings in the future. This may be possible via DFA minimum dataset reporting, NADC iHRFS data collection and benchmarking or via individual primary care or hospital audits. Furthermore, the panel felt that it would be helpful to monitor how SINBAD is being used, either as a total score or reporting of individual components. The effectiveness of SINBAD as a communication and audit tool depends on widespread adoption and use by health professionals across the care spectrum, so the panel felt it was important to monitor the use of SINBAD subsequent to the release of these recommendations. In regard to the use of wound classifications systems such as SINBAD and Wifl to provide an individual prognosis, the panel felt that specific monitoring could include clinical practice surveys to determine if iHRFS in Australia utilise prognostic wound classification systems for individual patients.

Future research considerations

The critical review of diabetic foot ulcer classification systems recently conducted by the IWGDF identified eight important prognostic features of a DFU, however no existing wound classification system includes all of these variables (18, 19). In agreement with the IWGDF, future research should investigate whether the addition of more complexity to existing wound classification systems can improve clinical and prognostic utility without compromising reliability and/ or simplicity of use (19). Furthermore, there may be uniquely Australian considerations when evaluating prognostic utility of a wound classification system in an Australian setting - Aboriginal and Torres Strait Islander people and people living in rural and remote location experience a higher rate of LEA however these important patient-related factors are not included in any existing wound classification or scoring system (9, 44). Future research work should also explore the utility and reliability of existing wound classification systems such as SINBAD and Wifl for providing an individual prognosis. Furthermore, whether the addition of complexity to existing wound classifications systems via additional parameters or measures improves ability to predict outcomes without compromising reliability or utility should be the subject of further study. Finally, the development of an Australian DFU prognostic tool or score could be considered for further investigation, with the inclusion of parameters that are uniquely important to outcomes in an Australian context, such as a patient being from a geographically remote location or from an Aboriginal or Torres Strait Islander population.



CONCLUSION

We have developed new guidelines for wound classification for people with DFU that are appropriate and applicable for use across diverse care settings and geographical locations in Australia, including Aboriginal and Torres Strait Islander populations and people living in remote locations. These recommendations should serve to support clinicians to provide more effective communication, reliable prognostication and conduct detailed and productive audit and benchmarking activities in an Australian context. Whilst the panel agrees with the IWGDF that it is possible that no single wound classification system will be developed for DFU that is suitable for all clinical scenarios, future research should focus on whether the addition of more parameters and complexity to existing DFU wound classification systems results in provision of a more reliable estimation of key DFU outcomes.

LIST OF ABBREVIATIONS

AWTRS	Australasian Wound & Tissue Repair Society
APP-HRF	Advanced Practicing Podiatrists – High Risk Foot group
DFA	Diabetes Feet Australia
DFD	Diabetes-related foot disease
DFU	Diabetes-related foot ulcer
EtD	Evidence to Decision
GRADE	Grading of Recommendations Assessment, Development and Evaluation
IDSA	Infectious Diseases Society of America
iHRFS	interdisciplinary high-risk foot service
IWGDF	International Working Group on the Diabetic Foot
LEA	Lower extremity amputation
NADC	National Association of Diabetes Centres
NHMRC	National Health and Medical Research Council
RACGP	Royal Australian College of General Practitioners
SINBAD	Site, Ischaemia, Neuropathy, Bacterial Infection, Area and Depth
Wifi	Wound, Ischaemia, and foot Infection



DECLARATIONS

Ethical approval

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Competing interests

The funding/supporting bodies below provided oversight and final approval for this guideline, however, did not have any input into the decisions on recommendations and rationale contained in these guidelines or in the writing of these guidelines.

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All other authors declare that they have no relevant competing interests.

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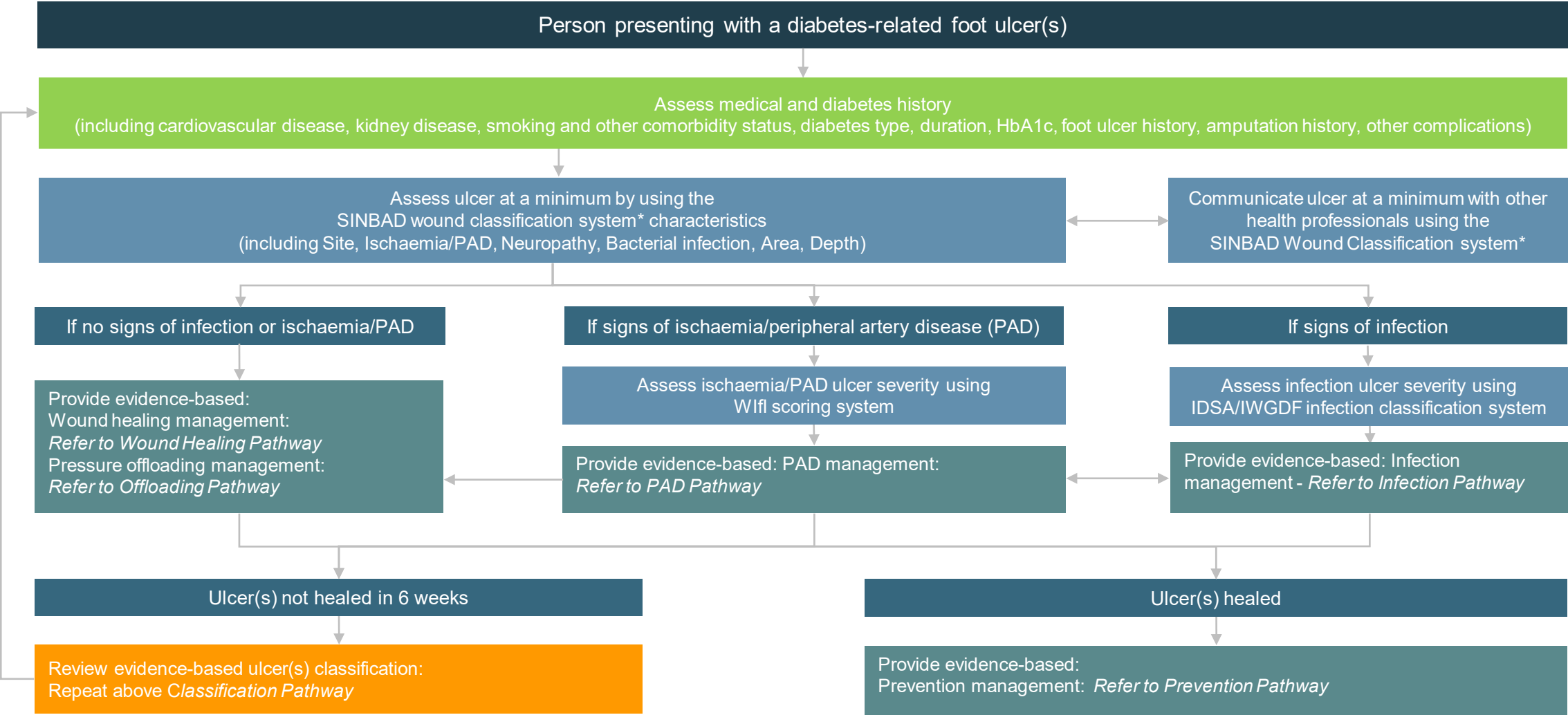
Authors' contributions

EJH screened, assessed and drafted all recommendations and rationale of allocated IWGDF wound classification recommendations, and drafted the initial manuscript and critically reviewed the manuscript. JS, HR and BP and SMT screened, assessed allocated and drafted all recommendations and rationale of allocated IWGDF wound classification recommendations and critically revised the manuscript. JCha provided Aboriginal and Torres Strait Islander and end-user intellectual input and content into the screening, assessment and drafting of all recommendations and rationale, and critically reviewed the manuscript. JChe provided lived experience and consumer intellectual input and content into the screening, assessment and drafting of all recommendations and rationale, and critically reviewed the manuscript. EJH and SMT screened, assessed and drafted all recommendations and rationale of allocated IWGDF wound classification recommendations, and drafted the initial manuscript and critically reviewed the manuscript. EJH and SMT prepared the ETD templates; All authors collectively reviewed the ADAPT-E and ETD templates and recommendations text. EJH and SMT wrote the primary manuscript, which was reviewed by all authors. EJH acted as the secretary and SMT as the chair of the author/chapter group and take full responsibility for the content of the manuscript. All authors approved the manuscript for submission.

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Figure 1. Australian evidence-based clinical pathway on wound classification of foot ulcers for people with diabetes



CAUTION: Be cautious using any foot ulcer classification system to provide a definite individual ulcer prognosis

LEGEND

DARK BLUE BOX: Ulcer characteristics **LIGHT BLUE BOX:** Wound classification recommendations **GREEN BOX:** Best standard of care recommendations **ORANGE BOX:** Monitor and review progress

**Figure 2** Sinbad System*

Category	Definition	Score
Site	Forefoot	0
	Midfoot and hindfoot	1
Ischaemia	Pedal blood flow intact: at least one palpable pulse	0
	Clinical evidence of reduced pedal flow	1
Neuropathy	Protective sensation intact	0
	Protective sensation lost	1
Bacterial infection	None	0
	Present	1
Area	Ulcer <1 cm ²	0
	Ulcer ≥1 cm ²	1
Depth	Ulcer confined to skin and subcutaneous tissue	0
	Ulcer reaching muscle, tendon or deeper	1
Total possible score		6

* Adapted from Ince P et al. Use of the SINBAD classification system and score in comparing outcome of foot ulcer management on three continents. Diabetes Care. 2008;31(5):964-7



WOUND CLASSIFICATION

Figure 3 Wound, ischaemia, and foot infection system*

Wound

Grade	Ulcer	Gangrene
0	No ulcer	No gangrene
	Clinical description: ischaemic rest pain (requires typical symptoms + ischaemia grade 3); no wound	
1	Small, shallow ulcer(s) on distal leg or foot; no exposed bone, unless limited to distal phalanx	No gangrene
	Clinical description: minor tissue loss. Salvageable with simple digital amputation (1 or 2 digits) or skin coverage	
2	Deeper ulcer with exposed bone, joint or tendon; generally not involving the heel; shallow heel ulcer, without calcaneal involvement	Gangrenous changes limited to digits
	Clinical description: major tissue loss salvageable with multiple (≥ 3) digital amputations or standard TMA $\pm$ skin coverage	
3	Extensive, deep ulcer involving forefoot and/or midfoot; deep, full thickness heel ulcer $\pm$ calcaneal involvement	Extensive gangrene involving forefoot and/or midfoot; full thickness heel necrosis $\pm$ calcaneal involvement
	Clinical description: extensive tissue loss salvageable only with complex foot reconstruction or nontraditional TMA (Chopart or Lisfranc); flap coverage or complex wound management for large soft tissue defect	

Ischaemia

Grade	Ankle-brachial index	Ankle Systolic Pressure (mmHg)	Toe pressure, transcutaneous oxygen pressure (mmHg)
0	≥ 0.80	>100 mmHg	≥ 60 mmHg
1	0.60 - 0.79	70 - 100 mmHg	40 - 59 mmHg
2	0.4 - 0.59	50 - 70 mmHg	30 - 39 mmHg
3	≤ 0.39	< 50 mmHg	< 30 mmHg

Foot infection

Grade	Clinical manifestation of infection	IDSA/PEDIS infection severity
0	No symptoms or signs of infection	Uninfected
1	Infection present, as defined by the presence of at least two of the following items: - Local swelling or induration - Erythema > 0.5 to ≤ 2 cm around the ulcer - Local tenderness or pain - Local warmth - Purulent discharge (thick, opaque to white, or sanguineous secretion)	Mild
	Local infection involving only the skin and the subcutaneous tissue (without systemic signs).	
	Exclude other causes of an inflammatory response of the skin (e.g. trauma, gout, acute Charcot Neuro-osteoarthropathy, fracture, thrombosis, venous stasis)	
2	Local infection (as described above) with erythema > 2 cm, or involving structures deeper than skin and subcutaneous tissues (e.g. abscess, osteomyelitis, septic arthritis, fasciitis)	Moderate
	No systemic inflammatory response signs (as described below)	
3	Local infection (as described above) with the signs of SIRS as manifested by two or more of the following: - Temperature $> 38^{\circ}\text{C}$ or $< 36^{\circ}\text{C}$ - Heart rate > 90 beats/min - Respiratory rate > 20 breaths/min or $\text{PaCO}_2 < 32\text{mmHg}$ - White blood cell count $> 12,000$ or $< 4000\text{cu/mm}$ or 10% immature (band) forms	Severe ^a
PACO ₂ : Partial pressure of arterial carbon dioxide, SIRS: systemic inflammatory response syndrome		
^a Ischaemia may complicate and increase the severity of any infection. Systemic infection may sometimes manifest with other clinical findings, such as hypotension, confusion, vomiting, or evidence of metabolic disturbances, such as acidosis, severe hyperglycaemia, new-onset azotaemia.		

*Adapted from Mills, J.L et al. The Society for Vascular Surgery Lower Extremity Threatened Limb Classification System: Risk stratification based on Wound, Ischaemia and foot Infection (WIFI). Journal of Vascular Surgery, Jan 2014 and Lew, EJ et al. Clinical Application of the Society for Vascular Surgery (SVS) Lower Extremity Threatened Limb Classification System: Risk stratification based on Wound, Ischaemia and foot Infection (WIFI). Wound practice and research, Nov 2014



Table 1

Summary of screening ratings for acceptability and applicability in the Australian context for all IWGDF wound classification recommendations.

RECOMMENDATION	ACCEPTABILITY			APPLICABILITY				FULL ASSESSMENT	COMMENTS
	1	2	3	4	5	6	7		
1	+	+	?	+	+	?	+	Yes	Assess acceptability, culture, values and expertise in local context
2	?	?	-	+	+	+	?	Yes	Assess strength of evidence and recommendation, culture, values
3	+	+	+	+	+	+	+	No	
4	+	+	+	+	+	+	+	No	
5	+	+	?	+	+	+	?	Yes	Assess acceptability, culture, values, local policies or constraints
TOTAL	4	4	2	5	5	4	3	3	
%	80	80	40	100	100	80	60	60	

Note: +, yes item is met; -, no item is not met; ? unsure if item is met



WOUND CLASSIFICATION

Table 2: Summary of final panel judgements compared with IWGDF judgements for all IWGDF wound classification recommendations.

NO	PROBLEM	DESIRABLE EFFECTS	UNDESIRABLE EFFECTS	QUALITY OF EVIDENCE	VALUES	BALANCE OF EFFECTS	ACCEPTABILITY	APPLICABILITY/FEASIBILITY	DECISION	COMMENT
1	+	+	+	+	+	+	Partially agreed	Partially agreed	Adapt	Adapted acceptability and feasibility
2	+	+	+	+	+	-	-	-	Adapt	Adapted balance of effects, acceptability & feasibility
3	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
4	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
5	+	+	+	+	+	+	Partially agreed	Partially agreed	Adapt	Adapted acceptability and feasibility

Note: +, panel agreed with original IWGDF judgement; -, panel disagreed with original IWGDF judgement; ?, panel unsure if agreed with original IWGDF judgement due to lack of IWGDF information on judgement; =, panel agreed with original IWGDF judgements during screening (see Table 1); QoE: Quality of evidence.

Table 3: Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for Wound classification.

NO	ORIGINAL IWGDF RECOMMENDATION	DECISION	NEW AUSTRALIAN RECOMMENDATION
1	In a person with diabetes and a foot ulcer, use the SINBAD system for communication among health professionals about the characteristics of the ulcer (strong; moderate)	Adapted	In a person with diabetes and a foot ulcer, <u>as a minimum</u> , use the SINBAD wound classification system for communication among health professionals about the characteristics of the ulcer (strong; moderate)
2	Do not use any of the currently available classification/scoring systems to offer an individual prognosis for a person with diabetes and a foot ulcer (strong; low)	Adapted	<u>Be cautious</u> in the application of any of the currently available classification/scoring systems to offer an individual prognosis for a person with diabetes and a foot ulcer (weak; low)
3	In a person with diabetes and an infected foot ulcer, use the IDSA/IWGDF infection classification to characterise and guide infection management (weak; moderate)	Adopted	As stated in original the IWGDF Recommendation
4	In a person with diabetes and a foot ulcer who is being managed in a setting where appropriate expertise in vascular intervention is available, use WIfI scoring to aid decision making in the assessment of perfusion and likelihood of benefit from revascularisation (weak; moderate)	Adopted	As stated in original the IWGDF Recommendation
5	Use the SINBAD system for any regional/national/international audits to allow comparisons between institutions on the outcomes of patients with diabetes and an ulcer of the foot (strong; high)	Adapted	<u>As a minimum</u> , use the SINBAD system for any regional/national/international audits to allow comparisons between institutions on the outcomes of patients with diabetes and an ulcer of the foot (strong; high)

Note: underlined wording indicates the specific adapted changes to the original IWGDF recommendation



REFERENCES

1. Australian Institute of Health and Welfare. Diabetes: Australian facts 2008. AIHW, Canberra, 2008.
2. Bergin SM, Alford JB, Allard BP, Gurr JM, Holland EL, Horsley MW, et al. A limb lost every 3 hours: can Australia reduce amputations in people with diabetes? *The Medical journal of Australia*. 197(4):197-8.
3. Van Netten JLL, P.A.; Fitridge, R.; Kinnear, E.; Griffiths, I.; Malone, M.; Perrin, B.M.; Prentice, J.; Sethi, S.; Wraight, P.R. Australian diabetes-related foot disease strategy 2018- 2022: The first step towards ending avoidable amputations within a generation. National Strategy. Brisbane: Diabetic Foot Australia, Wound Management CRC; 2017.
4. Lazzarini PA, Hurn SE, Kuys SS, Kamp MC, Ng V, Thomas C, et al. Direct inpatient burden caused by foot-related conditions: a multisite point-prevalence study. *BMJ Open*. 2016;6(6):e010811.
5. Schaper NC, Van Netten JJ, Apelqvist J, Lipsky BA, Bakker K, International Working Group on the Diabetic F. Prevention and management of foot problems in diabetes: a Summary Guidance for Daily Practice 2015, based on the IWGDF Guidance Documents. *Diabetes Metab Res Rev*. 2016;32 Suppl 1:7-15.
6. Mills JL, Sr., Conte MS, Armstrong DG, Pomposelli FB, Schanzer A, Sidawy AN, et al. The Society for Vascular Surgery Lower Extremity Threatened Limb Classification System: risk stratification based on wound, ischemia, and foot infection (WIFI). *J Vasc Surg*. 2014;59(1):220-34 e1-2.
7. Lazzarini PA, Hurn SE, Kuys SS, Kamp MC, Ng V, Thomas C, et al. The silent overall burden of foot disease in a representative hospitalised population. *Int Wound J*. 2017;14(4):716-28.
8. Lazzarini PA, Gurr JM, Rogers JR, Schox A, Bergin SM. Diabetes foot disease: the Cinderella of Australian diabetes management? *J Foot Ankle Res*. 2012;5(1):24.
9. Australian Commission on Safety and Quality in Health Care (ACSQHC) and National Health Performance Authority. Australian Atlas of Healthcare Variation. ACSQHC, Sydney, 2016.
10. Larsson J, Apelqvist J, Agardh CD, Stenstrom A. Decreasing incidence of major amputation in diabetic patients: a consequence of a multidisciplinary foot care team approach? *Diabet Med*. 1995;12(9):770-6.
11. West M, Chuter V, Munteanu S, Hawke F. Defining the gap: a systematic review of the difference in rates of diabetes-related foot complications in Aboriginal and Torres Strait Islander Australians and non-Indigenous Australians. *Journal of Foot and Ankle Research*. 2017;10(1):48.
12. Lazzarini PA, Van Netten JJ, Fitridge R, Griffiths I, Kinnear EM, Malone M, et al. Pathway to ending avoidable diabetes-related amputations in Australia. *The Medical Journal Of Australia*. 2018;209(7):288-90.
13. Charles J, Pillu M. The foot biomechanics and pathology of Aboriginal Australians. *Scientific Kinesitherapy*. 2020;06(22):23-31.
14. Charles J, Chuter V, O'Brien L. The history and evolution of foot biomechanics in Aboriginal Australians. . *Podiatry Review*. 2020;77(4):4.
15. Charles J. Musculoskeletal injury and the correlation with foot plantar pressure in an Australian Aboriginal population. *Australian Indigenous Health Bulletin*. 2018;18(1).
16. NIAA. NATIONAL AGREEMENT ON CLOSING THE GAP Canberra: National Indigenous Australians Agency; 2020.
17. Crawford F, Chappell FM, Lewsey J, Riley R, Hawkins N, Nicolson D, et al. Risk assessments and structured care interventions for prevention of foot ulceration in diabetes: development and validation of a prognostic model. *Health Technol Assess*. 2020;24(62):1-198.
18. Monteiro-Soares M, Boyko EJ, Jeffcoate W, Mills JL, Russell D, Morbach S, et al. Diabetic foot ulcer classifications: A critical review. *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3272.
19. Monteiro-Soares M, Russell D, Boyko EJ, Jeffcoate W, Mills JL, Morbach S, et al. Guidelines on the classification of diabetic foot ulcers (IWGDF 2019). *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3273.
20. Armstrong DG, Peters EJ. Classification of wounds of the diabetic foot. *Curr Diab Rep*. 2001;1(3):233-8.
21. Game F. Classification of diabetic foot ulcers. *Diabetes Metab Res Rev*. 2016;32 Suppl 1:186-94.
22. Jeffcoate WJ, Macfarlane RM, Fletcher EM. The description and classification of diabetic foot lesions. *Diabet Med*. 1993;10(7):676-9.
23. Monteiro-Soares M, Martins-Mendes D, Vaz-Carneiro A, Sampaio S, Dinis-Ribeiro M. Classification systems for lower extremity amputation prediction in subjects with active diabetic foot ulcer: a systematic review and meta-analysis. *Diabetes Metab Res Rev*. 2014;30(7):610-22.
24. Boyko EJ, Seelig AD, Ahroni JH. Limb- and Person-Level Risk Factors for Lower-Limb Amputation in the Prospective Seattle Diabetic Foot Study. *Diabetes Care*. 2018;41(4):891-8.
25. Fife CE, Horn SD, Smout RJ, Barrett RS, Thomson B. A Predictive Model for Diabetic Foot Ulcer Outcome: The Wound Healing Index. *Adv Wound Care (New Rochelle)*. 2016;5(7):279-87.
26. National Health Service. National Diabetes Foot Care Audit, 2014- 2018. United Kingdom, 2019.
27. Gershater MA, Londahl M, Nyberg P, Larsson J, Thorne J, Eneroth M, et al. Complexity of factors related to outcome of neuropathic and neuroischaemic/ischaemic diabetic foot ulcers: a cohort study. *Diabetologia*. 2009;52(3):398-407.



REFERENCES

28. Oyibo SO, Jude EB, Tarawneh I, Nguyen HC, Armstrong DG, Harkless LB, et al. The effects of ulcer size and site, patient's age, sex and type and duration of diabetes on the outcome of diabetic foot ulcers. *Diabet Med*. 2001;18(2):133-8.
29. Prompers L, Schaper N, Apelqvist J, Edmonds M, Jude E, Mauricio D, et al. Prediction of outcome in individuals with diabetic foot ulcers: focus on the differences between individuals with and without peripheral arterial disease. The EURODALE Study. *Diabetologia*. 2008;51(5):747-55.
30. Yotsu RR, Pham NM, Oe M, Nagase T, Sanada H, Hara H, et al. Comparison of characteristics and healing course of diabetic foot ulcers by etiological classification: neuropathic, ischemic, and neuro-ischemic type. *J Diabetes Complications*. 2014;28(4):528-35.
31. Baker IDI Heart and Diabetes Institute. National evidence-based guideline on prevention, identification and management of foot complications in diabetes (Part of the National Health & Medical Research Council Approved Guidelines on Management of Type 2 Diabetes). Melbourne: Baker IDI Heart & Diabetes Institute, 2011.
32. Schaper NC, van Netten JJ, Apelqvist J, Bus SA, Hinchliffe RJ, Lipsky BA, et al. Practical Guidelines on the prevention and management of diabetic foot disease (IWGDF 2019 update). *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3266.
33. Lazzarini PA, Raspovic A, Prentice J, Commons RJ, Fitridge R, Charles J, et al. Development of the guidelines: The 2021 Australian evidence-based guidelines for diabetes-related foot disease. In DRAFT. 2021.
34. National Health & Medical Research Council (NHMRC). Guidelines for Guidelines: Adopt, adapt or start from scratch - Version 5.2; Last updated 22 November 2018. In: NHMRC, editor. Canberra, Australia 2018 <https://www.nhmrc.gov.au/guidelinesforguidelines/plan/adopt-adapt-or-start-scratch>.
35. The ADAPTE Collaboration. The ADAPTE Process: Resource Toolkit for Guideline Adaptation - Version 2.0. Perthshire, Scotland: Guideline International Network; 2009 <https://g-i-n.net/library/tools>.
36. Schünemann HJ, Wiercioch W, Brozek J, Etzeandía-Ikabalzeta I, Mustafa RA, Manja V, et al. GRADE Evidence to Decision (EtD) frameworks for adoption, adaptation, and de novo development of trustworthy recommendations: GRADE-ADOLOPMENT. *J Clin Epidemiol*. 2017;81:101-10.
37. Alonso-Coello P, Schünemann HJ, Moberg J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 1: Introduction. 2016;353:i2016.
38. Alonso-Coello P, Oxman AD, Moberg J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 2: Clinical practice guidelines. *Bmj*. 2016;353:i2089.
39. Alonso-Coello P, Oxman AD, Moberg J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 2: Clinical practice guidelines. 2016;353:i2089.
40. Andrews J, Guyatt G, Oxman AD, Alderson P, Dahm P, Falck-Ytter Y, et al. GRADE guidelines: 14. Going from evidence to recommendations: the significance and presentation of recommendations. *J Clin Epidemiol*. 2013;66(7):719-25.
41. Andrews JC, Schünemann HJ, Oxman AD, Pottie K, Meerpohl JJ, Coello PA, et al. GRADE guidelines: 15. Going from evidence to recommendation-determinants of a recommendation's direction and strength. *J Clin Epidemiol*. 2013;66(7):726-35.
42. National Association of Diabetes Centres and the Australian Diabetes Society. NADC Collaborative Interdisciplinary Diabetes High Risk Foot Services (HRFS) standards. Sydney, 2018.
43. Diabetes Feet Australia. Australian Diabetic Foot Ulcer Minimum Dataset Dictionary. Brisbane 2016.
44. Australian Institute of Health and Welfare. Burden of lower limb amputations due to diabetes in Australia: Australian Burden of Disease Study 2011. Australian Burden of Disease Study series no. 10. BOD 11. AIHW, Canberra, 2017.
45. Lavery LA, Armstrong DG, Murdoch DP, Peters EJ, Lipsky BA. Validation of the Infectious Diseases Society of America's diabetic foot infection classification system. *Clin Infect Dis*. 2007;44(4):562-5.
46. Monteiro-Soares M, Martins-Mendes D, Vaz-Carneiro A, Dinis-Ribeiro M. Lower-limb amputation following foot ulcers in patients with diabetes: classification systems, external validation and comparative analysis. *Diabetes Metab Res Rev*. 2015;31(5):515-29.
47. Bravo-Molina A, Linares-Palomino JP, Vera-Arroyo B, Salmeron-Febres LM, Ros-Die E. Inter-observer agreement of the Wagner, University of Texas and PEDIS classification systems for the diabetic foot syndrome. *Foot Ankle Surg*. 2018;24(1):60-4.
48. Weaver ML, Hicks CW, Canner JK, Sherman RL, Hines KF, Mathioudakis N, et al. The Society for Vascular Surgery Wound, Ischemia, and foot Infection (WIFI) classification system predicts wound healing better than direct angiosome perfusion in diabetic foot wounds. *J Vasc Surg*. 2018;68(5):1473-81.



REFERENCES

49. Hicks CW, Canner JK, Karagozlu H, Mathioudakis N, Sherman RL, Black JH, 3rd, et al. The Society for Vascular Surgery Wound, Ischemia, and foot Infection (WIFI) classification system correlates with cost of care for diabetic foot ulcers treated in a multidisciplinary setting. *J Vasc Surg.* 2018;67(5):1455-62.
50. Hicks CW, Canner JK, Mathioudakis N, Sherman R, Malas MB, Black JH, 3rd, et al. The Society for Vascular Surgery Wound, Ischemia, and foot Infection (WIFI) classification independently predicts wound healing in diabetic foot ulcers. *J Vasc Surg.* 2018;68(4):1096-103.
51. Mathioudakis N, Hicks CW, Canner JK, Sherman RL, Hines KF, Lum YW, et al. The Society for Vascular Surgery Wound, Ischemia, and foot Infection (WIFI) classification system predicts wound healing but not major amputation in patients with diabetic foot ulcers treated in a multidisciplinary setting. *J Vasc Surg.* 2017;65(6):1698-705 e1.
52. Robinson WP, Loretz L, Hanesian C, Flahive J, Bostrom J, Lunig N, et al. Society for Vascular Surgery Wound, Ischemia, foot Infection (WIFI) score correlates with the intensity of multimodal limb treatment and patient-centered outcomes in patients with threatened limbs managed in a limb preservation center. *J Vasc Surg.* 2017;66(2):488-98 e2.
53. Ince P, Abbas ZG, Lutale JK, Basit A, Ali SM, Chohan F, et al. Use of the SINBAD classification system and score in comparing outcome of foot ulcer management on three continents. *Diabetes Care.* 2008;31(5):964-7.
54. Forsythe RO, Ozdemir BA, Chemla ES, Jones KG, Hinchliffe RJ. Interobserver Reliability of Three Validated Scoring Systems in the Assessment of Diabetic Foot Ulcers. *Int J Low Extrem Wounds.* 2016;15(3):213-9.
55. Abbas ZG, Lutale JK, Game FL, Jeffcoate WJ. Comparison of four systems of classification of diabetic foot ulcers in Tanzania. *Diabet Med.* 2008;25(2):134-7.
56. Chuan F, Tang K, Jiang P, Zhou B, He X. Reliability and validity of the perfusion, extent, depth, infection and sensation (PEDIS) classification system and score in patients with diabetic foot ulcer. *PLoS One.* 2015;10(4):e0124739.
57. Jeon BJ, Choi HJ, Kang JS, Tak MS, Park ES. Comparison of five systems of classification of diabetic foot ulcers and predictive factors for amputation. *Int Wound J.* 2017;14(3):537-45.
58. Parisi MC, Zantut-Wittmann DE, Pavin EJ, Machado H, Nery M, Jeffcoate WJ. Comparison of three systems of classification in predicting the outcome of diabetic foot ulcers in a Brazilian population. *Eur J Endocrinol.* 2008;159(4):417-22.



SUPPLEMENTARY INFORMATION

Recommendation 1

DETAILED JUSTIFICATIONS

Problem: Agreed.

The panel agreed with the IWGDF (19) that the use of a classification system to communicate information clearly and effectively about the characteristics of a DFU was of high importance, to aid appropriate triage of referrals, communication of information between practitioners, continuity of care, as well as quality assurance activities.

Desirable effects: Agreed.

The panel agreed it is highly desirable to have as a minimum, one validated wound classification system for communication amongst health professionals, for a DFU in a person with diabetes. The panel agreed with the IWGDF, that for a wound classification system to be used by all health professionals involved in the care of people with DFU, it needs to be quick and simple to use, require no specialised equipment or expertise, but also communicate important information about the DFU to facilitate accurate triage and timely intervention by the receiving practitioner (19). The panel also agreed with the IWGDF that although ideally all patients with a DFU should be referred and reviewed by an iHRFS as a matter of urgency, it was important that a classification system included critical information that would necessitate urgent review, including size of the ulcer (area and depth), presence of infection and presence of ischaemia, ideally without requiring specialist equipment (19). There are a number of classification systems which have been validated for ulcer healing and lower extremity amputation occurrence, including Meggit-Wagner, SINBAD, University of Texas and Wifl, however of these systems, only SINBAD includes the necessary information for triage, while also being quick, simple and requiring no specialist equipment (19). The SINBAD system grades six DFU characteristics, including site, ischaemia, neuropathy, bacterial infection, area and depth as either zero or one point, with a maximum of six points (53).

Of the available wound classification systems, the panel felt that the SINBAD system had a number of advantages. The panel agreed with the IWGDF that SINBAD is a simple system, requiring clinical assessment alone, and yet it includes six key parameters for describing a DFU. It has also been shown to have good reliability, both intra- and inter- observer. All of these considerations mean that it would be a good communication tool particularly between an iHRFS and primary care.

There are some significant challenges and concerns however in prospectively recommending using SINBAD as the only, single recommended wound classification system in Australia for wounds in diabetes. Firstly, SINBAD does not detail the status of the wound within each of the key aspects of infection, ischaemia, and depth. Specifically, it does not report the severity of infection, the severity of the ischaemia, nor the depth of the ulcer in any nuanced way. In comparison, other validated wound classification systems recommended for use by iHRFS and datasets in Australia do report severity, such as Wifl. Secondly, while the SINBAD wound classification system provides a simplistic scoring system, it is recognised that the global score out of six, treats each of the parameters measured as the same score of zero or one; as such a score of three out of six could have no ischaemia, no infection present nor any depth, or it could have each of those clinically important factors. The IWGDF recognises that not only should the SINBAD score be reported for a wound but the actual individual components that are positive should also be described. Such requirement reflects that a single score using SINBAD is not optimal, particularly for clinical settings where more detail about the wound is required for management. Indeed, the IWGDF recognises that there is not likely to be one wound classification system that will meet all needs.

Thirdly, in Australia the SINBAD system of wound classification is not in current routine use by either primary care or iHRFS practitioners. While such a situation should not prevent its commencement and recommendation per se, education and familiarisation programs may be required, both for primary care and iHRFS practitioners to encourage widespread use and adoption of SINBAD in clinical care.



SUPPLEMENTARY INFORMATION

Recommendation 1

Undesirable effects: Agreed.

The Panel recognised that it is highly desirable to have as a minimum, one validated wound classification system for communication amongst health professionals, for a DFU in a person with diabetes. The undesirable aspects of this outcome are small, however it is possible that if SINBAD is adopted and the score from six is used, rather than also reporting the individual components, it could potentially result in false reassurance. Overall, the panel determined the risks of such undesirable outcomes as being relatively small.

Quality (or certainty) of evidence: Agreed.

The panel agreed with the IWGDF evaluation of the quality of evidence to support the use of SINBAD (moderate) (18, 19). The SINBAD system is in widespread use in the UK and is utilised in the UK National Diabetic Foot Audit (26). The SINBAD system is reliable and has been validated in a number of countries for both ulcer healing and lower extremity amputation (LEA) prediction in cohort studies (26, 46, 53-58).

Values: Agreed.

The panel felt that most patients were likely unaware of the wound classification systems being used by clinicians at present. However, it was agreed that patients would likely place importance on clear, effective and reliable communication of important clinical information to facilitate triage and timely review.

Balance of effects: Agreed.

The panel agreed with the IWGDF that the balance of effects favoured the use of SINBAD as a single, minimum standard for wound classification in patients with DFU (19), and the desirable effects outweighed the undesirable effects.

Acceptability: Partially agreed.

The panel was in partial agreement with the IWGDF. The SINBAD system is in widespread use in the United Kingdom and is the accepted compulsory standard (26). Given similarities in health care delivery between the United Kingdom and Australia, the panel agreed that SINBAD would also likely be acceptable to Australian clinicians. However, in an Australian setting, it is recommended for patients with DFU to be managed in an iHRFS, where the National Association of Diabetes Centres (NADC) iHRFS standards and Diabetic Foot Australia Minimum Dataset Dictionary recommend the use of more detailed classification systems such as Wifl and/ or University of Texas (42, 43). As a result, both primary care providers and specialist iHRFS clinicians may be more familiar with wound classification systems other than SINBAD, however the panel did not think this would be a barrier in the longer term to more widespread use of SINBAD, although some education initiatives may be required initially to encourage adoption of SINBAD in Australia.

Feasibility: Partially agreed.

The panel partially agreed with the IWGDF as the simplicity and reliability of SINBAD would make it feasible for widespread clinical use as the minimum standard for wound classification in patients with DFU in Australia. However the panel felt that SINBAD would not be the optimal wound classification system for assessment of patients with DFU in specialist clinical settings, such as iHRFS, where more detailed, nuanced wound classification systems would ideally be used, in line with recent and current Australian NADC iHRFS Standards processes, and Diabetes Feet Australia (DFA) and NADC minimal datasets [36,37].



SUPPLEMENTARY INFORMATION

Recommendation 2

DETAILED JUSTIFICATIONS

Problem: Agreed.

The panel agreed with the IWGDF (19) that the use of a classification system to provide prognostic information regarding wound healing and/ or LEA risk for a patient with a DFU was of high importance.

Desirable effects: Agreed.

The panel recognised that it is highly desirable for both patients and clinicians to have available a wound classification system or risk prediction tools that can reliably predict prognosis including DFU healing outcomes and LEA risk at an individual level.

Undesirable effects: Agreed.

The panel agreed that undesirable effects were likely moderate with uncertain risk associated with providing inaccurate prognostic information via the use of a wound classification system not validated at an individual patient level. However, the panel also agreed that currently in Australia, classification systems, particularly Wifl which is recommended for use in iHRFS, were not utilised as a single definitive indicator of prognosis but rather as a guide to prognosis as part of a holistic assessment and management plan.

Quality (or certainty) of evidence: Agreed.

The panel agreed with the IWGDF evaluation of the evidence (low) that there is no one DFU classification system that includes all eight key clinical parameters, is simple and reliable and has been validated not only in cohort studies but for individual patient outcomes (18, 19).

Values: Agreed.

Consumer representatives indicated no strong preference about the use of a particular wound classification tool for an individual prognosis, recognising that, as able, evidence-based, reliable information should be shared with patients with diabetes who have foot wounds, in a balanced manner. The panel agreed that consumers may vary as to the degree to which each individual would seek and expect to receive a reliable prognosis, however having some indication of prognosis was felt to be desirable for the consumer.

Balance of effects: Disagreed.

The panel disagreed with the IWGDF and determined that where possible, it is desirable to use a wound classification system, either Wifl or SINBAD, to provide prognostic information to patients with DFU regarding outcomes such as wound healing and LEA risk, however this information should be provided with caution, given the limitations of validation of risk prediction at an individual patient level.

Acceptability: Disagreed.

The panel disagreed with the IWGDF and determined that it would likely be unacceptable to both patients and providers to not provide a prognosis related to DFU outcomes. Instead, with caution, an individual prognosis for DFU could be provided, based on wound classification/scoring systems such as Wifl and SINBAD that are reliable and validated, albeit at cohort rather than individual patient level.

Feasibility: Disagreed.

The panel determined that it would be feasible to use existing, validated wound classification systems, particularly Wifl and SINBAD, with caution, to predict DFU outcomes such as healing and LEA.



SUPPLEMENTARY INFORMATION

Recommendation 5

DETAILED JUSTIFICATIONS

Problem: Agreed.

The panel agreed with the IWGDF (19) that the use of a classification system to document information effectively about the characteristics of a DFU for the purpose of audit, was of high importance, to aid comparison of outcomes for patients with DFU across health services, regions, or countries, to support benchmarking activities and to help drive improvement of service delivery and long term outcomes for people living with DFU. The panel agreed with the IWGDF that the ideal classifications system for audit should be simple, reliable, validated and require no specialised equipment in order to allow audit and comparisons across diverse populations and geographical locations.

Desirable effects: Agreed.

The panel agreed with IWGDF and recognised that it is highly desirable to have as a minimum, one validated wound classification system for documenting the characteristics of a DFU in a person with diabetes, for the purpose of regional/ national/ international audit. It was recognised by the panel that in clinical settings such as primary care, there is currently no recognised wound classification system used consistently or routinely in Australia to enable routine health audit outcomes. This includes rural and regional settings and also services focused on health care delivery for Aboriginal and Torres Strait Islander people with diabetes who have foot ulcers. However, the iHRFS to which a patient will commonly be referred will be using a more complex system, and auditing the same wound classification or scoring to primary care will not likely provide additional value. In that context, routine use of the SINBAD wound classification and scoring system in Australia for audit would be a major advance upon current practice. However, in some settings using SINBAD alone would not be adequate for audit of case mix and comparison of outcomes.

Undesirable effects: Agreed.

The panel recognised that it is highly desirable to have as a minimum, one validated DFU wound classification system for the purpose of audit and the undesirable aspects of this outcome are small. If SINBAD is adopted and the score from six is used rather than the individual components, it is possible that the scoring system may provide somewhat misleading information or classification, given that it is likely some SINBAD components have a greater impact on clinical outcomes than others (26). Overall, the risks of such undesirable outcomes were assessed by the panel as being relatively small.

Quality (or certainty) of evidence: Agreed.

The panel agreed with the IWGDF evaluation of the quality of evidence to support the use of SINBAD for the purpose of regional/ national/ international audit (strong) (18, 19). The panel agreed with the IWGDF that to be appropriate for use for international audit, diverse clinical settings and suitable for comparison of outcomes for large numbers of patients, a DFU classification/ scoring system needs to be simple, reliable, quick to perform and require no specialised equipment or expertise. The SINBAD system meets these criteria, is reliable and has been validated in a number of countries for both ulcer healing and lower extremity amputation (LEA) prediction in cohort studies (26, 46, 53-58). The SINBAD system is in widespread use in the UK and is utilised in the UK National Diabetic Foot Audit with reporting of outcomes for over 20,000 people with DFU (26).

Values: Agreed.

The panel felt that most patients were likely to be unaware of the wound classification systems being used by clinicians for the purpose of audit at present and would probably not have a specific preference. However, it was recognised by the panel that patients would likely view it as being desirable that audits report reliably and accurately about their wound and outcomes in order to enable benchmarking of health care systems and services that provide care to people with diabetes and foot ulcers. In contrast, some health professionals in Australia may prefer to, in addition to SINBAD, use detailed, validated systems which they have routinely used previously for the purpose of audit such as Wifl and University of Texas, and which are currently recommended in existing standards of care for iHRFS in Australia (42, 43).



SUPPLEMENTARY INFORMATION

Recommendation 5

Balance of effects: Agreed.

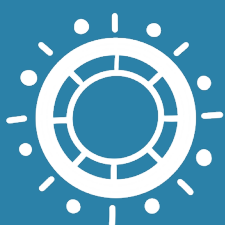
The panel agreed with the IWGDF that the balance of effects favoured the use of SINBAD as a single, minimum standard for the purposes of regional/ national/ international audit in patients with DFU (19), and the desirable effects outweighed the undesirable effects.

Acceptability: Partially agreed.

The panel was in partial agreement with the IWGDF. The SINBAD system is in widespread usage in the United Kingdom and is the accepted compulsory standard (26). Given similarities in health care delivery between the United Kingdom and Australia, the panel agreed that SINBAD would also likely be acceptable to Australian clinicians for the purpose of audit. However, the panel also recognised that to acquire a more detailed assessment of a wound, it is not optimal to indicate whether as a dichotomous variable, a wound has infection, ischaemia, or is deep or not. In an Australian context, it is recommended for patients with DFUs to be managed in an iHRFS, where the NADC iHRFS guidelines and the Diabetic Foot Australia minimum dataset dictionary recommend the use of more detailed classification systems such as University of Texas and/ or WIfI (42, 43). As a result, both primary care providers and specialist iHRFS providers may be more familiar with wound classification systems other than SINBAD, however the panel did not think this would be a barrier in the longer term to more widespread use of SINBAD for the purposes of audit, although some education initiatives may be required initially to encourage adoption of SINBAD more widely in Australia.

Feasibility: Partially agreed.

The panel partially agreed with the IWGDF as the simplicity, reliability and validation of SINBAD would make it feasible for widespread use as the minimum standard for wound classification for the purpose of audit in patients with DFU in Australia. However, the panel felt that SINBAD would not be the optimal wound classification system for audit purposes in specialist clinical settings, such as iHRFS, where more detailed nuanced wound classification systems would ideally be used, in line with current Australian recommendations. When the use of SINBAD as a wound classification system comes into more routine clinical practice in Australia, it would likely be accepted as the minimum wound classification system for use in a clinical setting for audit. Being simple and reliable, the panel agreed the use of SINBAD for audit would be sustainable and suitable across diverse Australian clinical settings.

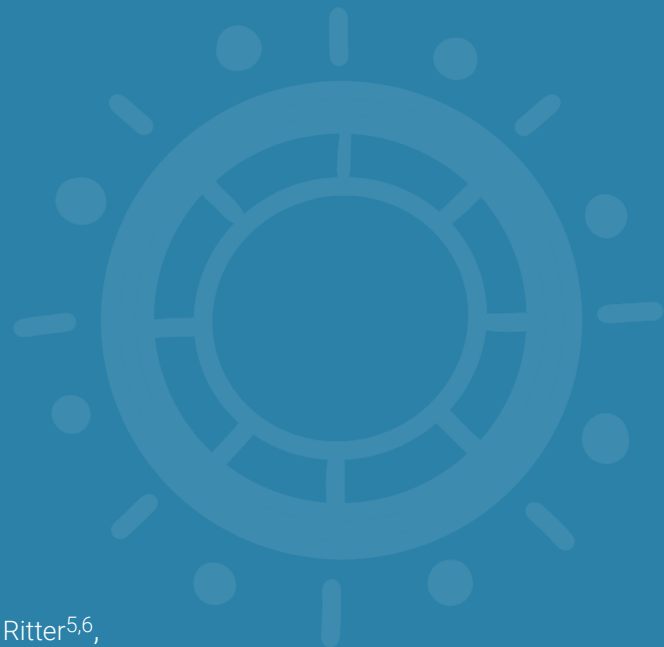


PERIPHERAL ARTERY DISEASE

Australian guideline on diagnosis and
management of peripheral artery disease

Part of the 2021 Australian
evidence-based guidelines for
diabetes-related foot disease

VERSION 1.0 280921



AUTHORS

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Disclaimer

These Australian Evidence-based Guidelines are a general guide to appropriate practice, to be followed subject to the clinician's judgment and the patient's preference in each individual case. The Guidelines are designed to provide information to assist decision-making and are based on the best evidence available at the time of development.

Diabetes Feet Australia would like to thank and acknowledge Mikaela Cameron who has created the artwork to represent the guidelines. Mikaela Cameron (M. J. Badagarang) is a proud Dharug saltwater woman from the Hawkesbury River in New South Wales, Australia. She's worked the past 4 years as a cultural educator delivering cultural workshops and creating murals. "Worimi, I am a proud Dharug woman. My totem is the Badagarang (Eastern Grey Kangaroo), and Waroo (the brown-eyes crow). I pay my respects to all Elders past, present and emerging, and extend this acknowledgment to you and your people. Welcome, let's walk together."

ABSTRACT

Background

Peripheral artery disease (PAD) is implicated in up to 50% of diabetes-related foot ulcers (DFU) and significantly contributes to morbidity and mortality in this population. An evidence-based guideline that is relevant to the national context is urgently required to improve outcomes for patient with PAD and DFU in Australia. We aimed to identify and adapt current international guidelines for diagnosis and management of patients with PAD and DFU to develop an updated Australian guideline.

Methods

Using a panel of national content experts and the National Health and Medical Research Council procedures, the 2019 International Working Group on the Diabetic Foot (IWGDF) guidelines were adapted to the Australian context. The guideline adaptation frameworks ADAPTE and Grading of Recommendations Assessment, Development and Evaluation (GRADE) were applied to the IWGDF guideline for PAD by the expert panel. Recommendations were then adopted, adapted or excluded, and specific considerations for implementation, population subgroups, monitoring and future research in Australia were developed with accompanying clinical pathways provided to support guideline implementation.

Results

Of the 17 recommendations from the IWGDF Guideline on diagnosis, prognosis and management of PAD in patients with diabetes and foot ulcers, 16 were adopted for the Australian guideline and one recommendation was adapted due to the original recommendation lacking feasibility in the Australian context. In Australia we recommend all people with diabetes and DFU undergo clinical assessment for PAD with accompanying bedside testing. Further vascular imaging and possible need for revascularisation should be considered for all patients with non-healing DFU irrespective of bedside results. All centres treating DFU should have expertise in, and/or rapid access to facilities necessary to diagnose and treat, PAD and should provide multidisciplinary care post-operatively including implementation of intensive cardiovascular risk management.

Conclusions

A guideline containing 17 recommendations for the diagnosis and management of PAD for Australian patients with DFU was developed with accompanying clinical pathways. As part of the adaption of the IWGDF guideline to the Australian context, recommendations are supported by considerations for implementation, monitoring, and future research priorities, and in relation to specific subgroups including Aboriginal and Torres Strait Islander people, and geographically remote people.

Keywords

Diabetes feet; peripheral artery disease; foot ulcer; guidelines; diagnosis; revascularisation



PERIPHERAL ARTERY DISEASE

AUSTRALIAN RECOMMENDATIONS LIST

PREVENTION

WOUND CLASSIFICATION

PERIPHERAL ARTERY
DISEASE

INFECTION

OFFLOADING

WOUND HEALING
INTERVENTIONS

- 1 Examine the feet of all patients with diabetes annually for the presence of peripheral artery disease (PAD) even in the absence of foot ulceration. At a minimum, this should include taking a relevant history and palpating foot pulses. (Strength of the recommendation: strong; quality of the evidence: low)
- 2 Clinically examine (by relevant history and palpation of foot pulses) all patients with diabetes and foot ulceration for the presence of PAD. (Strong; low)
- 3 As clinical examination does not reliably exclude PAD in most persons with diabetes and a foot ulcer, evaluate pedal Doppler arterial waveforms in combination with ankle systolic pressure and systolic ankle brachial index (ABI) or toe systolic pressure and toe brachial index (TBI) measurement. No single modality has been shown to be optimal, and there is no definite threshold value above which PAD can reliably be excluded. However, PAD is a less likely diagnosis in the presence of ABI, 0.9-1.3; TBI, ≥ 0.75 ; and triphasic pedal Doppler waveforms. (Strong; low)
- 4 Perform at least one of the following bedside tests in a patient with a diabetes-related foot ulcer and PAD, any of which increases the pretest probability of healing by at least 25%: a skin perfusion pressure of ≥ 40 mmHg, a toe pressure of ≥ 30 mmHg, or a transcutaneous oxygen pressure (TcPO₂) of ≥ 25 mmHg. (Strong; moderate)
- 5 Use the Wound, Ischaemia, and foot Infection (WIFI) classification system as a means to stratify amputation risk and revascularisation benefit in a patient with a diabetes-related foot ulcer and PAD. (Strong; moderate) comparisons between institutions on the outcomes of patients with diabetes and an ulcer of the foot (strong; high)
- 6 Always consider urgent vascular imaging, and revascularisation, in a patient with a diabetes-related foot ulcer and an ankle pressure of < 50 mmHg, ABI of < 0.5 , a toe pressure of < 30 mmHg, or a TcPO₂ of < 25 mmHg. (Strong; low)
- 7 Always consider vascular imaging in patients with a diabetes-related foot ulcer, irrespective of the results of bedside tests, when the ulcer is not healing within 4 to 6 weeks despite good standard of care. (Strong; low)
- 8 Always consider revascularisation in a patient with a diabetes-related foot ulcer and PAD, irrespective of the results of bedside tests, when the ulcer is not healing within 4 to 6 weeks despite optimal management. (Strong; low)
- 9 Do not assume diabetes-related microangiopathy, when present, is the cause of poor healing in patients with a diabetes-related foot ulcer; therefore, always consider other possibilities for poor healing. (Strong; low)
- 10 Use any of the following modalities to obtain anatomical information when considering revascularising a patient's lower extremity: colour duplex ultrasound, computed tomographic angiography, magnetic resonance angiography, or intra-arterial digital subtraction angiography. Evaluate the entire lower extremity arterial circulation with detailed visualisation of below-the-knee and pedal arteries, in an anteroposterior and lateral plane. (Strong; low)
- 11 When performing revascularisation in a patient with a diabetes-related foot ulcer, aim to restore direct blood flow to at least one of the foot arteries, preferably the artery that supplies the anatomical region of the ulcer. After the procedure, evaluate its effectiveness with an objective measurement of perfusion. (Strong; low)
- 12 As evidence is inadequate to establish whether an endovascular, open, or hybrid revascularisation technique is superior, make decisions based on individual factors, such as morphological distribution of PAD, availability of autogenous vein, patient co-morbidities, and local expertise. (Strong; low)



PERIPHERAL ARTERY DISEASE

AUSTRALIAN RECOMMENDATIONS LIST

PREVENTION

WOUND CLASSIFICATION

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OFFLOADING

WOUND HEALING
INTERVENTIONS

13

Any centre treating patients with a diabetes-related foot ulcer should have expertise in, and/or rapid access to facilities necessary to diagnose and treat, PAD, including both endovascular techniques and bypass surgery. (Strong; low)

14

Ensure that after a revascularisation procedure in a patient with a diabetes-related foot ulcer, the patient is treated by a multidisciplinary team as part of a comprehensive care plan. (Strong; low)

15

Urgently assess and treat patients with signs or symptoms of PAD and a diabetes-related foot infection, as they are at particularly high risk for major limb amputation. (Strong; moderate)

16

Avoid revascularisation in patients in whom, from the patient's perspective, the risk-benefit ratio for the probability of success of the procedure is unfavourable. (Strong; low)

17

Provide intensive cardiovascular risk management for any patient with diabetes and an ischaemic foot ulcer, including support for cessation of smoking, treatment of hypertension, control of glycaemia, and treatment with a statin drug as well as low-dose clopidogrel or aspirin. (Strong; low)





BACKGROUND

Current global estimates are that diabetes affects 1 in 11 adults (463 million people) (1). This is expected to increase to 1 in 10, or 700 million people, by 2045 (1). Diabetes is associated with significant risk of diabetes-related foot disease (DFD) including a life-time incidence of foot ulcer of up to 34% and it is the leading cause of amputation (2). Up to 50,000 Australians are estimated to be affected by diabetes-related foot ulcer (DFU) with a further 300,000 living at risk of DFU development. DFD occurs more frequently in Aboriginal and Torres Strait Islander people and outcomes are more severe (3), with amputation rates up to 38 times higher than in age-matched non-Indigenous counterparts (4). Reducing rates of DFD for all Australians is essential to prevent avoidable amputations and reduce the associated AUD\$1.6 billion in annual health care costs (5, 6). As reflected by key outcomes identified in the 2020 Closing the Gap in Partnership agreement, there is an urgent need to prioritise and achieve better health outcomes for Aboriginal and Torres Strait Islander people to protect against the devastating consequences of DFD in this population (3, 7).



Peripheral artery disease (PAD) is estimated to affect up to 15% of Australian adults (8). Diabetes is associated with a four-fold increase in incidence of PAD, independent of other risk factors (9). PAD is estimated to be present in up to 50% of DFU and to be an independent risk factor in their development (10, 11). PAD commonly co-exists with systemic atherosclerosis and underlying generalised endothelial dysfunction due to vascular inflammation and, an abnormal metabolic state (9, 12). Together these changes increase the risk of cardiovascular morbidity and mortality significantly (13). When associated with diabetes, PAD is also more diffuse with increased involvement of tibial arteries (14), greater severity of the disease process, higher likelihood of distal ischaemic ulcer and extensive tissue loss, and increased risk of amputation (15). Early diagnosis and treatment of PAD in people with DFU is critical due to the increased risk of non-healing, infection and amputation, as well as elevated rate of cardiovascular complications such as myocardial infarction and stroke, and a five-year mortality rate of more than 50% (16-20).

Despite the severity of the outcomes of PAD in people with diabetes, and particularly in those with DFU, there are limited data to determine best practice treatments for this specific population (21, 22). The majority of current evidence for diagnosis and management of PAD is garnered from the general population and does not account for the multi-system nature of diabetes, and the impact of related complications on healing and amputation outcomes (22). Multiple diagnostic, surgical, and conservative management options are available to treat PAD and chronic limb-threatening ischaemia (22). However, to determine best practice in a diabetes population, evidence-based guidelines that provide recommendations specifically for the diagnosis and management of PAD in patients with diabetes and DFU have been developed internationally (21).

In Australia, national evidence-based guidelines for the assessment and management of DFD have not been published since 2011 (23). Several international evidence-based DFD guidelines have been published recently (17, 24, 25). However, parts of these guidelines may not be appropriate or applicable in an Australian clinical setting. This is due to the unique geographical and health care system differences between Australia and other parts of the world. Further, the diverse population groups within Australia such as Aboriginal and Torres Strait Islander people, and those in geographically remote areas, require specific focus (26). To develop new, high quality, evidenced-based guidelines for an Australian context is estimated to cost \$AU1 million and significant development time preventing rapid translation to practice (26). Therefore, to develop a suitable national guideline for the assessment of management of PAD in people with DFU, we aimed to systematically identify and adapt suitable international guidelines.



METHODS

The methodology for this guideline is detailed in an accompanying paper authored by the Australian DFD Guidelines working group (27). We followed the eight overarching National Health and Medical Research Council (NHMRC) recommendations for adapting source guidelines as described previously (28-30). The initial three steps of these recommendations include defining the scope, identifying potential source guidelines, and assessing their suitability. The outcomes from this process are described in the development paper (27). Through this process the 2019 International Working Group on the Diabetic Foot (IWGDF) guidelines were identified as the only suitable source guideline (27). This guideline and the subsequent five NHMRC steps for adapting source guidelines are the subject of this manuscript and are outlined below.

A national expert panel ('the authors') was established by the Australian DFD Guidelines Working Group to develop this PAD guideline. The panel consists of recognised multi-disciplinary (inter)national experts in PAD for people with DFU along with consumer, end-user, and Aboriginal and Torres Strait Islander DFD experts (27). The authors were provided all PAD recommendations (and all supporting rationale and evidence) from the IWGDF guidelines (19, 21, 22, 31) to consider as the basis for developing this guideline (27).

Using a customised 7-item ADAPTE evaluation form, two members of the panel independently screened each IWGDF PAD recommendation (and rationale) for their quality of evidence, strength of recommendation, and acceptability and applicability in the Australian national context (27, 30). Disagreements between the two panel members on any ratings were discussed until consensus was reached. If required, a third panel member arbitrated disagreements. The panel then met to discuss and gain consensus decisions on the ratings for all recommendations. Any recommendations in which the panel were 'certain' that all items agreed with the quality of evidence and strength of recommendation made by IWGDF, and they were acceptable and applicable in the Australian national context were adopted. Recommendations that the panel rated as being 'unsure' or 'not certain' of the quality of evidence, strength of recommendation, or being acceptable or applicable in the Australia context, were referred to be further assessed in the next stage (27, 30).

The GRADE Evidence to Decision (EtD) tool for clinical recommendations was used to assess recommendations requiring full assessment (27, 29, 32, 33). This process required one panel member to extract and populate the EtD tool with supporting text for the recommendation from the IWGDF PAD guideline and systematic reviews (19, 21, 22, 31) for eight EtD criteria: the problem, desirable effects, undesirable effects, quality (or certainty) of evidence, values (of importance of outcomes), balance of effects, acceptability and applicability (27, 29, 32, 33). The populated EtD tool was cross-checked by a second panel member and any disagreements were discussed until a consensus was reached. Following this, an additional panel member assessed the completed EtD tool which was then checked by another panel member with any disagreements discussed until consensus achieved. The panel then met to discuss and gain consensus on their summary judgements for the eight EtD criteria (32, 33) followed by a direct comparison with the IWGDF judgements (27, 29).

Based on the level of agreement between the panel and IWGDF summary judgements, the panel then decided to adopt, adapt, or exclude the recommendation for the Australian national context (27, 29). A recommendation was 'adopted' if there were no substantial differences between the panel and IWGDF summary judgements. Recommendations were 'adapted' if there were substantial differences between the panel and IWGDF summary judgements, or 'excluded' if there were substantial differences and/or the panel concluded the recommendation was not acceptable or not applicable in Australia (27, 29). Disagreements within the panel were discussed until consensus was reached or, if that was not possible, by discussing with the Guideline Working Group until consensus was reached.



METHODS

Those recommendations the panel decided to 'adapt' had their quality of evidence, strength of recommendation rating (29, 32, 33), and written recommendations re-evaluated, via consensus based on the panel's summary judgements (27, 29). The panel rated the quality of evidence as per the GRADE system (34, 35). A 'high' quality rating was determined if the panel was very confident that the findings from the supporting evidence were from studies with low risk of bias that reported consistent effects and further research was unlikely to change that confidence. A 'moderate' quality rating was determined if the panel had moderate confidence in the risk of bias or consistency of effects and additional research was likely to impact that confidence further. A 'low' quality rating was determined if the panel had limited confidence in the risk of bias and inconsistency of effects and further research was very likely to impact confidence. Finally, a 'very low' quality rating was determined if the panel had very little confidence in the available supporting evidence (32, 33). The panel also rated the strength of recommendation based on GRADE system. This required the panel members to weigh up the balance of effects, quality of evidence, values, and applicability and acceptability (32, 33) in the Australian national context (27). The panel provided a 'strong' recommendation if there was clearly a moderate-to-large difference in the balance of effects between the intervention compared with the control. The panel provided a 'weak' recommendation if there was an uncertainty and/or mild-to-moderate difference between the intervention and control (32, 33). The panel then re-wrote any 'adapted' recommendation to be clear, specific and unambiguous for the Australian context, as per GRADE requirements (34, 35).

For each recommendation the panel drafted the decision rationale, summary justifications for their judgements, detailed justifications for important EtD criteria (if the recommendation was fully assessed), and considerations for implementation (including for geographically remote and Aboriginal and Torres Strait Islander populations), monitoring and potential future research priorities (29, 32, 33) in the Australian national context (27). For recommendations relating to diagnostic testing consideration was given to diagnostic accuracy, direct benefits and adverse effects or burden of the test, as well implications for management. A consultation draft manuscript, including all recommendations (and rationale) for the PAD guideline, was developed by the panel and distributed for public consultation (27). The consultation draft manuscript of the PAD guideline underwent a formal one-month public consultation period using a customised consultation survey from ADAPTE (27, 30). All relevant survey and written feedback from the consultation period was collated and analysed, and the manuscript was revised accordingly by the panel members (27, 30).

The panel then used the finalised recommendations to develop two PAD clinical pathways, one for patients with DFU and one for those with diabetes only (27). The pathway development methodology followed the 10-step process for developing and implementing clinical pathways (18) and has been outlined in detail in the accompanying development of the guideline paper (27). The purpose of the clinical pathways is to assist the implementation of the PAD recommendations by the multiple health professional disciplines caring for Australians with DFU in secondary and tertiary health care settings (27). Finally, the panel members sought endorsement from the Guidelines Development Working Group and relevant peak national bodies, including the Australian and New Zealand Society for Vascular Surgery, Diabetes Australia, Indigenous Allied Health Australia, and the Australian Podiatry Association before the final guideline was released (27).



RESULTS

A systematic evaluation of the 17 IWGDF recommendations for the diagnosis, prognosis and management of PAD in patients with diabetes-related foot ulcers was conducted to determine their quality of evidence, strength of recommendation, acceptability and applicability to the Australian context. After screening, one of the 17 recommendations required additional full assessment (Table 1). Following full assessment, the recommendation was adapted to be considered acceptable and applicable in the Australian health context. The reasons for adaption related to differing availability of expertise and equipment in more geographically isolated areas. The other 16 recommendations were considered applicable and acceptable and were adopted. The adopted and adapted IWGDF guidelines are summarised in Table 3.

Two responses to the public consultation survey were received with both responding that they strongly agreed that the guideline should be approved as the new Australian PAD guideline, that the guideline would be supported by the majority of their colleagues and if approved they would encourage its use in practice. All de-identified feedback comments received during public consultation and the panel's responses to each comment were collated and posted on the Diabetes Feet Australia website. Based on the collated public consultation feedback, the guideline was revised, approved by the panel and Australian DFD Guidelines working group, and endorsed as the new Australian guideline on diagnosis and management of peripheral artery disease by nine peak national bodies listed below.

In the subsequent section each of the 17 Australian PAD recommendation are listed. In addition, the question addressed by the recommendation, the panel decision and rationale to adopt, adapt or exclude; summary justification and detailed justification where applicable for the recommendation; and considerations for implementation including for specific subgroups (including for Aboriginal and Torres Strait Islander and geographically remote populations), summary monitoring and potential future research priorities are provided. For detailed justifications, implementation, monitoring and research considerations for each recommendation see the eTables in the Supplementary Material. Finally, all recommendations are incorporated in two consensus Australian clinical pathways to guide evidence-based diagnosis and management of PAD people with diabetes (Figures 1 and 2).

The recommendations are displayed in order under the categories of A. Diagnosis, B. Prognosis and C. Treatment. A glossary of definitions is included at the end of the document.

PAD GUIDELINE ENDORSEMENT

- Aboriginal and Torres Strait Islander Diabetes-related Foot Complications Program (SAHMRI)
- Australian and New Zealand Society for Vascular Surgery
- Australian Diabetes Society
- Australian Orthotic Prosthetic Association
- Australian Podiatry Association
- Australasian Society for Infectious Diseases
- Diabetes Feet Australia
- Pedorthic Association of Australia
- Wounds Australia





A: DIAGNOSIS

Recommendation 1

Examine the feet of all patients with diabetes annually for the presence of peripheral artery disease even in the absence of foot ulceration. At a minimum, this should include taking a relevant history and palpating foot pulses. (Strength of the recommendation: strong; quality of the evidence: low)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The panel agreed with the IWGDF that the recommendation was strong based on the balance of effects favouring the annual screening over no screening, and that the quality of evidence was low. There are currently limited data investigating the diagnostic accuracy of signs/symptoms or pulse palpation for PAD (19, 36). The panel agreed with the IWGDF that this recommendation is consistent with current international guidelines where annual screening for PAD is recommended for all people with diabetes (37-39). The panel agreed this recommendation is compatible with Australian culture and the Australian health care setting, that the necessary expertise is widely available, and there is no limitation on implementation of this recommendation due to lack of equipment, or Australian healthcare legislation or policies. A clinical pathway for diagnosis and management of PAD in people with diabetes without DFU is provided in Figure 1.

Implementation considerations

In people with diabetes, PAD is frequently asymptomatic or has atypical symptoms (40, 41). For example, peripheral neuropathy can mask pain symptoms and autonomic neuropathy and result in a warm foot, meaning that the widely recognised signs and symptoms of PAD may not be present (40-42). While this recommendation is applicable to all people with diabetes with and without DFU, where there are clinical signs and symptoms of PAD more frequent screening may be necessary. Further investigation with bedside testing is also recommended in populations considered at higher risk of PAD including those over 50 years of age and Aboriginal and Torres Strait Islander people (3, 37). In addition, the high incidence of cardiovascular disease co-existing with PAD necessitates additional cardiovascular risk management in this population to reduce risk of myocardial infarction and stroke (21).

Subgroup considerations

Geographically remote people

Given that a range of health professionals have the expertise to conduct a clinical examination for PAD including history taking and pulse palpation, the panel considered that such a service should be available in more geographically remote areas.

Aboriginal and Torres Strait Islander Peoples

More frequent screening may be required and further bedside testing in the population should be used due to increased risk of PAD (3). Basic PAD screening can be provided by a range of health professionals including appropriately trained Aboriginal Health Workers. This may assist in timely screening being provided to Aboriginal and Torres Strait Islander communities in more geographically remote areas particularly. The panel agreed on the high importance of involving an Aboriginal Health Worker in care delivery. The panel also agreed on the importance of explaining the need for, and nature of, the assessment, and discussing the results with the patient and their family using a professional interpreter when required.

For detailed implementation, monitoring and research considerations see eTable A1 in Supplementary Material.



A: DIAGNOSIS

Recommendation 2

Clinically examine (by relevant history and palpation of foot pulses) all patients with diabetes and foot ulceration for the presence of peripheral artery disease. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The panel agreed with the IWGDF that the quality of available evidence was low as there are little available data investigating the diagnostic accuracy of the presence of signs and symptoms or pulse palpation for identifying PAD in people with DFU. The panel also agreed with the IWGDF, that the recommendation to examine the feet of all patients with diabetes was strong as most patients and health care providers would place high importance on DFU healing over other outcomes, and that the risk was significantly outweighed by the benefit of the assessment. The panel agreed this recommendation is compatible with Australian culture and the Australian health care setting, that the necessary expertise is widely available, and, there is no limitation on implementation of this recommendation due to lack of equipment or Australian healthcare legislation or policies. A clinical pathway for diagnosis and management of PAD in people with diabetes with DFU is provided in Figure 2.

Implementation considerations

These are consistent with general implementation considerations for recommendation 1..

Subgroup considerations

Geographically remote people

These are consistent with the considerations for recommendation 1.

Aboriginal and Torres Strait Islander Peoples

In addition to the considerations detailed in recommendation 1, the panel noted that due to the heightened risk of poor outcomes for DFU in Aboriginal and Torres Strait Islander people, and the increased likelihood of PAD in this population, clinical examination that does not suggest presence of PAD should be treated with an abundance of caution (3). It is particularly important in this population that further bedside testing is conducted as an adjunct to basic clinical examination.

For detailed implementation, monitoring and research considerations see eTable A2 in Supplementary Material



A: DIAGNOSIS

Recommendation 3

As clinical examination does not reliably exclude PAD in most persons with diabetes and a foot ulcer, evaluate pedal Doppler arterial waveforms in combination with ankle systolic pressure and systolic ankle brachial index (ABI) or toe systolic pressure and toe brachial index (TBI) measurement. No single modality has been shown to be optimal, and there is no definite threshold value above which PAD can reliably be excluded. However, PAD is a less likely diagnosis in the presence of ABI, 0.9-1.3; TBI, ≥ 0.75 ; and triphasic pedal Doppler waveforms. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The panel agreed with IWGDF that there was a low quality of supporting evidence, with a strong recommendation based on the high likelihood that most patients and care providers would consider the benefits of testing outweigh any risk, and would place critical importance on DFU healing over other outcomes. The panel also agreed that these bedside diagnostic tests are applicable to the Australian context, that there is adequate availability of knowledge and skills in objective lower limb vascular assessment, and, that there are no constraints from current legislation or policy to prevent implementation in Australia.

Implementation considerations

A range of health professionals are able to undertake bedside diagnostic vascular testing of the lower limb. Provision of appropriate equipment and training to health professionals caring for people with DFU is necessary to ensure adequate testing can be conducted. Of note, there is not enough evidence to determine if there is any single, or combination of bedside tests, which has greater diagnostic accuracy for PAD. Therefore choice of test or tests should be made based on available equipment and expertise at any given location, and in consideration of limitations of the capacity of each of these tests to accurately identify the presence of significant PAD.

Subgroup considerations

Geographically remote people

There may be restricted access to appropriate expertise and equipment in geographically remote areas. However the panel felt that where there are existing health services providing DFU treatment and management, the required bedside testing should be available with choice of test or tests directed by availability of specific equipment and expertise.

Aboriginal and Torres Strait Islander Peoples

This recommendation is applicable to Aboriginal and Torres Strait Islander people. Considerations for this recommendation are consistent with those provided in Recommendations 1 and 2.

For detailed implementation, monitoring and research considerations see eTable B3 in Supplementary Material.



B: PROGNOSIS

Recommendation 4

Perform at least one of the following bedside tests in a patient with a diabetes-related foot ulcer and PAD, any of which increases the pretest probability of healing by at least 25%: a skin perfusion pressure of ≥ 40 mmHg, a toe pressure of ≥ 30 mmHg, or a transcutaneous oxygen pressure (TcPO₂) of ≥ 25 mmHg. (Strong; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The panel agreed with the IWGDF recommendation of the quality of supporting evidence (moderate), with a strong recommendation as most patients would place high importance on ulcer healing over other outcomes, and that the risk was significantly outweighed by the benefit of the assessment. The panel was in agreement that the intervention is applicable to the Australian context, that there is adequate availability of knowledge and skills to implement the above testing methods, and, that expertise and equipment would be available in the majority of health care settings providing such patient services. The panel also agreed that there are no constraints from current legislation or policy to prevent implementation in Australia.

Implementation considerations

In a small number of studies (although outcomes are variable) there is evidence that skin perfusion pressure of ≥ 40 mmHg, toe pressure ≥ 30 mmHg, or TcPO₂ ≥ 25 mmHg have individually been shown to increase the probability of DFU healing by more than 25% (31). The panel agreed that these findings suggest the above thresholds are useful in determining patient suitability for initial implementation of conservative therapy prior to considering revascularisation. This is on the provision that the results of assessment of peripheral perfusion are considered in the context of the presence or absence of other factors, for example infection, which may further impede healing. In addition, in circumstances where there are pressures above these bedside testing thresholds, due to limitations in all the diagnostic testing methods recommended (TcPO₂, skin perfusion pressure and toe pressures), and the lack of consistency in their accuracy for predicting healing in the literature, PAD should not be excluded as a contributor to poor wound healing when there is a lack of response to optimal care (22). Similarly, where there are other factors indicating poor healing prognosis including presence of extensive infection or large wound surface area, urgent imaging and potential revascularisation should still be considered (43).

Subgroup considerations

Geographically remote people

Lack of specialised equipment, particularly for measuring skin perfusion pressure and TcPO₂, may limit choice of testing being conducted in remote areas. However as health care centres treating people with DFU in remote areas should routinely be performing bedside testing for PAD in patients, toe pressures are a suitable measure.

Aboriginal and Torres Strait Islander Peoples

This recommendation is applicable to Aboriginal and Torres Strait Islander people. Considerations for this recommendation in this population are consistent with those detailed in recommendations 1 and 2. In addition, the panel noted the need to consider the results of the vascular testing performed within the context of other risk factors for non-healing in the population is particularly important. To the panel's knowledge there are currently no data investigating the capacity for skin perfusion pressure, TcPO₂ or toe pressure to predict likelihood of DFU healing specifically in Aboriginal and Torres Strait Islander people.

For detailed implementation, monitoring and research considerations see eTable B4 in Supplementary Material.



B: PROGNOSIS

Recommendation 5

Use the Wound, Ischaemia, and foot Infection (Wifl) classification system as a means to stratify amputation risk and revascularisation benefit in a patient with a diabetes-related foot ulcer and PAD. (Strong; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The Wifl classification provides a guide to estimate risk of amputation and potential benefit of revascularisation based on the ulcer, severity of ischaemia measured via non-invasive bedside testing, and infection severity (using IWGDF/Infectious Diseases Society of America classification)(44). The panel was in agreement with the IWGDF with a strong recommendation, with the balance of effects for patients and health care providers strongly favouring use of the Wifl system. The panel also agreed with the moderate rating for the quality of available evidence with the Wifl system validated for use in people with diabetes (44, 45). The panel also agreed with the IWGDF that the application of the Wifl classification system would be acceptable for the majority of Australian patients, and would be applicable as there are no legislative or policy constraints on its use. The classification system is readily available and can be downloaded as a calculator tool to assist with application (46).

Implementation considerations

Given the availability of the Wifl tool, and its use of non-invasive bedside testing to determine level of ischaemia, and clinical grading of infection and the wound, the panel agreed there would be no specific limitations to implementation.

Subgroup considerations

Geographically remote people

The panel agreed that the nature of the classification system, including use of bedside testing and clinical grading of wound and infection severity makes it suitable for use in geographically isolated areas.

Aboriginal and Torres Strait Islander Peoples

The panel agreed that this recommendation is generally applicable to Aboriginal and Torres Strait Islander people. As the Wifl tool has not been validated in this specific population, as per recommendation 4, the disproportionately high risk of amputation in Aboriginal and Torres Strait Islander people particularly in rural and remote areas, and extrinsic and cultural barriers to care access (for example the need to stay on Country, family and community circumstances and roles, and the preference for community-delivered care) need to be considered in addition to the Wifl classification system to better determine risk of amputation and benefits of revascularisation.

For detailed implementation, monitoring and research considerations see eTable B5 in Supplementary Material.



B: PROGNOSIS

Recommendation 6

Always consider urgent vascular imaging, and revascularisation, in a patient with a diabetes-related foot ulcer and an ankle pressure of <50 mmHg, ABI of <0.5, a toe pressure of <30 mmHg, or a TcPO₂ of <25 mmHg. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The panel agreed with the IWGDF that the recommendation was strong, with low quality of supporting evidence. In addition, the panel agreed that there would probably be no important uncertainty in relation to the majority of Australian patients preferring imaging and consideration of urgent revascularisation compared to no intervention where likelihood of successful healing with conservative care is very low. The panel also concluded that the recommendation is applicable, that there is no legislative or policy constraints to its use, and, that the resources and expertise are available for the majority of patients and health care providers in health care settings typically providing such treatment services in Australia.

Implementation considerations

These are consistent with the implementation considerations for recommendation 5.

Subgroup considerations

Geographically remote people

This recommendation is applicable to geographically remote locations, however in these situations timely referral for imaging and revascularisation require well established rapid referral pathways which should be developed in consideration of the local availability of services and expertise.

Aboriginal and Torres Strait Islander Peoples

This recommendation is applicable to Aboriginal and Torres Strait Islander people. The reader is referred to considerations in recommendation 1 and 2. The panel also agreed on the importance of explaining the need for, and nature of, any further vascular intervention or surgical intervention including the expected timeframes for, and location of, related hospitalisation and longer term post-operative care with the patient and their family using a professional interpreter when required. Furthermore due to the disproportionately high risk of amputation in Aboriginal and Torres Strait Islander people particularly in rural and remote areas, extrinsic and cultural barriers to care access need to be considered in the establishment of appropriate rapid referral pathways and in considering revascularisation procedures.

For detailed implementation, monitoring and research considerations see eTable B6 in Supplementary Material.



B: PROGNOSIS

Recommendation 7

Always consider vascular imaging in patients with a diabetes-related foot ulcer, irrespective of the results of bedside tests, when the ulcer is not healing within 4 to 6 weeks despite good standard of care. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The panel was in agreement with the IWGDF in regard to both the strength of the recommendation (strong) and the quality of available evidence (low). In addition, the panel agreed that there would be no important uncertainty in relation to the majority of Australian patients preferring the intervention (imaging) and valuing DFU healing over other outcomes. The panel considered that this recommendation was applicable to the Australian context, that there were no policy or legislative constraints on implementation of this recommendation, and, that there is adequate expertise and equipment available in secondary and tertiary health care settings where patients typically access this care.

Implementation considerations

As discussed in recommendation 3, the paucity of available research investigating diagnostic accuracy of bedside testing for PAD in patients with DFU highlights the limited capacity for this testing to rule out presence of the disease. Undiagnosed ischaemia is therefore a potential contributing factor to delayed healing in situations where appropriate conservative care is being provided. Current available evidence suggests the timeframe for implementing additional vascular imaging and undertaking revascularisation where appropriate influences healing outcomes (47).

Subgroup considerations

Geographically remote people

Differing levels of accessibility to conservative DFU care in remote regions may affect ulcer healing outcomes including time to achieve healing. A good standard of multidisciplinary DFU care involves regular debridement and wound dressing, as well as effective pressure offloading and rapid control of the presence of infection. In more geographically remote areas, delays or more extended time between appointments, as well as hot or dry and dusty environments, may reduce adherence to some conservative therapies (for example, offloading devices). This may also slow the healing time. Nevertheless, due to the need to diagnose PAD as soon as possible where delayed healing is occurring further imaging should be sought.

Aboriginal and Torres Strait Islander Peoples

Differing levels of accessibility to conservative DFU care in remote regions may affect ulcer healing outcomes including time to achieve healing. A good standard of multidisciplinary DFU care involves regular debridement and wound dressing, as well as effective pressure offloading and rapid control of the presence of infection. In more geographically remote areas, delays or more extended time between appointments, as well as hot or dry and dusty environments, may reduce adherence to some conservative therapies (for example, offloading devices). This may also slow the healing time. Nevertheless, due to the need to diagnose PAD as soon as possible where delayed healing is occurring further imaging should be sought.

For detailed implementation, monitoring and research considerations see eTable B5 in Supplementary Material.



B: PROGNOSIS

Recommendation 8

Always consider revascularisation in a patient with a diabetes-related foot ulcer and PAD, irrespective of the results of bedside tests, when the ulcer is not healing within 4 to 6 weeks despite optimal management. (Strong; low).

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

That panel was in agreement with the IWGDF on the strength of this recommendation (strong) and the low level of available evidence. The panel agreed that the intervention is acceptable and feasible in the Australian context with the majority of Australian patients preferring revascularisation and valuing DFU healing over other outcomes. The panel agreed that there were no policy or legislative constraints on implementation of this recommendation, and that there is adequate expertise and equipment available in health care settings where patients typically access this care. The panel noted applicability of the recommendation is likely to vary between patients as DFU are frequently complex with multiple contributing factors including infection, ischaemia and neuropathy. Determining the most appropriate trial duration for conservative care is therefore challenging and likely to vary between individuals.

Implementation considerations

These are consistent with the implementation considerations for recommendation 7.

Subgroup considerations

Geographically remote people

As per recommendation 7, difficulties for patients regularly accessing optimal conservative care either due to distance or service availability may contribute to delayed healing. This highlights the need for individual patient circumstances and results of vascular imaging to be used to inform decisions relating to revascularisation.

Aboriginal and Torres Strait Islander Peoples

This recommendation is applicable to Aboriginal and Torres Strait Islander people. Specific considerations for this recommendation are consistent with those outlined in recommendations 1, 2 and 6 in relation to care delivery involving an Aboriginal Health Worker and the need for effective patient and family communication regarding assessment and treatment options. As per recommendation 7, the panel noted Aboriginal and Torres Strait Islander people may experience reduced frequency of access to appropriate care due to cultural barriers and lack of culturally safe care, as well as difficulty due to geographical remoteness. This may have an adverse effect on healing rates and as with those living in remote geographical areas such circumstances should be considered in addition to vascular imaging when considering revascularisation.

For detailed implementation, monitoring and research considerations see eTable B8 in Supplementary Material.



B: PROGNOSIS

Recommendation 9

Do not assume diabetes-related microangiopathy, when present, is the cause of poor healing in patients with a diabetes-related foot ulcer; therefore, always consider other possibilities for poor healing. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The panel agreed with IWGDF that there was a low quality of supporting evidence, with a strong recommendation based on expert opinion. The panel also agreed that this recommendation is acceptable to the Australian setting, and, that there would be no important uncertainty in relation to the majority of Australian patients preferring all likely causes of poor healing to be investigated. The panel agreed that the intervention is applicable to the Australian context, that there is adequate availability of knowledge and skills in assessment of the foot with diabetes, and that there are no policy or legislative constraints on implementation of this recommendation.

Implementation considerations

Diabetes-related microangiopathy is characterised by increased capillary basement membrane thickening and is proposed to have a deleterious effect on wound healing. Presence of neuropathy is proposed to further contribute to localised tissue hypoxia and reduced vasodilatory capacity of the microvasculature in response to injury (48, 49). However, due to the lack of compelling evidence supporting a role of microangiopathy in poor DFU healing, the panel agreed with the IWGDF that other factors that may impair wound healing and reduce peripheral perfusion including PAD undiagnosed by bedside testing, presence of high plantar pressures, oedema and infection should be considered first and foremost.

Subgroup considerations

Geographically remote people

The panel consider this recommendation to be applicable to people living in geographically remote areas. The panel noted the importance of thorough investigation of both intrinsic (e.g. infection, PAD) and extrinsic (e.g. access to care) factors for delayed healing in geographically remote people.

Aboriginal and Torres Strait Islander Peoples

The panel considered this recommendation to be suitable for Aboriginal and Torres Strait Islander people, but, as per recommendations 6 and 7, identified the need to consider extrinsic factors that may contribute to delayed, or non-healing in this population. These include adequate access to culturally safe care, suitability of conservative care to cultural needs, and similar potential restrictions in access to regular conservative care in geographically remote areas.

For detailed implementation, monitoring and research considerations see eTable B9 in Supplementary Material.



C: TREATMENT

Recommendation 10

Use any of the following modalities to obtain anatomical information when considering revascularising a patient's lower extremity: colour duplex ultrasound (CDUS), computed tomographic angiography (CTA), magnetic resonance angiography (MRA), or intra-arterial digital subtraction angiography (DSA). Evaluate the entire lower extremity arterial circulation with detailed visualisation of below-the-knee and pedal arteries, in an anteroposterior and lateral plane. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The panel agreed with the IWGDF judgement on the strength of the recommendation (strong), with low quality of available evidence. Revascularisation of the lower limb should be guided by appropriate imaging of the entire lower limb arterial circulation including pedal circulation. Detailed visualisation of vessels below the knee and the pedal arteries is required due to increased likelihood of more distally located disease in people with diabetes (15). CDUS, MRA, CTA and DSA are all modalities that may be used to establish lower limb circulation in a patient with diabetes. The panel agreed the majority of Australian patients would prefer to undergo imaging. The panel agreed that the intervention is applicable to the Australian context and that there were no policy or legislative constraints on implementation of this recommendation. The panel noted that choice of imaging may be influenced by the availability of expertise and equipment, and patient specific factors (see below: implementation considerations), however, the panel considered there to be adequate expertise and equipment available in secondary and tertiary health care settings where patients typically access this care.

Implementation considerations

The panel agreed with the IWGDF that CDUS, CTA, MRA, or DSA could be used for evaluation of lower limb arterial circulation. Each form of imaging has specific limitations and contraindications which need to be considered in the selection of the type of imaging used. In brief, presence of significant calcification reduces the accuracy of CDUS and CTA. Multi-segment disease and oedema also reduce the imaging capability of CDUS. Imaging requiring contrast agents including MRA, CTA, and DSA are contraindicated where there is allergy to the contrast agent or there is significant risk of nephrotoxicity. MRA is also contraindicated in those patients with cardiac pacemakers, and some other implants and in claustrophobic patients without sedation.

Subgroup considerations

Geographically remote people

The panel agreed that while a range of imaging services may be available in metropolitan and regional areas, this access is likely to be very limited in geographically remote areas. In such situations the importance of well-established clinical referral pathways to support timely access to services is paramount.

Aboriginal and Torres Strait Islander Peoples

The panel considered that this recommendation was appropriate for Aboriginal and Torres Strait Islander people. Consistent with populations in remote geographical areas, the importance of established referral pathways developed in conjunction with community based Aboriginal Health and Medical Services and where the care provision is supported by an Aboriginal Health Worker, is integral to optimising patient outcomes. In addition, the reader is referred to considerations for Aboriginal and Torres Strait Islander people for recommendations 1 and 2.

For detailed implementation, monitoring and research considerations see eTable C10 in Supplementary Material.



C: TREATMENT

Recommendation 11

When performing revascularisation in a patient with a diabetes-related foot ulcer, aim to restore direct blood flow to at least one of the foot arteries, preferably the artery that supplies the anatomical region of the ulcer. After the procedure, evaluate its effectiveness with an objective measurement of perfusion. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The panel was in agreement with the IWGDF regarding the strength of the recommendation (strong) based on the balance of effects favouring revascularisation over no intervention for improving tissue perfusion and DFU healing. The panel also agreed with the IWGDF on the quality of the available evidence (low) due to lack of reporting of included study populations, inconsistent application of interventions and the poor control of potential confounders. The panel agreed that the intervention is applicable to the Australian context with the majority of Australian patients preferring revascularisation and valuing DFU healing and limb salvage over other outcomes. The panel also agreed that there were no policy or legislative constraints on implementation of this recommendation, and that there is adequate expertise and equipment available in health care settings where patients typically access this care.

Implementation considerations

While the most effective approach to revascularisation remains a point of contention, the panel agreed with the IWGDF that direct revascularisation, where there is restoration of flow to the anatomical area in which the ulcer is located, will theoretically be more effective than an indirect technique. The panel also agreed that in the presence of end-stage renal disease revascularisation needs to be carefully considered due to high rates of complications, a five year mortality rate of up to 91% and moderate limb salvages rates (65-70%) for those surviving to one year (21). The panel agreed with the IWGDF that, in the presence of extensive infection, therapy should be implemented to control the infection prior to undertaking a revascularisation procedure and subsequent restoration of perfusion should be undertaken within a few days of stabilisation of the patient (22).

Subgroup considerations

Geographically remote people

The panel agreed that this recommendation is applicable to people living in geographically remote areas. The panel noted that, for these patients, rapid referral pathways are required to treatment centres offering revascularisation procedures and that access to appropriate follow-up assessments and care needs to be established as part of the management model in conjunction with involved health care providers. Options to support health practitioners in remote areas with appropriate expertise via telehealth and other forms of remote monitoring should be considered.

Aboriginal and Torres Strait Islander Peoples

The panel considered this recommendation to be applicable to Aboriginal and Torres Strait Islander people. Consistent with recommendation 6, the panel agreed on the importance of explaining the need for, and nature of, any further vascular intervention or surgical intervention including the expected timeframes for, and location of, related hospitalisation and longer-term post-operative care with the patient and their family using a professional interpreter when required. Furthermore, established referral pathways, as well as appropriate, culturally safe follow-up care, are required for Aboriginal and Torres Strait Islander people in all geographical locations. These should be developed in conjunction with community-based Aboriginal Health and Medical Services where the care access and provision is supported by an Aboriginal Health Worker and professional interpreter (where required) to optimise patient outcomes.

For detailed implementation, monitoring and research considerations see eTable C11 in Supplementary Material.



C: TREATMENT

Recommendation 12

As evidence is inadequate to establish whether an endovascular, open, or hybrid revascularisation technique is superior, make decisions based on individual factors, such as morphological distribution of PAD, availability of autogenous vein, patient co-morbidities, and local expertise. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

Review of the literature reporting DFU healing and limb salvage outcomes following endovascular and open techniques show these to be similar. However there is a lack of comparative studies evaluating endovascular, open or hybrid techniques in people with diabetes. The panel therefore agreed with the IWGDF on the strength of recommendation (strong) based on a low level of quality of available evidence, and the need for centres treating people with DFU to be able to provide a range of surgical treatment options. The panel agreed that there would probably be no important uncertainty in relation to the majority of Australian patients preferring the intervention and valuing DFU healing over other outcomes. The panel considered that this recommendation was applicable to the Australian context, that there are no policy or legislative constraints on implementation of this recommendation, and, that there is adequate expertise and equipment available in health care settings where patients typically access this care.

Implementation considerations

The panel agreed with the IWGDF that the complex nature of diabetes-related PAD, supports the patient-specific approach to selection of revascularisation techniques.

Subgroup considerations

Geographically remote people

This recommendation is applicable to people in geographically remote areas, however, the panel agreed that access to expertise may be variable in some locations and that considerations for this subgroup are consistent with those for recommendation 11.

Aboriginal and Torres Strait Islander Peoples

The panel considered that this recommendation was appropriate for Aboriginal and Torres Strait Islander people and considerations for this subgroup are the same as for recommendation 11.

For detailed implementation, monitoring and research considerations see eTable C12 in Supplementary Material.



C: TREATMENT

Recommendation 13

Any centre treating patients with a diabetes-related foot ulcer should have expertise in, and/or rapid access to facilities necessary to diagnose and treat, PAD, including both endovascular techniques and bypass surgery. (Strong; low)

DECISION: ADAPTED

Rationale

The panel agreed with the judgements of the IWGDF in relation to the acceptability of the recommendation. The panel decided to adapt this recommendation based on the panel having a difference in judgement of the applicability, specifically in relation to the feasibility of the recommendation in the Australian context (Table 1). Therefore the wording changes to original IWGDF included the addition of 'and/or'.

Summary justification

The panel agreed with the strength of the recommendation (strong) and the low quality of the available evidence. As per recommendation 12, the panel noted the complex nature of patients presenting with PAD and DFU requiring the availability of a range of surgical treatment options. The panel also agreed that the need for urgent medical intervention particularly in the presence of infection, as well as the short optimal timeframe for revascularisation supports the need to rapid access to diagnostic and treatment services.

The panel agreed that there would probably be no important uncertainty in relation to the majority of Australian patients preferring the intervention and valuing DFU healing over other outcomes. The panel were unsure that having expertise in, and rapid access to, facilities necessary to diagnose and treat PAD including both endovascular techniques and bypass surgery in any centre treating DFU was feasible in the Australian context due to the geographical isolation of many parts of the country. The detailed justifications from our full assessment are provided below.

Detailed justifications

Problem

PAD is estimated to be present in up to 50% of DFU and to be an independent risk factor in their development (10, 11). The panel agreed that DFU and ischaemia are associated with increased risk of amputation and delay in revascularisation is associated with poorer outcomes. This supports the need for centres treating DFU to have expertise in non-invasive diagnosis of PAD and, at minimum, rapid access to facilities necessary to treat PAD including access to both endovascular and bypass surgery.

Desirable effects

The panel agreed with the IWGDF that there was a large anticipated benefit of revascularisation over conservative care based on a limb salvage rate at 1 year of 82% following revascularisation versus 50-54% in patients deemed unsuitable for revascularisation and receiving conservative care (21).

Undesirable effects

The panel agreed with the IWGDF that the available evidence supported that the difference in undesirable effects associated with revascularisation was small. This was based on the available evidence showing improved healing and limb salvage outcomes at one year following revascularization. Specifically, higher amputation rates (approximately 50%) associated with conservative care in those with DFU and ischaemia at one year follow up have been demonstrated compared to those undergoing revascularisation (approximately 18 %) at one year follow up (21, 50, 51).

Quality (or certainty) of evidence

The panel agreed with the IWGDF that the quality of evidence was low. This was based on observational and retrospective data demonstrating shorter time periods to revascularisation of between 2 and 8 weeks were associated with higher probability of DFU healing and lower likelihood of limb loss (47, 52).



C: TREATMENT

Recommendation 13

Any centre treating patients with a diabetes-related foot ulcer should have expertise in, and/or rapid access to facilities necessary to diagnose and treat, PAD, including both endovascular techniques and bypass surgery. (Strong; low)

DECISION: ADAPTED

Values

The panel agreed with the IWGDF that there was probably no important uncertainty or variability in the extent to which patients valued the outcome measures used to compare the intervention (revascularisation) versus conservative care, such as healing and amputation.

Balance of effects

Although there is a low level of evidence, the panel agreed with the IWGDF that the recommendation was strong based on large desirable effects on healing outcomes and limb salvage rates and trivial undesirable effects on adverse events with vascular intervention in patients with ischaemic DFU.

Acceptability

The panel agreed with the IWGDF that revascularisation with either endovascular techniques and/or bypass surgery would be acceptable to the majority of patients and providers in most healthcare settings that typically provide such services in Australia. This was on the basis that the panel considered that most Australian patients and providers would accept the evidence that the balance of effects was in favour of revascularisation over conservative care in the presence of DFU with ischaemia.

Feasibility

The panel members were unsure if they agreed with the IWGDF on the feasibility of this recommendation in the Australian context. The basis of the uncertainty related to the recommendation that all centres treating DFU have expertise in, and rapid access to facilities necessary to diagnose and treat, PAD, including both endovascular techniques and bypass surgery. The expert opinion of the panel was that such expertise and facilities were not available at all centres treating DFU in Australia. The panel recognised that high service costs and low target populations challenge viability of health care provision in regional and remote areas, and, that this applied to the specialised services and facilities required for advanced diagnosis and surgical interventions for PAD. The panel agreed that in these circumstances, in addition to ensuring availability of appropriate bedside vascular testing onsite, establishing formal pathways to ensure rapid access to such facilities and expertise was appropriate for centres treating DFU in regional and rural Australia.

Implementation considerations

The panel agreed with the IWGDF regarding the need for rapid access to further vascular imaging and revascularisation services based on evidence of improved outcomes with prompt revascularisation intervention (47, 52, 53). Given the lack of evidence to support one form of revascularisation technique over others (i.e. open versus endovascular), the panel agreed with the IWGDF that both techniques should be available (53). As per recommendation 12, given the complex, multi-system nature of diabetes and the specific complications this causes the panel agreed the patient-specific approach to choice of revascularisation technique is appropriate. Due to the variable nature of the extent of health care services available throughout rural and regional Australia and, related to this, the differing availability of services to provide post-operative follow-up care, the panel noted the need for development of local pathways specific to the needs of individual DFU centres. The panel also identified that, as per recommendations 11 and 12, telehealth and other forms of remote monitoring provide mechanisms to support health practitioners, referral pathways and care models in rural and remote areas. Facilitation of rapid referral and provision of appropriate expertise via these mechanisms should be integrated into the development of local referral pathways, and as part of the management model in conjunction with involved health care providers. As alternatives to providing onsite care in geographical regions with small populations, the panel agreed these resources should be prioritised for future government and health services funding to support a nation-wide approach to provision of optimal DFU care.



C: TREATMENT

Recommendation 13

Any centre treating patients with a diabetes-related foot ulcer should have expertise in, and/or rapid access to facilities necessary to diagnose and treat, PAD, including both endovascular techniques and bypass surgery. (Strong; low)

DECISION: ADAPTED

Subgroup considerations

Geographically remote people

The reader is referred to the panel's advice for recommendations 11 and 12.

Aboriginal and Torres Strait Islander Peoples

In terms of considerations for Aboriginal and Torres Strait Islander people, the panel's advice is consistent with recommendation 11.

Monitoring considerations

The panel agreed formal monitoring systems to be able to collect, monitor and analyse revascularisation and DFU healing outcomes in accordance with national based High Risk Foot Service database monitoring systems and datasets were applicable to this recommendation (54-56). This is particularly important to monitor outcomes for patients being referred from rural and remote areas, to include effectiveness of referral processes and wait times.

Future research considerations

Existing data demonstrates health disparities for all Australians living in rural and remote areas (57). Further prospective research assessing comparative outcomes for patients with DFU in rural and regional Australia is required to better inform service delivery models to support patients in these areas. In addition, increasing availability of health technology offers the opportunity to investigate methods to improve access to diabetes-related foot care for people living in rural and remote areas through remote monitoring programs supported by local community health workers, and should be a focus for populations where access to care is restricted and there is high risk of amputation. This is particularly relevant to Aboriginal and Torres Strait Islander communities with Aboriginal and Torres Strait Islander people comprising up to 91% of those undergoing amputation in rural and remote Australia (58-60).



C: TREATMENT

Recommendation 14

Ensure that after a revascularisation procedure in a patient with a diabetes-related foot ulcer, the patient is treated by a multidisciplinary team as part of a comprehensive care plan. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The panel concurred with the IWGDF on the strength of this recommendation (strong) and the low quality of available evidence. The panel agreed that the intervention is applicable to the Australian context with the majority of Australian patients preferring DFU healing through use of patient-specific multidisciplinary management over other outcomes. The panel agreed that there were no policy or legislative constraints for implementation of this recommendation, and, that there is adequate expertise and equipment available in health care settings in the majority of locations where patients typically access this care.

Implementation considerations

The IWGDF Practical guidelines on prevention and management of diabetes-related foot disease reflect the multifaceted nature of DFU development and management, and highlight that the restoration of perfusion is only one aspect of a good standard of DFU care (25). Other aspects of care should include effective pressure offloading and protection of the ulcer, ongoing wound debridement, appropriate management of infection, glycaemic control, and other comorbidities, and patient education, remain essential components of successful management (61).

Subgroup considerations

Geographical remote people

The panel agreed that this recommendation was applicable to geographically remote people and the panel's advice is consistent with recommendations 11 and 12.

Aboriginal and Torres Strait Islander peoples

The panel agreed that this recommendation was applicable to Aboriginal and Torres Strait Islander people and refer the reader to considerations noted for this subgroup in recommendation 11.

For detailed implementation, monitoring and research considerations see eTable C14 in Supplementary Material.



C: TREATMENT

Recommendation 15

Urgently assess and treat patients with signs or symptoms of PAD and a diabetes-related foot infection, as they are at particularly high risk for major limb amputation. (Strong; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The panel was in agreement with the IWGDF that this was a strong recommendation with moderate quality of available evidence. There is a limb loss rate of up to 44% at 12 months for patients with diabetes and foot infection (11). In Australia, in patients with diabetes-related foot infections, Aboriginal and Torres Strait Islander people have been shown to have a four to six-fold increase in risk of amputation compared to non-Indigenous patients (62). The panel agreed with the IWGDF that revascularisation should take place promptly following control of significant infection and patient stabilisation and that any further procedures required to restore foot function should be considered after successful revascularisation. The panel agreed that the intervention is applicable to the Australian context with the majority of Australian patients preferring DFU healing and reduction in risk of limb loss. The panel agreed that there were no policy or legislative constraints on implementation of this recommendation. The panel also agreed that there is adequate expertise and equipment available in health care settings in the majority of locations where patients typically access this care.

Implementation considerations

The panel agreed with the IWGDF that revascularisation should take place promptly following control of significant infection and patient stabilisation and that any further procedures required to restore foot function should be considered after successful revascularisation.

Subgroup considerations

Geographically remote people

In terms of considerations to use this recommendation in geographically remote people, the panel's advice is consistent with recommendations 11 and 12.

Aboriginal and Torres Strait Islander Peoples

In terms of considerations for Aboriginal and Torres Strait Islander people, the panel's advice is consistent with recommendation 11.

For detailed implementation, monitoring and research considerations see eTable C15 in Supplementary Material.



C: TREATMENT

Recommendation 16

Avoid revascularisation in patients in whom, from the patient's perspective, the risk-benefit ratio for the probability of success of the procedure is unfavourable. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The panel agreed with the IWGDF on the strength of the recommendation (strong) and the low quality of available evidence. The panel also agreed with the IWGDF that, from a patient perspective, a revascularisation procedure may represent an unacceptable risk due to the heightened possibility of perioperative mortality, or due to a limited chance of a favourable surgical outcome. The panel also agreed that this recommendation is applicable to the Australian context, with the majority of Australian patients preferring avoidance of revascularisation where the risk: benefit ratio is likely to be unfavourable over other management outcomes. The panel agreed that there were no policy or legislative constraints on implementation of this recommendation in Australia. The panel also agreed that there is adequate expertise and equipment in health care settings where the majority of patients typically access DFU care to support implementation of this recommendation.

Implementation considerations

The panel agreed with the IWGDF that a decision to choose conservative care over revascularisation should be discussed with the patient in conjunction with a multidisciplinary care team including a vascular surgeon. Evidence of a 50% healing rate for ischaemic DFU in patients with diabetes unsuitable for revascularisation should also be considered in determining choice of care (50, 51). Further to this, the panel agreed with the IWGDF that, where a patient was considered to be unsuitable for revascularisation, other experimental techniques including venous arterialisation or intermittent pneumatic compression therapy may offer potential alternative treatments, although their effectiveness has not yet been substantiated.

Subgroup considerations

Geographically remote people

The panel agreed that this recommendation was applicable to people in geographically remote locations. Ensuring ease of access to regular ongoing care in the case of conservative treatment should be a priority when developing individual management plans. Use of remote support via telehealth to support local delivery of care both post revascularisation and in patients that are unsuitable for revascularisation should be considered in areas where there are limited local health services.

Aboriginal and Torres Strait Islander Peoples

The panel agreed this recommendation was applicable to Aboriginal and Torres Strait Islander people. The panel agreed involvement of Aboriginal and Torres Strait Islander Health Workers and Aboriginal Health and Medical Services and health care providers in discussions relating to vascular intervention and conservative care and subsequent care provision is essential for optimising patient outcomes.

For detailed implementation, monitoring and research considerations see eTable C16 in Supplementary Material.



C: TREATMENT

Recommendation 17

Provide intensive cardiovascular risk management for any patient with diabetes and an ischaemic foot ulcer, including support for cessation of smoking, treatment of hypertension, control of glycaemia, and treatment with a statin drug as well as low-dose clopidogrel or aspirin. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation. The panel agreed with the judgements of the IWGDF and considered this recommendation to be acceptable and applicable in the Australian context (Table 1).

Summary justification

The panel concurred with the IWGDF on the strength (strong) of this recommendation and the low I quality of available evidence. The panel also agreed that this recommendation is applicable to the Australian context with the majority of Australian patients likely to be in favour of the intervention. The panel agreed that there were no policy or legislative constraints on implementation of this recommendation in Australia, and that there is adequate expertise and equipment in health care settings where the majority of patients typically access DFU care to support implementation of this recommendation.

Implementation considerations

The panel agreed with the IWGDF that all patients with PAD and DFU should be supported to stop smoking, maintain current guideline recommendations for glycaemic and blood pressure control and to take statin and antiplatelet therapy (61). The panel agreed with the IWGDF that there is no clear evidence in favour of one antiplatelet agent over another, although the panel also agreed that their use individually and in combination is likely to reduce major lower limb events and contribute to a reduction in 5 year mortality (63, 64).

Subgroup considerations

Geographically remote people

Relative geographical isolation may reduce access to available support and health education and promotion services required for successful risk factor modification. Referral to appropriate remote support through telehealth and online services should be a priority for patients in these areas.

Aboriginal and Torres Strait Islander Peoples

This recommendation is applicable to Aboriginal and Torres Strait Islander people. The panel noted the high prevalence of risk factors for PAD and cardiovascular disease including smoking and hypertension in this population. This highlights the need for establishment of appropriate care referral pathways and care provision to be co-ordinated through Aboriginal Health and Medical Services and for care provision to be supported by an Aboriginal Health Worker to optimise patient outcomes. Further considerations are consistent with those provided for this subgroup in recommendation 11.

For detailed implementation, monitoring and research considerations see eTable C17 in Supplementary Material.



DISCUSSION

This new Australian guideline for diagnosis and management of PAD in patients with DFU has been developed through a process of reviewing and adopting, adapting or excluding recent international guidelines to meet the needs of the Australian context. This new PAD guideline is one of six new guidelines that together make up the new 2021 Australian evidence-based guidelines for diabetes-related foot disease and replace the previous 2011 Australian guidelines released in 2011 (23).

This new guideline includes substantial new evidence relating to diagnosis, prognosis and management in the patient with PAD and DFU. This includes incorporation of new evidence demonstrating the clinical challenge of diagnosing PAD in diabetes cohorts, particularly in relation to the limited capacity of clinical examination (including pulse palpation) and various bedside testing methods to rule out the presence of disease with no single or combination of tests yet to be found to be superior (recommendations 1 to 4, 6 to 8). In addition, the new guideline incorporates the validated WIfI classification system to estimate risk of amputation and potential benefit of revascularisation based on the ulcer characteristics, severity of ischaemia measured via non-invasive bedside testing, and infection severity (recommendation 5). Furthermore, the new guideline provides recommendations regarding revascularisation techniques with limited available evidence and expert opinion favouring direct revascularisation over indirect techniques (recommendation 11).

Lastly, the new guideline additionally considers the recommendations in relation to specific subpopulations relevant to the Australian context including those in geographically remote circumstances, and for Aboriginal and Torres Strait Islander people.

While the process of revision and adaptation of existing international guidelines is cost efficient and allows for timely updates, it should also be acknowledged that the adaption process reduces the capacity firstly to assess new evidence released since publication of the original guideline, and secondly to systematically evaluate more recent available evidence relevant to the Australian context.

Recommendations and justification summary

Of the 17 recommendations from the IWGDF Guidelines on diagnosis, prognosis and management of PAD in patients with diabetes and foot ulcers, 16 were adopted for this Australian guideline and one recommendation was adapted. For each of the 16 adopted recommendations the panel agreed with both the strength of the recommendation and the quality of available evidence that was determined by the IWGDF.

Recommendation 13 of the IWGDF Guidelines on diagnosis, prognosis and management of PAD in patients with diabetes and DFU was the only recommendation considered necessary to adapt to the Australian context by the panel. The panel agreed there should be onsite access to appropriate clinical examination and bedside vascular assessment for PAD in any secondary or tertiary centre routinely treating patients with DFU. However, the recommendation in its original form required centres treating DFU to have onsite expertise in diagnosis and treatment of PAD including revascularisation. This was considered by the panel to be unfeasible in Australia. This is due to the geographical expanse of Australia and the smaller populations living in more regional and remote areas challenging the capacity for specialised services and facilities required for advanced diagnosis and surgical interventions for PAD to be available onsite. This recommendation was therefore adapted to include an alternative care model using established referral pathways to ensure rapid access to such facilities and expertise for centres treating DFU in regional and rural Australia.



Implementation considerations summary

General considerations for implementation related to the limited ability for clinical examination and bedside vascular assessments to rule out PAD in people with diabetes with and without DFU. This highlights the need to undertake further vascular investigation in any patient with DFU where there is evidence of delayed healing (non-healing within 4-6 weeks with optimal care). Further main considerations related to contraindications for specific forms of vascular imaging, for example due to contrast agent allergy or risk of nephrotoxicity, and determination of patient suitability for revascularisation. These factors include poor likelihood of achieving DFU healing or inevitable major amputation, significant risk posed by anaesthesia and the surgical procedure due to the presence of comorbidities including renal disease and infection, the presence of large areas of tissue loss preventing restoration of a functional foot, incapacity for subsequent mobilisation, as well as poor functional status and short life expectancy independent of the presenting DFD.

For geographically remote people, implementation considerations were predominantly in relation to care access. The panel considered it is likely that people in remote areas may experience delayed access to conservative care, particularly in relation to receiving ongoing conservative wound management. The need for early diagnosis of PAD in all patients with diabetes and DFU is paramount. Therefore the panel agreed that further investigation should be undertaken where there is delayed healing without signs of other factors known to impact the healing response such as infection even when there is less regular conservative wound care due to geographical isolation. Similarly, access to advanced diagnostic services (i.e. vascular imaging) and surgical revascularisation for geographically remote people is likely to be an ongoing challenge to ensuring best outcomes in this population. As discussed previously, rapid referral pathways are required to treatment centres offering revascularisation procedures. Care models inclusive of access to appropriate follow-up assessment and care need to be established in conjunction with involved health care providers. Additional options to support health practitioners in remote areas with appropriate expertise via telehealth and other forms of remote monitoring should also be considered. Future funding priorities should support strengthening of diabetes-related health care networks across rural and regional Australia to improve provision of, and access to, cohesive care models for PAD and DFU that incorporate appropriate diagnostic, surgical, and conservative management services.

Ensuring adequate access to relevant health services was also considered to be a priority for Aboriginal and Torres Strait Islander people in rural and remote areas where the same restrictions created by geographic isolation occur. In addition, access to culturally safe care is inconsistent across Australia. Distrust of Western health service delivery models has been documented in Aboriginal and Torres Strait Islander people. This is linked to historical and current issues of dispossession and socioeconomic inequality, concern over being removed from family and community for treatment, along with lack of improvement in Aboriginal and Torres Strait Islander health outcomes through a Western model of health care delivery (65). Recent research has demonstrated high uptake of preventative DFU care when delivered in a culturally safe manner through a co-designed footcare service developed with an Aboriginal and Torres Strait Islander community (66). This emphasises the need for establishment of appropriate care models and related referral pathways that incorporate community-linked Aboriginal Health and Medical Services and Aboriginal Health Workers.

Monitoring considerations summary

Monitoring and evaluation is an essential component of establishing best-practice clinical management of DFU. The panel encourages organisations to include in their formal monitoring systems options to be able to collect, monitor and analyse revascularisation and DFU healing outcomes in accordance with national based High Risk Foot Service database monitoring systems and datasets (54-56). In addition, within services, collection of existing monitoring data from their local hospital discharge datasets also using Australian Classification of Health Interventions codes for specific surgical interventions for PAD is encouraged.



Future research considerations summary

Fourteen of the 17 recommendations adopted and adapted as part of this revised guideline are supported by low quality of available evidence. The panel agreed with the IWGDF on a number of key priorities for further research. In brief, in relation to bedside testing, there is a need for high quality studies investigating the diagnostic accuracy of bedside testing techniques for diagnosing PAD in people with DFU. Further, the panel agreed with the IWGDF that well-designed prospective research, use of standardised datasets, and the development of international registries are required to more thoroughly assess the predictive capacity of individual and combinations of bedside testing techniques for ischaemic DFU healing outcomes and amputation risk. The panel also agreed with the IWGDF that there is a need for further investigation of novel methods of assessment of perfusion (both micro- and macrovascular) to inform decisions to revascularise. The most effective methods or combination of methods for obtaining imaging of tibial and pedal arteries is of particular importance due to the predilection for a more distally distributed disease pattern in diabetes cohorts, and the increasing use of the angiosome-directed approach to revascularisation where there is direct revascularisation to the feeding artery at the anatomical site of the DFU.

Regarding revascularisation, there is a strong need for high quality evidence to determine optimal time frames for intervention with revascularisation to achieve the best healing outcomes for ischaemic and neuro-ischaemic DFU. The panel agreed with the IWGDF on the need for high level evidence comparing outcomes for angiosome-directed revascularisation compared to indirect revascularisation using both open and endovascular techniques, via randomised controlled trials using pre-defined and standardised outcomes for wound healing and limb salvage (20). In addition, the proportion of patients with DFU and co-morbidities including cardiovascular and renal disease that require revascularisation is rising. As many of these patients are unsuitable for revascularisation or at higher risk of perioperative mortality, the panel agreed with the IWGDF that further research is also required to establish the effectiveness of venous arterialisation for DFU healing and reducing rates of amputation in patients unsuitable for standard revascularisation.

Finally, specific to the Australian context, the panel agreed there is an urgent need for further prospective research investigating DFU healing and limb salvage outcomes in rural and remote areas where accessibility of health care continues to negatively impact health outcomes. For Aboriginal and Torres Strait Islander communities, achieving better health outcomes for those with PAD and DFU requires a multifaceted approach to establish a more comprehensive understanding of the extent of PAD in those with DFU, and to undertake prospective evaluation of both models of care delivery, and intervention outcomes for this population.



CONCLUSION

This new Australian guideline, adapted from the IWGDF 2019 Guideline on the diagnosis, prognosis and management of PAD in patients with foot ulcers in diabetes, provides a current and comprehensive synthesis of the literature. Modified to suit the Australian context, and in consideration of specific patient subgroups including those in geographically remote areas and Aboriginal and Torres Strait Islander people, the 17 recommendations and the accompanying clinical pathways provide a guide to assist practitioners in secondary and tertiary settings with the implementation of best practice management for patients with diabetes, PAD and DFU. This guideline also highlights the limited available evidence informing strategies for the diagnosis and management of PAD in patients with DFU and the need for future high quality studies of effectiveness of diagnostic accuracy and vascular interventions to reduce amputation rates in non-Indigenous and Aboriginal and Torres Strait Islander people.

LIST OF ABBREVIATIONS

ABI	Ankle brachial index
CDUS	Colour duplex ultrasound
CTA	Computed tomography angiography
DFD	Diabetes-related foot disease
DFU	Diabetes-related foot ulcer
DSA	Digital subtraction angiography
EtD	Evidence to Decision
ESRD	End-stage renal disease
GRADE	Grading of Recommendations Assessment, Development and Evaluation
IWGDF	International Working Group on the Diabetic Foot
MRA	Magnetic resonance angiography
NHMRC	National Health and Medical Research Council
TcPO ₂	Transcutaneous oxygen pressure
TBI	Toe brachial index
WIFI	Wound, Ischaemia, and foot Infection



DECLARATIONS

Ethical approval

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Competing interests

The funding/supporting bodies below provided oversight and final approval for this guideline, however, did not have any input into the decisions on recommendations contained in these guidelines or in the writing of these guidelines. JChe is employed by Diabetes Victoria and is fully funded by the National Diabetes Services Scheme. RF was an author of the IWGDF Peripheral Artery Disease Guidelines and associated Systematic Review on which this manuscript is based. RF addressed this conflict by not screening or assessing recommendations for this guideline. All other authors declare that they have no relevant competing interests.

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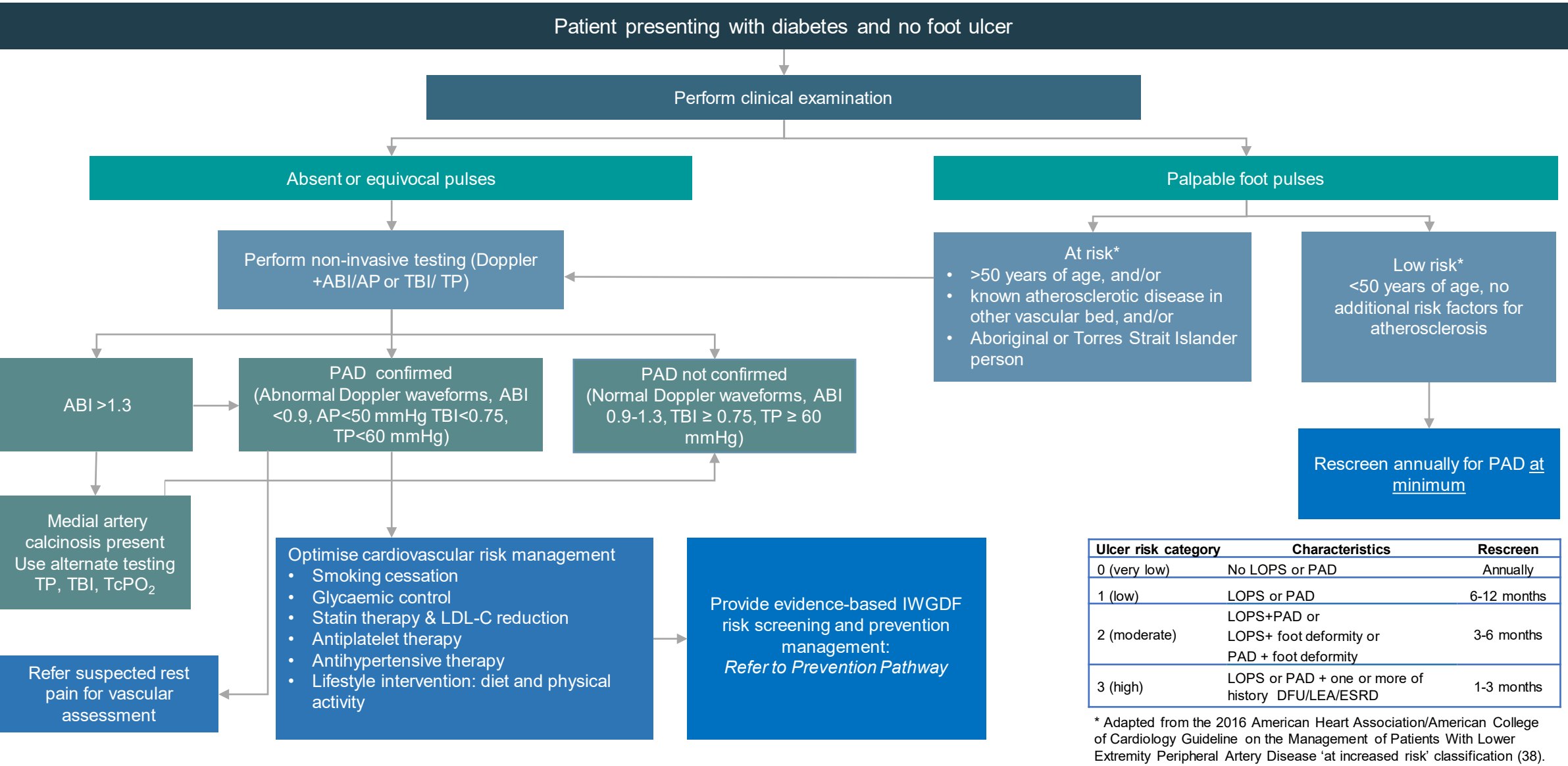
Authors' contributions

VC screened, assessed, and drafted all recommendations and rationale of recommendations, and drafted and critically reviewed the manuscript. FQ, JCR, and PT screened, assessed, and drafted all recommendations and rationale for the recommendations, and critically reviewed the manuscript. JCha provided Aboriginal and Torres Strait Islander and end-user intellectual input and content into the screening, assessment and drafting of all recommendations and rationale, and critically reviewed the manuscript. JChe provided lived experience and consumer intellectual input and content into the screening, assessment and drafting of all recommendations and rationale, and critically reviewed the manuscript. RF drafted all recommendations and rationale for the recommendations, and drafted and critically reviewed the manuscript. VC acted as the secretary and RF as the chair of the author/chapter group. VC and RF take full responsibility for the content of the manuscript and all authors approved the manuscript for submission.

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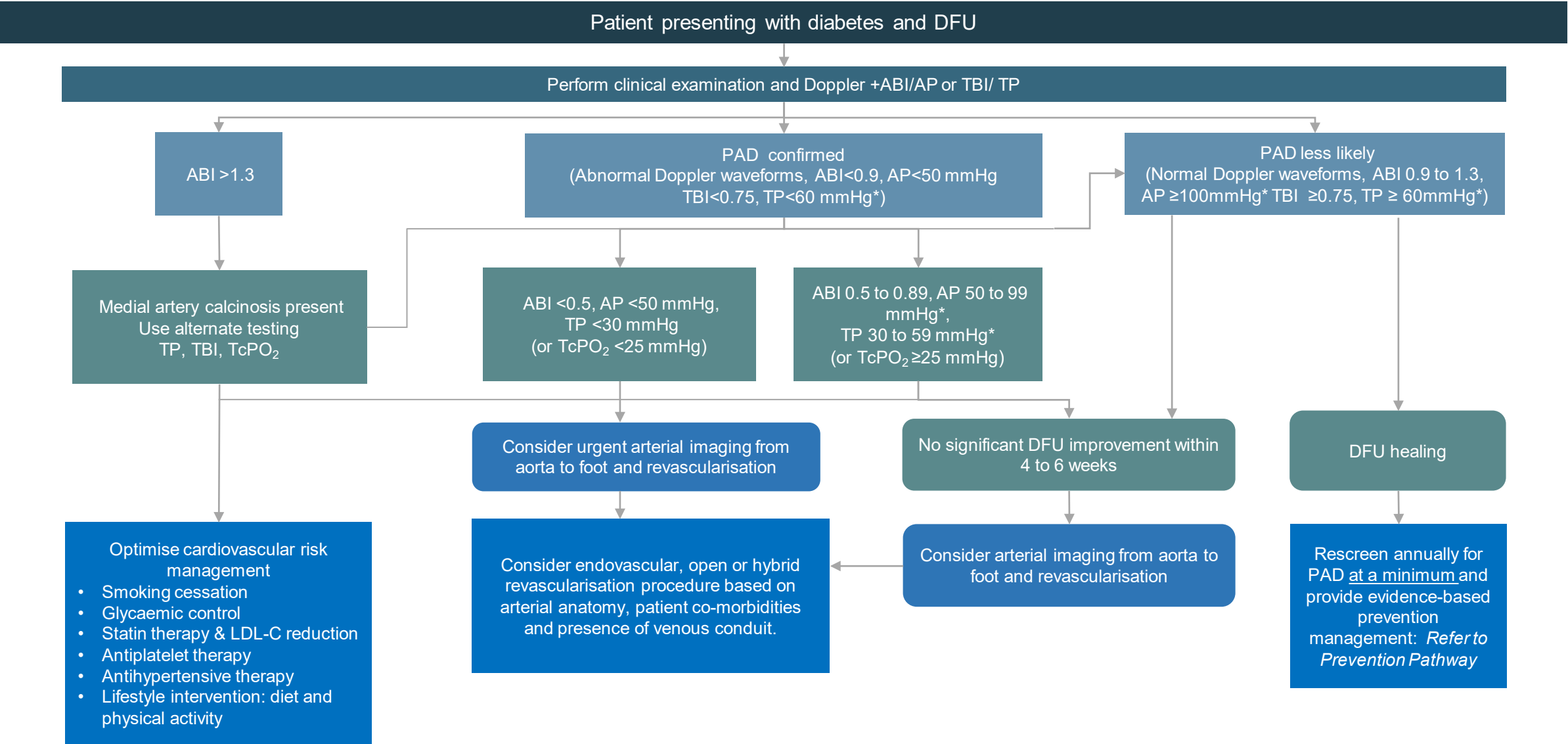
Figure 1. Australian evidence-based clinical pathway on diagnosis and management of peripheral artery disease for people with diabetes without a foot ulcer



ABBREVIATIONS: ABI Ankle-brachial index AP Ankle pressure DFU Diabetes-related foot ulcer ESRD End-stage renal disease IWGDF International Working Group for the Diabetic Foot LDL-C Low density lipoprotein cholesterol LEA Lower extremity amputation LOPS Loss of protective sensation PAD Peripheral artery disease TBI Toe-brachial index TcPO₂ Transcutaneous oxygen pressure TP Toe pressure

PAD treatments recommended

Figure 2. Australian evidence-based clinical pathway on diagnosis and management of peripheral artery disease for people with diabetes and a foot ulcer



ABBREVIATIONS ABI Ankle-brachial index, AP Ankle pressure, DFU Diabetes-related foot ulcer, LDL-C Low density lipoprotein cholesterol, PAD Peripheral artery disease, TBI Toe-brachial index, TcPO₂ Transcutaneous oxygen pressure TP Toe pressure

 PAD treatments recommended *Figures based on wound, ischaemia, and foot infection (WIFI) classification system (44)



TABLE 1

Summary of screening ratings for acceptability and applicability in the Australian context for all IWGDF PAD recommendations.

RECOMMENDATION	ACCEPTABILITY			APPLICABILITY				FULL ASSESSMENT	COMMENTS
	1	2	3	4	5	6	7		
1	+	+	+	+	+	+	+	No	
2	+	+	+	+	+	+	+	No	
3	+	+	+	+	+	+	+	No	
4	+	+	+	+	+	+	+	No	
5	+	+	+	+	+	+	+	No	
6	+	+	+	+	+	+	+	No	
7	+	+	+	+	+	+	+	No	
8	+	+	+	+	+	+	+	No	
9	+	+	+	+	+	+	+	No	
10	+	+	+	+	+	+	+	No	
11	+	+	+	+	+	+	+	No	
12	+	+	+	+	+	+	+	No	
13	+	+	+	+	?	?	+	Yes	Assess equipment availability & availability of expertise
14	+	+	+	+	+	+	+	No	
15	+	+	+	+	+	+	+	No	
16	+	+	+	+	+	+	+	No	
17	+	+	+	+	+	+	+	No	
TOTAL	17	17	17	17	16	16	17	1	
%	100	100	100	100	100	94	100	6	

Note: +, yes item is met; -, no item is not met; ? unsure if item is met



PERIPHERAL ARTERY DISEASE

TABLE 2: Summary of final panel judgements compared with IWGDF judgements for all IWGDF PAD recommendations.

NO	PROBLEM	DESIRABLE EFFECTS	UNDESIRABLE EFFECTS	QUALITY OF EVIDENCE	VALUES	BALANCE OF EFFECTS	ACCEPTABILITY	APPLICABILITY/ FEASIBILITY	DECISION	COMMENT
1	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
2	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
3	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
4	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
5	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
6	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
7	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
8	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
9	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
10	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
11	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
12	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
13	+	+	+	+	+	+	+	?	Adapt	Adapted assess equipment availability & availability of expertise
14	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
15	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
16	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening
17	+	+	+	+	+	+	+	+	Adopt	Adopted in ADAPTE screening

Note: +, panel agreed with original IWGDF judgement; -, panel disagreed with original IWGDF judgement; ?, panel unsure if agreed with original IWGDF judgement due to lack of IWGDF information on judgement; =, panel agreed with original IWGDF judgements during screening (see Table 1); QoE: Quality of evidence.



PERIPHERAL ARTERY DISEASE

TABLE 3: Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for Peripheral artery disease.

NO	ORIGINAL IWGDF RECOMMENDATION	DECISION	NEW AUSTRALIAN RECOMMENDATION
1	Examine the feet of all patients with diabetes annually for the presence of peripheral artery disease even in the absence of foot ulceration. At a minimum, this should include taking a relevant history and palpating foot pulses. (Strong; low)	Adopted	As stated in original the IWGDF Recommendation
2	Clinically examine (by relevant history and palpation of foot pulses) all patients with diabetes and foot ulceration for the presence of peripheral artery disease. Clinically examine (by relevant history and palpation of foot pulses) all patients with diabetes and foot ulceration for the presence of PAD. (Strong; low)	Adopted	As stated in original the IWGDF Recommendation
3	As clinical examination does not reliably exclude PAD in most persons with diabetes and a foot ulcer, evaluate pedal Doppler arterial waveforms in combination with ankle systolic pressure and systolic ankle brachial index (ABI) or toe systolic pressure and toe brachial index (TBI) measurement. No single modality has been shown to be optimal, and there is no definite threshold value above which PAD can reliably be excluded. However, PAD is a less likely diagnosis in the presence of ABI, 0.9-1.3; TBI, ≥ 0.75 ; and triphasic pedal Doppler waveforms. (Strong; low)	Adopted	As stated in original the IWGDF Recommendation
4	Perform at least one of the following bedside tests in a patient with a diabetes-related foot ulcer and PAD, any of which increases the pretest probability of healing by at least 25%: a skin perfusion pressure of ≥ 40 mmHg, a toe pressure of ≥ 30 mmHg, or a transcutaneous oxygen pressure (TcPO ₂) of ≥ 25 mmHg. (Strong; moderate)	Adopted	As stated in original the IWGDF Recommendation
5	Use the Wound, Ischaemia, and foot Infection (WIFI) classification system as a means to stratify amputation risk and revascularisation benefit in a patient with a diabetes-related foot ulcer and PAD. (Strong; moderate)	Adopted	As stated in original the IWGDF Recommendation
6	Always consider urgent vascular imaging, and revascularisation, in a patient with a diabetes-related foot ulcer and an ankle pressure of <50 mmHg, ABI of <0.5 , a toe pressure of <30 mmHg, or a TcPO ₂ of <25 mmHg. (Strong; low)	Adopted	As stated in original the IWGDF Recommendation
7	Always consider vascular imaging in patients with a diabetes-related foot ulcer, irrespective of the results of bedside tests, when the ulcer is not healing within 4 to 6 weeks despite good standard of care. (Strong; low)	Adopted	As stated in original the IWGDF Recommendation
8	Always consider revascularisation in a patient with a diabetes-related foot ulcer and PAD, irrespective of the results of bedside tests, when the ulcer is not healing within 4 to 6 weeks despite optimal management. (Strong; low)	Adopted	As stated in original the IWGDF Recommendation
9	Do not assume diabetes-related microangiopathy, when present, is the cause of poor healing in patients with a diabetes-related foot ulcer; therefore, always consider other possibilities for poor healing. (Strong; low)	Adopted	As stated in original the IWGDF Recommendation

Note: underlined wording indicates the specific adapted changes to the original IWGDF recommendation



PERIPHERAL ARTERY DISEASE

TABLE 3 (cont): Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for Peripheral artery disease.

NO	ORIGINAL IWGDF RECOMMENDATION	DECISION	NEW AUSTRALIAN RECOMMENDATION
10	Use any of the following modalities to obtain anatomical information when considering revascularizing a patient's lower extremity: colour duplex ultrasound, computed tomographic angiography, magnetic resonance angiography, or intra-arterial digital subtraction angiography. Evaluate the entire lower extremity arterial circulation with detailed visualization of below-the-knee and pedal arteries, in an anteroposterior and lateral plane. (Strong; low)	Adopted	As stated in original the IWGDF Recommendation
11	When performing revascularisation in a patient with a diabetes-related foot ulcer, aim to restore direct blood flow to at least one of the foot arteries, preferably the artery that supplies the anatomical region of the ulcer. After the procedure, evaluate its effectiveness with an objective measurement of perfusion. (Strong; low)	Adopted	As stated in original the IWGDF Recommendation
12	As evidence is inadequate to establish whether an endovascular, open, or hybrid revascularisation technique is superior, make decisions based on individual factors, such as morphological distribution of PAD, availability of autogenous vein, patient co-morbidities, and local expertise. (Strong; low)	Adopted	As stated in original the IWGDF Recommendation
13	Any centre treating patients with a diabetes-related foot ulcer should have expertise in, and rapid access to facilities necessary to diagnose and treat, PAD, including both endovascular techniques and bypass surgery. (Strong; low)	Adapted	Any centre treating patients with a diabetes-related foot ulcer should have expertise in, and/or rapid access to facilities necessary to diagnose and treat, PAD, including both endovascular techniques and bypass surgery. (Strong; low)
14	Ensure that after a revascularisation procedure in a patient with a diabetes-related foot ulcer, the patient is treated by a multidisciplinary team as part of a comprehensive care plan. (Strong; low)	Adopted	As stated in original the IWGDF Recommendation
15	Urgently assess and treat patients with signs or symptoms of PAD and a diabetes-related foot infection, as they are at particularly high risk for major limb amputation. (Strong; moderate)	Adopted	As stated in original the IWGDF Recommendation
16	Avoid revascularisation in patients in whom, from the patient's perspective, the risk-benefit ratio for the probability of success of the procedure is unfavourable. (Strong; low)	Adopted	As stated in original the IWGDF Recommendation
17	Provide intensive cardiovascular risk management for any patient with diabetes and an ischaemic foot ulcer, including support for cessation of smoking, treatment of hypertension, control of glycaemia, and treatment with a statin drug as well as low-dose clopidogrel or aspirin. (Strong; low)	Adopted	As stated in original the IWGDF Recommendation

Note: underlined wording indicates the specific adapted changes to the original IWGDF recommendation



REFERENCES

1. Saeedi P, Petersohn I, Salpea P, Malanda B, Karuranga S, Unwin N, et al. Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: Results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Research and Clinical Practice*. 2019;157.
2. Armstrong DG, Boulton AJM, Bus SA. Diabetic foot ulcers and their recurrence. *New England Journal of Medicine*. 2017;376(24):2367-75.
3. West M, Chuter V, Munteanu S, Hawke F. Defining the gap: a systematic review of the difference in rates of diabetes-related foot complications in Aboriginal and Torres Strait Islander Australians and non-Indigenous Australians. *Journal of Foot and Ankle Research*. 2017;10(1):48.
4. Norman PE, Schoen DE, Gurr JM, Kolybaba ML. High rates of amputation among Indigenous people in Western Australia. *Medical Journal of Australia*. 2010;192(7):421.
5. Lazzarini PA, Van Netten JJ, Fitridge R, Griffiths I, Kinnear EM, Malone M, et al. Pathway to ending avoidable diabetes-related amputations in Australia. *Medical Journal of Australia*. 2018;209(7):288-90.
6. Van Netten JJ, Lazzarini PA, Fitridge R, Kinnear EM, Griffiths I, Malone M, et al. Australian diabetes-related foot disease strategy 2018-2022: The first step towards ending avoidable amputations within a generation. Brisbane: Wound Management CRC; 2017.
7. National Indigenous Australians Agency. National Agreement on Closing the Gap. Canberra, Australia: National Indigenous Australians Agency; 2020.
8. Conte SM, Vale PR. Peripheral arterial disease. *Heart, Lung and Circulation*. 2018;27(4):427-32.
9. Beckman J, Creager M, Libby P. Diabetes and atherosclerosis: Epidemiology, pathophysiology, and management. *Journal of the American Medical Association*. 2002;287(19):2570-81.
10. Morbach S, Furchert H, Gröblichhoff U, Hoffmeier H, Kersten K, Klauke G-T, et al. Long-term prognosis of diabetic foot patients and their limbs: amputation and death over the course of a decade. *Diabetes Care*. 2012;35(10):2021-7.
11. Prompers L, Huijberts M, Apelqvist J, Jude E, Piaggese A, Bakker K, et al. High prevalence of ischaemia, infection and serious comorbidity in patients with diabetic foot disease in Europe. Baseline results from the Eurodiale study. *Diabetologia*. 2007;50(1):18-25.
12. De Vriese AS, Verbeuren TJ, Van de Voorde J, Lameire NH, Vanhoutte PM. Endothelial dysfunction in diabetes. *British Journal of Pharmacology*. 2000;130(5):963-74.
13. Leibson CL, Ransom JE, Olson W, Zimmerman BR, O'Fallon WM, Palumbo PJ. Peripheral arterial disease, diabetes, and mortality. *Diabetes Care*. 2004;27(12):2843-9.
14. Aerden D, Massaad D, von Kemp K, van Tussenbroek F, Debing E, Keymeulen B, et al. The ankle-brachial index and the diabetic foot: A troublesome marriage. *Annals of Vascular Surgery*. 2011;25(6):770-7.
15. Jude EB, Oyibo SO, Chalmers N, Boulton AJM. Peripheral arterial disease in diabetic and nondiabetic patients: A comparison of severity and outcome. *Diabetes Care*. 2001;24(8):1433-7.
16. Barshes NR, Flores E, Belkin M, Kougiass P, Armstrong DG, Mills JL, Sr. The accuracy and cost-effectiveness of strategies used to identify peripheral artery disease among patients with diabetic foot ulcers. *Journal of Vascular Surgery*. 2016;64(6):1682-90.e3.
17. Conte MS, Bradbury AW, Kolh P, White JV, Dick F, Fitridge R, et al. Global vascular guidelines on the management of chronic limb-threatening ischemia. *Journal of Vascular Surgery*. 2019;69(6s):3S-125S.e40.
18. Flores EJ, Mull NK, Lavenberg JG, Mitchell MD, Leas BF, Williams A, et al. Using a 10-step framework to support the implementation of an evidence-based clinical pathways programme. *BMJ Quality and Safety*. 2019;28(6):476-85.
19. Forsythe RO, Apelqvist J, Boyko EJ, Fitridge R, Hong JP, Katsanos K, et al. Effectiveness of bedside investigations to diagnose peripheral artery disease among people with diabetes mellitus: A systematic review. *Diabetes/Metabolism Research and Reviews*. 2020;36 Suppl 1:e3277.
20. O'Rourke S, Steffen C, Rauli A, Tulip F. Diabetic major amputation in Far North Queensland 1998–2008: What is the Gap for Indigenous patients? *Australian Journal of Rural Health*. 2013;21(5):268-73.
21. Forsythe RO, Apelqvist J, Boyko EJ, Fitridge R, Hong JP, Katsanos K, et al. Effectiveness of revascularisation of the ulcerated foot in patients with diabetes and peripheral artery disease: A systematic review. *Diabetes/Metabolism Research and Reviews*. 2020;36 Suppl 1:e3279.
22. Hinchliffe RJ, Forsythe RO, Apelqvist J, Boyko EJ, Fitridge R, Hong JP, et al. Guidelines on diagnosis, prognosis, and management of peripheral artery disease in patients with foot ulcers and diabetes (IWGDF 2019 update). *Diabetes/Metabolism Research and Reviews*. 2020;36 Suppl 1:e3276.
23. Baker IDI Heart and Diabetes Institute. National evidence-based guideline on prevention, identification and management of foot complications in diabetes (Part of the National Health & Medical Research Council Approved Guidelines on Management of Type 2 Diabetes). Melbourne: Baker IDI Heart & Diabetes Institute; 2011.
24. International Diabetes Federation. Clinical Practice Recommendation on the Diabetic Foot: A guide for health care professionals. Brussels, Belgium: International Diabetes Federation; 2017.



REFERENCES

25. Schaper NC, Van Netten JJ, Apelqvist J, Bus SA, Hinchliffe RJ, Lipsky BA, et al. Practical guidelines on the prevention and management of diabetic foot disease (IWGDF 2019 update). *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3266
26. National Health & Medical Research Council (NHMRC). Guidelines for Guidelines: Project planning - Version 5.0; Last updated 5 September 2019. In: NHMRC, editor. Canberra, Australia 2019.
27. Lazzarini PA, Raspovic A, Prentice J, Commons RJ, Fitridge RA, Charles J, Cheney J, Purcell N, Twigg SM. Guidelines development protocol and findings: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease; version 1.0. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021
28. National Health & Medical Research Council (NHMRC). Guidelines for Guidelines: Adopt, adapt or start from scratch - Version 5.2; Last updated 22 November 2018. In: NHMRC, editor. Canberra, Australia 2018 <https://www.nhmrc.gov.au/guidelinesforguidelines/plan/adopt-adapt-or-start-scratch>.
29. Schünemann HJ, Wiercioch W, Brozek J, Etzeandía-Ikobaltzeta I, Mustafa RA, Manja V, et al. GRADE Evidence to Decision (EtD) frameworks for adoption, adaptation, and de novo development of trustworthy recommendations: GRADE-ADOLOPMENT. *Journal of clinical epidemiology*. 2017;81:101-10.
30. The ADAPTE Collaboration. The ADAPTE Process: Resource Toolkit for Guideline Adaptation - Version 2.0. Perthshire, Scotland: Guideline International Network; 2009 <https://g-i-n.net/library/tools>.
31. Forsythe RO, Apelqvist J, Boyko EJ, Fitridge R, Hong JP, Katsanos K, et al. Performance of prognostic markers in the prediction of wound healing or amputation among patients with foot ulcers in diabetes: A systematic review. *Diabetes/Metabolism Research and Reviews*. 2020;36 Suppl 1:e3278.
32. Alonso-Coello P, Oxman AD, Moher J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 2: Clinical practice guidelines. *British Medical Journal* 2016;353:i2089.
33. Alonso-Coello P, Schünemann HJ, Moher J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 1: Introduction. *British Medical Journal* 2016;353:i2016.
34. Andrews J, Guyatt G, Oxman AD, Alderson P, Dahm P, Falck-Ytter Y, et al. GRADE guidelines: 14. Going from evidence to recommendations: the significance and presentation of recommendations. *Journal of Clinical Epidemiology*. 2013;66(7):719-25.
35. Andrews JC, Schünemann HJ, Oxman AD, Pottie K, Meerpohl JJ, Coello PA, et al. GRADE guidelines: 15. Going from evidence to recommendation-determinants of a recommendation's direction and strength. *Journal of Clinical Epidemiology*. 2013;66(7):726-35.
36. Khan NA, Rahim SA, Anand SS, Simel DL, Panju A. Does the clinical examination predict lower extremity peripheral arterial disease? *Journal of the American Medical Association*. 2006;295(5):536-46.
37. Gerhard-Herman MD, Gornik HL, Barrett C, Barshes NR, Corriere MA, Drachman DE, et al. 2016 AHA/ACC guideline on the management of patients with lower extremity peripheral artery disease: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Journal of the American College of Cardiology*. 2017;69(11):e71-e126.
38. Hart T, Milner R, Cifu A. Management of a diabetic foot. *Journal of the American Medical Association*. 2017;318(14):1387-8.
39. Hingorani A, LaMuraglia GM, Henke P, Meissner MH, Loretz L, Zinszer KM, et al. The management of diabetic foot: a clinical practice guideline by the Society for Vascular Surgery in collaboration with the American Podiatric Medical Association and the Society for Vascular Medicine. *Journal of vascular surgery*. 2016;63(2):3S-21S.
40. Dolan NC, Liu K, Criqui MH, Greenland P, Guralnik JM, Chan C, et al. Peripheral artery disease, diabetes, and reduced lower extremity functioning. *Diabetes Care*. 2002;25(1):113-20.
41. Jude E, Eleftheriadou I, Tentolouris N. Peripheral arterial disease in diabetes—a review. *Diabetic Medicine*. 2010;27(1):4-14.
42. Rayman G, Hassan A, Tooke JE. Blood flow in the skin of the foot related to posture in diabetes mellitus. *British Medical Journal (Clinical Research Edition)*. 1986;292(6513):87-90.
43. Ince P, Game FL, Jeffcoate WJ. Rate of healing of neuropathic ulcers of the foot in diabetes and its relationship to ulcer duration and ulcer area. *Diabetes Care*. 2007;30(3):660-3.
44. Mills Sr JL, Conte MS, Armstrong DG, Pomposelli FB, Schanzer A, Sidawy AN, et al. The society for vascular surgery lower extremity threatened limb classification system: risk stratification based on wound, ischemia, and foot infection (WIFI). *Journal of Vascular Surgery*. 2014;59(1):220-34. e2.
45. Hicks CW, Canner JK, Mathioudakis N, Sherman R, Malas MB, Black III JH, et al. The Society for Vascular Surgery Wound, Ischemia, and foot Infection (WIFI) classification independently predicts wound healing in diabetic foot ulcers. *Journal of Vascular Surgery*. 2018;68(4):1096-103.



REFERENCES

46. Monteiro-Soares M, Russell D, Boyko EJ, Jeffcoate W, Mills JL, Morbach S, et al. Guidelines on the classification of diabetic foot ulcers (IWGDF 2019). *Diabetes/Metabolism Research and Reviews*. 2020;36:e3273.
47. Noronen K, Saarinen E, Albäck A, Venermo M. Analysis of the elective treatment process for critical limb ischaemia with tissue loss: diabetic patients require rapid revascularisation. *European Journal of Vascular and Endovascular Surgery*. 2017;53(2):206-13.
48. Fiordaliso F, Clerici G, Maggioni S, Caminiti M, Bisighini C, Novelli D, et al. Prospective study on microangiopathy in type 2 diabetic foot ulcer. *Diabetologia*. 2016;59(7):1542-8.
49. Vinik AI, Erbas T, Park TS, Pierce KK, Stansberry KB. Methods for evaluation of peripheral neurovascular dysfunction. *Diabetes Technology & Therapeutics*. 2001;3(1):29-50.
50. Elgzyri T, Larsson J, Thörne J, Eriksson K-F, Apelqvist J. Outcome of ischemic foot ulcer in diabetic patients who had no invasive vascular intervention. *European Journal of Vascular and Endovascular Surgery*. 2013;46(1):110-7.
51. Lepäntalo M, Mätzke S. Outcome of unreconstructed chronic critical leg ischaemia. *European Journal of Vascular and Endovascular Surgery*. 1996;11(2):153-7.
52. Elgzyri T, Larsson J, Nyberg P, Thörne J, Eriksson K-F, Apelqvist J. Early revascularization after admittance to a diabetic foot center affects the healing probability of ischemic foot ulcer in patients with diabetes. *European Journal of Vascular and Endovascular Surgery*. 2014;48(4):440-6.
53. Butt T, Lilja E, Elgzyri T, Apelqvist J, Gottsäter A, Engström G, et al. Amputation-free survival in patients with diabetic foot ulcer and peripheral arterial disease: Endovascular versus open surgery in a propensity score adjusted analysis. *Journal of Diabetes and its Complications*. 2020;34(5):107551.
54. Lazzarini PA, Ng V, Kinnear EM, Kamp MC, Kuys SS, Hurst C, et al. The Queensland high risk foot form (QHRFF) - is it a reliable and valid clinical research tool for foot disease? *Journal of Foot And Ankle Research*. 2014;7(1):7-.
55. Lazzarini PA, Van Netten JJ, Fitridge R, Kinnear E, Malone M, Perrin BM, Prentice J, Wraight PR. *Australian Diabetic Foot Ulcer Minimum Dataset Dictionary*. Brisbane: Diabetic Foot Australia, Wound Management Innovation CRC; 2016.
56. National Association of Diabetes Centres (NADC) and Australian Diabetes Society (ADS). *NADC Collaborative Interdisciplinary Diabetes High Risk Foot Services Standards Version 1.1* Sydney, Australia: National Association of Diabetes Centres; 2018 [Available from: <https://nadc.net.au/national-standards/>].
57. Phillips A. Health status differentials across rural and remote Australia. *Australian Journal of Rural Health*. 2009;17(1):2-9.
58. Steffen C, O'Rourke S. Surgical management of diabetic foot complications: the Far North Queensland profile. *Australian and New Zealand Journal of Surgery*. 1998;68(4):258-60.
59. Ewald D, Patel M, Hall G. Hospital separations indicate increasing need for prevention of diabetic foot complications in central Australia. *Australian Journal of Rural Health*. 2001;9(6):275-9.
60. O'Rourke S, Steffen C, Rauli A, Tulip F. Diabetic major amputation in Far North Queensland 1998-2008: what is the Gap for Indigenous patients? *Australian Journal of Rural Health*. 2013;21(5):268-73.
61. Young MJ, McCardle JE, Randall LE, Barclay JI. Improved survival of diabetic foot ulcer patients 1995–2008: possible impact of aggressive cardiovascular risk management. *Diabetes Care*. 2008;31(11):2143-7.
62. Commons RJ, Robinson CH, Gawler D, Davis JS, Price RN. High burden of diabetic foot infections in the top end of Australia: an emerging health crisis (DEFINE study). *Diabetes Research and Clinical Practice*. 2015;110(2):147-57.
63. Anand SS, Bosch J, Eikelboom JW, Connolly SJ, Diaz R, Widimsky P, et al. Rivaroxaban with or without aspirin in patients with stable peripheral or carotid artery disease: an international, randomised, double-blind, placebo-controlled trial. *The Lancet*. 2018;391(10117):219-29.
64. Bonaca MP, Bauersachs RM, Anand SS, Debus ES, Nehler MR, Patel MR, et al. Rivaroxaban in peripheral artery disease after revascularization. *New England Journal of Medicine*. 2020;382(21):1994-2004.
65. Senior K, Chenhall R. Health beliefs and behavior: the practicalities of "looking after yourself" in an Australian aboriginal community. *Medical Anthropology Quarterly*. 2013;27(2):155-74.
66. West M, Sadler S, Hawke F, Munteanu SE, Chuter V. Foot health of Aboriginal and Torres Strait Islander Peoples in regional and rural NSW, Australia. *Journal of Foot and Ankle Research*. 2020;13(1):27.



INFECTION

Australian guideline on management of
diabetes-related foot infection

Part of the 2021 Australian
evidence-based guidelines for
diabetes-related foot disease

VERSION 1.0 051021



AUTHORS

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Disclaimer

These Australian Evidence-based Guidelines are a general guide to appropriate practice, to be followed subject to the clinician's judgment and the patient's preference in each individual case. The Guidelines are designed to provide information to assist decision-making and are based on the best evidence available at the time of development.

Diabetes Feet Australia would like to thank and acknowledge Mikaela Cameron who has created the artwork to represent the guidelines. Mikaela Cameron (M. J. Badagarang) is a proud Dharug saltwater woman from the Hawkesbury River in New South Wales, Australia. She's worked the past 4 years as a cultural educator delivering cultural workshops and creating murals. "Worimi, I am a proud Dharug woman. My totem is the Badagarang (Eastern Grey Kangaroo), and Waroo (the brown-eyes crow). I pay my respects to all Elders past, present and emerging, and extend this acknowledgment to you and your people. Welcome, let's walk together."

ABSTRACT

Background

Diabetes-related foot infections cause substantial morbidity and mortality, both globally and in Australia. There is a need for up-to-date evidence-based guidelines to ensure optimal management of patients with diabetes-related foot infections. We aimed to identify and adapt high quality international guidelines to the Australian context to become the new Australian evidence-based guideline for people with a diabetes-related foot infection.

Methods

Following Australian National Health and Medical Research Council (NHMRC) procedures we identified the 2019 International Working Group on the Diabetic Foot (IWGDF) guidelines as suitable for adaptation to the Australian context. Guidelines were screened, assessed and judged by an expert panel for the Australian context using the guideline adaptation frameworks ADAPTE and Grading of Recommendations Assessment, Development and Evaluation (GRADE). Judgements led to recommendations being adopted, adapted or excluded, with additional consideration regarding their implementation, monitoring and future research for the Australian context. Clinical pathways were then developed to assist implementation.

Results

Of 36 original diabetes-related foot infection IWGDF sub-recommendations, 31 were adopted, four were adapted and one was excluded. Adaption was primarily undertaken due to differences or clarification of the sub-recommendations' intended population. One sub-recommendation was excluded due to substantial differences in judgements between the panel and IWGDF and unacceptable heterogeneity of the target population. Therefore, we developed 35 evidence-based sub-recommendations for the Australian context that should guide best practice diagnosis and management of people with diabetes-related foot infection in Australia. Additionally, we incorporated these sub-recommendations into two clinical pathways to assist Australian health professionals to implement these evidence-based sub-recommendations into clinical practice.

Conclusions

A new national guideline for the diagnosis and management of people with diabetes-related foot infections were successfully developed for the Australian context. In combination with simplified clinical pathway tools they provide an evidence-based framework to ensure best management of individuals with diabetes-related foot infections across Australia and highlight considerations for implementation and monitoring.

Keywords

diabetes-related foot disease, diabetes-related foot infection, guidelines; antibiotic, surgery



INFECTION

AUSTRALIAN RECOMMENDATIONS LIST

PREVENTION

WOUND CLASSIFICATION

PERIPHERAL ARTERY
DISEASE

INFECTION

OFFLOADING

WOUND HEALING
INTERVENTIONS

- 1A** Diagnose a soft tissue diabetes-related foot infection clinically, based on the presence of local or systemic signs and symptoms of inflammation. (GRADE strength of recommendation: Strong; Quality of evidence: low)
- 1B** Assess the severity of any diabetes-related foot infection using the International Working Group on the Diabetic Foot / Infectious Diseases Society of America classification scheme. (Strong; moderate)
- 2** Consider hospitalising all persons with diabetes and a severe (grade 4) foot infection and those with a moderate (grade 3) infection that is complex or associated with key relevant morbidities. (Strong; low)
- 3** In a person with diabetes and a possible foot infection for whom the clinical examination is equivocal or uninterpretable, consider ordering an inflammatory serum biomarker, such as C-reactive protein, erythrocyte sedimentation rate, and perhaps procalcitonin, as an adjunctive measure for establishing the diagnosis. (Weak; low)
- 4** As neither electronically measuring foot temperature nor using quantitative microbial analysis has been demonstrated to be useful as a method for diagnosing diabetes-related foot infection, we suggest not using them. (Weak; low)
- 5** In a person with diabetes and suspected osteomyelitis of the foot, we recommend using a combination of the probe-to-bone test, the erythrocyte sedimentation rate (or C-reactive protein and/or procalcitonin), and plain X-rays as the initial studies to diagnose osteomyelitis. (Strong; moderate)
- 6A** In a person with diabetes and suspected osteomyelitis of the foot, if a plain X-ray and clinical and laboratory findings are most compatible with osteomyelitis, we recommend no further imaging of the foot to establish the diagnosis. (Strong; low)
- 6B** If the diagnosis of osteomyelitis remains in doubt, consider ordering an advanced imaging study, such as magnetic resonance imaging scan, 18F-FDG-positron emission tomography (PET)/computed tomography (CT) or leukocyte scintigraphy (with or without CT). (Strong; moderate)
- 7** In a person with diabetes and suspected osteomyelitis of the foot, in whom making a definitive diagnosis or determining the causative pathogen is necessary for selecting treatment, collect a sample of bone (percutaneously or surgically) to culture clinically relevant bone microorganisms and for histopathology (if possible). (Strong; low)
- 8A** Collect an appropriate specimen for culture for almost all clinically infected wounds to determine the causative pathogens. (Strong; low)
- 8B** For a soft tissue diabetes-related foot infection, obtain a sample for culture by aseptically collecting a tissue specimen (by curettage or biopsy) from the ulcer. (Strong; moderate)
- 9** Do not use molecular microbiology techniques (instead of conventional culture) for the first-line identification of pathogens from samples in a patient with a diabetes-related foot infection. (Strong; low)
- 10** Treat a person with a diabetes-related foot infection with an antibiotic agent that has been shown to be effective in a published randomised controlled trial and is appropriate for the individual patient. Some agents to consider include penicillins, cephalosporins, carbapenems, metronidazole (in combination with other antibiotic[s]), clindamycin, linezolid, daptomycin, fluoroquinolones, or vancomycin, but not tigecycline. (Strong; high)



- 11** Select an antibiotic agent for treating a diabetes-related foot infection based on: the likely or proven causative pathogen(s) and their antibiotic susceptibilities; the clinical severity of the infection; published evidence of efficacy of the agent for diabetes-related foot infections; risk of adverse events, including collateral damage to the commensal flora; likelihood of drug interactions; agent availability; and, financial costs. (Strong; moderate)
- 12** Administer antibiotic therapy initially by the parenteral route to any patient with a severe (grade 4) skin and soft tissue diabetes-related foot infection. Switch to oral therapy if the patient is clinically improving and has no contraindications to oral therapy and if there is an appropriate oral agent available. (Strong; very low)
- 13** Treat patients with a mild (grade 2) diabetes-related foot infection, and most with a moderate (grade 3) diabetes-related foot infection, with oral antibiotic therapy, either at presentation or when clearly improving with initial intravenous therapy. (Weak; low)
- 14** We suggest not using any currently available topical antimicrobial agent for treating a mild (grade 2) diabetes-related foot infection. (Weak; moderate)
- 15A** Administer antibiotic therapy to a patient with a skin or soft tissue diabetes-related foot infection for a duration of 1 to 2 weeks. (Strong; high)
- 15B** Consider continuing treatment, perhaps for up to 3 to 4 weeks, if the infection is improving but is extensive and is resolving slower than expected or if the patient has severe peripheral artery disease. (Weak; low)
- 15C** If evidence of infection has not resolved after 4 weeks of apparently appropriate therapy, re-evaluate the patient, and reconsider the need for further diagnostic studies or alternative treatments. (Strong; low)
- 16** For patients who have not recently received antibiotic therapy and have an acute infection, consider targeting empiric antibiotic therapy at just aerobic Gram positive pathogens (beta-haemolytic streptococci and *Staphylococcus aureus*) in cases of a mild (grade 2) diabetes-related foot infection. (Weak; low)
- 17** For patients who have been treated with antibiotic therapy within a few weeks, have a chronic infection, have a severely ischaemic affected limb, or a moderate (grade 3) or severe (grade 4) infection, we suggest selecting an empiric antibiotic regimen that covers Gram positive pathogens, commonly isolated Gram negative pathogens, and possibly obligate anaerobes in cases of moderate (grade 3) to severe (grade 4) diabetes-related foot infections. Then, reconsider the antibiotic regimen based on both the clinical response and culture and sensitivity results. (Weak; low)
- 18** Empiric treatment aimed at *Pseudomonas aeruginosa* is not usually necessary but consider it if *P. aeruginosa* has been isolated from cultures of the affected site within the previous few weeks, or in tropical/subtropical climates (at least for moderate (grade 3) or severe (grade 4) infection). (Weak; low)
- 19** Do not treat clinically uninfected foot ulcers with systemic or local antibiotic therapy with the goal of reducing the risk of infection or promoting ulcer healing. (Strong; low)
- 20** Non-surgeons should urgently consult with a surgical specialist in cases of severe (grade 4) infection or of moderate (grade 3) infection complicated by extensive gangrene, necrotising infection, signs suggesting deep (below the fascia) abscess or compartment syndrome, or severe lower limb ischaemia. (Strong; low)



- 21A** In a patient with diabetes and uncomplicated forefoot osteomyelitis, for whom there is no other indication for surgical treatment, consider treating with antibiotic therapy without surgical resection of bone. (Strong; moderate)
- 21B** In a patient with probable diabetes-related foot osteomyelitis with concomitant soft tissue infection, urgently evaluate for the need for surgery as well as intensive post-operative medical and surgical follow-up. (Strong; moderate)
- 22** Select antibiotic agents for treating diabetes-related foot osteomyelitis from among those that have demonstrated efficacy for osteomyelitis in clinical studies. (Strong; low)w)
- 23** Treat diabetes-related foot osteomyelitis with antibiotic therapy for just a few days if there is no soft tissue infection and all the infected bone has been surgically removed. (Weak; low)
- 24** For people with diabetes-related foot osteomyelitis that initially require parenteral therapy, consider switching to an oral antibiotic regimen that has high bioavailability after perhaps 5 to 7 days, if the likely or proven pathogens are susceptible to an available oral agent and the patient has no clinical condition precluding oral therapy. (Weak; moderate)
- 25A** During surgery to resect bone for diabetes-related foot osteomyelitis, consider obtaining a specimen of bone for culture (and, if possible, histopathology) at the stump of the resected bone to identify if there is residual bone infection. (Weak; moderate)
- 25B** If an aseptically collected culture specimen obtained during the surgery grows pathogen(s), or if the histology demonstrates osteomyelitis, administer appropriate antibiotic therapy for up to 6 weeks. (Strong; moderate)
- 26** For a diabetes-related foot infection, do not use hyperbaric oxygen therapy or topical oxygen therapy as an adjunctive treatment if the only indication is specifically for treating the infection. (Weak; low)
- To *specifically* address infection in a diabetes-related foot ulcer:
- 27A** do not use adjunctive granulocyte colony stimulating factor treatment (Weak; moderate), and
- 27B** do not *routinely* use topical antiseptics, silver preparations, honey, bacteriophage therapy, or negative pressure wound therapy (with or without instillation). (Weak; low)



BACKGROUND

As the prevalence of diabetes mellitus continues to rise worldwide, there has been an increase in associated diabetes-related foot disease, including diabetes-related foot infections. Diabetes-related foot infections cause substantial morbidity and mortality, with an increasingly large economic impact, both directly through patient management and indirectly through patient disability (1). Diabetes-related foot ulcers currently affect around 50,000 Australians (2), and up to 40% of these individuals can expect to have an associated infection in the first year after presentation (3).

Diabetes-related foot ulcers and infection are substantial risk factors for amputation, with 85% of all amputations in Australia associated with diabetes-related foot ulcers (4). In Darwin, Australia, major amputations occurred in almost 10% of individuals with diabetes-related foot infections (5) presenting to hospital over 14 months and death in 9% over 1-year (6), with the median hospital stay lasting 29 days (5). Risk of complications is further increased in Aboriginal and Torres Strait Islander Peoples (5, 7, 8) and addressing these risks is needed to successfully achieve key outcomes identified in the 2020 Closing the Gap in Partnership agreement (9).

A diabetes-related foot infection is defined as the presence of an infection in any tissue distal to the malleolus in an individual with diabetes mellitus. The majority of infections are associated with a breach of the epithelium (i.e. an ulcer). However, the presence of micro-organisms alone does not define the presence of an infection as a wound may be colonised by microorganisms. Thus, diagnosis generally requires the clinical recognition of inflammation (10). Given the severe complications that can arise from diabetes-related foot infections, all infections, even those that are mild, should be considered serious.

Evidence-based guidelines are vital to ensure optimal multi-disciplinary management and outcomes of patients with diabetes-related foot infections. An Australian national evidence-based diabetes-related foot diseases guideline has not been published since 2011 (11) and is now out-of-date, having been rescinded by the National Health and Medical Research Council (NHMRC) (12). New guidelines have been estimated to cost \$AU1 million to develop (13), however, adopting or adapting suitable international guidelines can be an alternative efficient method of guideline development that is cost-effective. The current guideline aimed to identify and adapt high quality international guidelines to the Australian context to become the new Australian multi-disciplinary evidence-based guideline for people with a diabetes-related foot infection. This was undertaken in parallel with development of other Australian guidelines for people with other diabetes-related foot disease.

METHODS

The development of this guideline is described in detail in the accompanying guidelines development paper (14). Guideline development followed Australian NHMRC recommendations for adapting international source guidelines (15, 16) combined with the ADAPTE process and GRADE Evidence to Decision (EtD) frameworks (17). After defining the scope of the guidelines, international source guidelines were assessed with only the 2019 International Working Group of the Diabetic Foot (IWGDF) guidelines (10, 18-23) identified as suitable for adaptation. Recommendations relating to infection were identified (10). Five further steps were then undertaken prior to the guideline presented here being finalised: i) assessing and deciding which source guideline recommendations to adopt, adapt or exclude in the new context; ii) drafting new recommendations and adding considerations for the Australian context; iii) collating recommendations and considerations into a new guideline; iv) developing clinical pathways to assist guideline implementation; and v) undertaking consultation and endorsement of the finalised guideline.

A six-member panel was convened to assess the 2019 IWGDF guidelines, including national experts in diabetes-related foot infection management and research together with consumer and Aboriginal and Torres Strait Islander experts. Each source sub-recommendation (and supporting IWGDF rationale and systematic review) was screened independently by two members of the panel for acceptability and applicability to the Australian context using a seven-item modified ADAPTE evaluation form (14, 16). Disagreements were resolved through discussion, or by involving a third panel member if required. The entire panel then reviewed each sub-recommendation's ratings to ensure consensus.



METHODS

If the sub-recommendation was considered acceptable and applicable across all seven items, the sub-recommendation was adopted. If there were items where the panel was unsure or which were considered not acceptable or applicable the sub-recommendation underwent full assessment using a modified GRADE EtD framework consisting of eight criteria (14, 17, 24, 25). One panel member populated the EtD template with all relevant evidence from the IWGDF guidelines and systematic reviews, and from relevant Australian literature or panel discussions during the ADAPTE process. Following review of the populated evidence by a second member, one member then rated the judgement items for each of the eight criteria. A second member then reviewed the judgements, with disagreements resolved through discussion, or a third panel member if required. The full panel then met and reviewed each of the summary judgements for the eight criteria to gain consensus and compared them to judgements made by the IWGDF.

The panel made a consensus decision to adopt, adapt or exclude the recommendation based on the degree of agreement between the panel and IWGDF judgements. Recommendations were adopted if no substantial disagreement existed between the panel and IWGDF judgement, were adapted if substantial disagreement existed or the population or intervention needed to be defined further, or were excluded if substantial disagreement existed and/or the panel considered the recommendation was not acceptable or applicable to the Australian setting. Consensus agreement was obtained through discussion, with review by the Guideline working group if needed.

The quality of evidence and strength of recommendation ratings and overall wording of recommendations that were adapted were reviewed by the panel based on the summary judgements of the GRADE EtD framework. The quality of evidence was rated according to GRADE methodology as high, moderate, low, or very low (24, 25). The strength of recommendation was rated similarly according to GRADE methodology by weighing up the balance of effects in the Australian national context as strong or weak (24, 25).

All recommendations were collated into a draft manuscript including for each sub-recommendation a detailed rationale for the decision, summary justification for the judgements, detailed justification if the recommendation was fully assessed, and where applicable considerations for implementation, special subgroups (including for geographically remote, Aboriginal and Torres Strait Islander and other populations), monitoring and potential future research priorities in the Australian context. Finalised recommendations were then developed into infection diagnosis and management clinical pathways (14), to assist the implementation of these recommendations by health professionals in secondary and tertiary health care settings caring for Australians with diabetes-related foot infections. Pathways were developed using a 10-step process as described by Flores et al (14, 26).

A six-week public consultation period was undertaken from March 2021 using a customised consultation survey from ADAPTE (14, 16). The manuscript was revised following collation and review of the survey feedback. Endorsement was then sought from the Guidelines Development working group, and the Australasian Society of Infectious Diseases prior to release of the final guideline (14) in conjunction with five other individual sub-field guidelines (27-31).



RESULTS

All 27 recommendations, including 36 separate sub-recommendations, were systematically evaluated. After screening, 29 sub-recommendations were adopted and seven required full assessment (Table 1). Of the seven sub-recommendations assessed, two were adopted without change, four were adapted, and one was excluded (Table 2). Of the four that were adapted, one had the strength of recommendation changed, one had the quality of evidence changed and four had the population adjusted or clarified.

The sub-recommendation that was excluded was considered to have too heterogeneous a population and be covered by alternative recommendations. Wording differences between IWGDF and Australian guidelines are summarised in Table 3.

Four responses were received to the public consultation survey with three responding that they agreed that the guideline should be approved as the new Australian Infection guideline, that the guideline would be supported by the majority of their colleagues and all agreed if approved they would encourage its use in practice. All de-identified feedback comments received during public consultation and the panel's responses to each comment were collated and posted on the Diabetes Feet Australia website.

Based on the collated public consultation feedback, the guideline was revised, approved by the panel and Australian DFD Guidelines working group, and endorsed as the new Australian guideline on management of diabetes-related foot infection by nine peak national bodies including the Australian and New Zealand Society for Vascular Surgery, Australian Podiatry Association, Wounds Australia, Australasian Society for Infectious Diseases, Australian Orthotic Prosthetic Association, Pedorthic Association of Australia, Australian Aboriginal and Torres Strait Islander Diabetes-related Foot Complications Program, Australian Diabetes Society and Diabetes Feet Australia.

Figures 1a and 1b incorporate the updated Australian recommendations in two clinical pathways to guide evidence-based diagnosis and treatment of people with diabetes-related foot infection in Australia. For each of the sub-recommendations, we outline below: the population, intervention, control and outcome (PICO) framed question the recommendation addressed in the IWGDF guidelines; the Australian recommendation; the panel decision and rationale to adopt, adapt or exclude; summary justification for the recommendation; detailed justification if it underwent full assessment; and where identified, considerations for implementation, special subgroups (including for Aboriginal and Torres Strait Islander and geographically remote populations), monitoring and potential future research priorities.

INFECTION GUIDELINE ENDORSEMENT

- Aboriginal and Torres Strait Islander Diabetes-related Foot Complications Program (SAHMRI)
- Australian and New Zealand Society for Vascular Surgery
- Australian Diabetes Society
- Australian Orthotic Prosthetic Association
- Australian Podiatry Association
- Australasian Society for Infectious Diseases
- Diabetes Feet Australia
- Pedorthic Association of Australia
- Wounds Australia





PART A

Recommendation 1A

Diagnose a soft tissue diabetes-related foot infection clinically, based on the presence of local or systemic signs and symptoms of inflammation. (GRADE strength of recommendation: Strong; Quality of evidence: low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening, as judgements were consistent with the IWGDF and the recommendation was acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that despite a low quality of evidence for the recommendation, there was a strong (strength of) recommendation for it based on the clinical signs and symptoms of infection being widely accepted and the substantial benefits of rapid clinical identification of soft tissue diabetes-related foot infections. The recommendation was considered compatible and applicable to the Australian context, and the clinical expertise was considered to be available for its implementation across primary, secondary and tertiary healthcare providers.

Subgroup considerations

Aboriginal and Torres Strait Islander Peoples

Clinical diagnosis of soft tissue infections may be more difficult in individuals with dark skin due to decreased contrast between infected and non-infected skin. This may be more likely for clinicians that treat individuals with dark skin less commonly.

Other subgroup considerations

As with Aboriginal and Torres Strait Islander Peoples, clinical diagnosis may be more difficult in other groups with darker skin.

Future research considerations

The panel identified that future studies could investigate differences in the time to identify an infected foot in individuals with darker and lighter skin and could define differences in clinical symptoms of infection between these two groups in order to adapt tools that use these clinical symptoms of infection to individuals with different skin colours.



PART A

Recommendation 1B

Assess the severity of any diabetes-related foot infection using the International Working Group on the Diabetic Foot / Infectious Diseases Society of America classification scheme. (Strong; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a moderate quality of evidence and a strong (strength of) recommendation for the recommendation given that the classification system has been validated in full or part by three prospective and four retrospective cohort studies. The recommendation was considered compatible and applicable to the Australian context, and the panel considered that the clinical expertise for its implementation was available across primary, secondary and tertiary healthcare providers.

Implementation considerations

The panel noted that there are a number of versions of the IWGDF/IDSA classification scheme with the IWGDF classification scheme being the most recently updated in 2019 as part of the IWGDF guideline recommendation process. As such, this classification scheme is recommended for use in Australia. In addition, the panel noted that a number of clinicians working with patients with diabetes-related foot infections use the Society for Vascular Surgery Wound, Ischaemia and Foot Infection (WIFI) classification scheme (32) to assess diabetes-related foot disease. This includes an infection component which is very similar to the IWGDF classification scheme although it ranges from 0 (no infection) to 3 (severe infection) compared with 1 (no infection) to 4 (severe infection) in the IWGDF classification scheme. In addition, it does not include the changes suggested by the 2019 IWGDF Guidelines to incorporate an 'O' when patients with moderate or severe infection have associated osteomyelitis.

Subgroup considerations

Geographically remote people

The panel noted that some components of the classification scheme associated with identifying systemic inflammatory response syndrome (SIRS) such as measurement of the PaCO₂, white blood cell count or band forms may not be available in all centres, however, inability to assess these was likely to only marginally impact on the sensitivity of identifying SIRS.

Monitoring considerations

The panel suggests that services use the IWGDF classification scheme to categorise patients in their service to assist with subsequent planning and management decisions.

Future research considerations

The panel noted that given the ongoing changes to the IWGDF guidelines and no studies having validated these in the Australian context it would be beneficial to conduct further validation studies of this classification scheme in the Australian setting.



PART B

Recommendation 2

Consider hospitalising all persons with diabetes and a severe (grade 4) foot infection and those with a moderate (grade 3) infection that is complex or associated with key relevant morbidities. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence but a strong (strength of) recommendation for the recommendation given that the desirable effects of hospitalisation on infection resolution, wound healing and mortality prevention in this setting likely outweigh the undesirable effects. The recommendation was considered compatible with most patients' values, applicable to the Australian context and feasible in most Australian locations, although they noted that some patient subgroups may disagree and in some remote locations the application of this recommendation would be more difficult.

Subgroup considerations

Geographically remote people

The panel noted there is a disparity across Australia in regard to access to multidisciplinary teams (MDT)-High Risk Foot Services or centres with specialist surgical services to manage patients with severe (grade 4) diabetes-related foot infections requiring urgent surgical intervention and some moderate (grade 3) diabetes-related foot infections that are amenable to elective surgery. This is particularly pertinent for individuals in remote areas where the adoption of more out-patient based managements may be preferred such as chairside surgeries or the utilisation of out-patient parenteral antibiotic therapy.

Aboriginal and Torres Strait Islander Peoples

Similar to people in geographically remote locations it was noted that some Aboriginal and Torres Strait Islander Peoples may be located in remote areas where hospitalisation is associated with substantial barriers, and alternative treatments may be considered preferable in some circumstances. If hospitalisation is required, the panel highlighted the need for adequate consultation with the patient and engagement with family to explain why hospitalisation is required and the approximate length of stay. There should also be consideration of language barriers and the need for a professional interpreter, especially where English may be a second, third or fourth language.

Future research considerations

The panel noted that there is a need to compare outcomes from alternative models of practice that may be of particular relevance to remote locations and Aboriginal and Torres Strait Islander communities around Australia.



PART A

Recommendation 3

In a person with diabetes and a possible foot infection for whom the clinical examination is equivocal or uninterpretable, consider ordering an inflammatory serum biomarker, such as C-reactive protein, erythrocyte sedimentation rate, and perhaps procalcitonin, as an adjunctive measure for establishing the diagnosis. (Weak; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence and a weak (strength of) recommendation for the recommendation given the minimal evidence supporting this recommendation. The recommendation was considered compatible and applicable to the Australian context, with the appropriate expertise and resources available to undertake these tests in many locations, although it was noted that procalcitonin had the most barriers to use.

Implementation considerations

Consistent with the evidence that CRP correlates most consistently and strongly with infection severity and changes rapidly, enabling dynamic interpretation, CRP was considered likely to be the most useful biomarker in this setting for many Australian settings. Procalcitonin is not widely available in the Australian healthcare setting and many clinicians likely have a decreased understanding of when it is best utilised, and its interpretation compared with CRP and ESR. In addition, it may incur additional costs in some settings and there may be a delayed time to results. The panel noted that despite the correlation between ESR and infection, it is generally used less commonly than CRP by Australian Infectious Diseases physicians.

Subgroup considerations

Geographically remote people

The panel noted that measurement of inflammatory biomarkers may not be available in all locations in a timely and feasible manner preventing implementation of this recommendation. As noted in the implementation section, access or delayed reporting is likely to be most widespread for procalcitonin.

Aboriginal and Torres Strait Islander Peoples

Similar to people in geographically remote locations it was noted that some Aboriginal and Torres Strait Islander Peoples may be located in remote areas restricting access to and delaying reporting of biomarkers. The panel noted that some Aboriginal and Torres Strait Islander Peoples may object to blood being taken, highlighting the need for clinicians to consider the necessity of testing for biomarkers (or other blood testing) and the need to explain the importance of this testing when required. There should also be consideration of language barriers as described in Recommendation 2.

Future research considerations

The IWGDF identified a need for additional research to correlate biomarkers with severity of infection, with careful identification of individuals who had been pre-treated with antibiotics. This was supported by the panel.



PART B

Recommendation 4

As neither electronically measuring foot temperature nor using quantitative microbial analysis has been demonstrated to be useful as a method for diagnosing diabetes-related foot infection, we suggest not using them. (Weak; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence for the use of foot temperature and quantitative microbial analysis to diagnose diabetes-related foot infection. They agreed that a weak (strength of) recommendation against their use was appropriate and consistent with minimal to no benefits, their low availability and in the case of quantitative microbial analysis, the associated potential delays and expense. The lack of resources and expertise recognised in the IWGDF guidelines also exist in the Australian setting. Thus, the recommendation against their use was considered applicable to the values of Australian patients.

Implementation considerations

As identified by the IWGDF there is low availability of these techniques in the global context and quantitative microbial analysis is time-consuming and expensive. These considerations are also pertinent in Australia.

Subgroup considerations

Geographically remote people

The panel considers the barriers identified to implementation in the Implementation considerations section even more relevant to geographically remote peoples.

Aboriginal and Torres Strait Islander Peoples

The panel considers the barriers identified to implementation in the Implementation considerations section even more relevant to many Aboriginal and Torres Strait Islander Peoples.

Future research considerations

As identified by the IWGDF there is a need for further evaluation of infrared imaging when coupled to photographic assessment through telemedicine. Similarly, the role of quantitative and semi-quantitative microbial analysis in clinical management of diabetes-related foot infections needs further exploration. This will require consistent methodology such as consensus definitions for the presence of infection as well as procedures for collection and processing of samples.



Recommendation 5

In a person with diabetes and suspected osteomyelitis of the foot, we recommend using a combination of the probe-to-bone test, the erythrocyte sedimentation rate (or C-reactive protein and/or procalcitonin), and plain X-rays as the initial studies to diagnose osteomyelitis. (Strong; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a moderate quality of evidence and a strong (strength of) recommendation for the recommendation. There is considerable evidence to support the use of the probe to bone test, ESR and plain X-rays to diagnose osteomyelitis in particular. The recommendation was considered compatible and applicable to the Australian context, with the appropriate expertise and resources available to undertake these tests in many locations, although it was noted that procalcitonin had the most barriers to use.

Implementation considerations

As described in the implementation section in Recommendation 3 procalcitonin is not widely available in the Australian healthcare setting, has less clinician expertise and in some settings may be associated with increased costs and delayed time to results. There is the potential to increase teaching of the probe to bone test, which is inexpensive and easy to learn and perform, to a broader clinical group.

Subgroup considerations

Geographically remote people

The panel noted that measurement of inflammatory biomarkers and plain X-rays may not be available in all locations in a timely and feasible manner. As noted in the implementation section, access or delayed reporting is likely to be most widespread for procalcitonin.

Aboriginal and Torres Strait Islander Peoples

Similar to people in geographically remote locations it was noted that some Aboriginal and Torres Strait Islander Peoples may be located in remote areas restricting access to and delaying reporting of diagnostic results. The panel also noted that some Aboriginal and Torres Strait Islander Peoples may object to bone being taken, highlighting the need for clinicians to consider the necessity of bone biopsy (or other specimens) and the need to explain the importance of this testing when required. There should also be consideration of language barriers as described in Recommendation 2.

Future research considerations

The panel identified that larger studies are needed to identify the sensitivity and specificity of the described tests to identify osteomyelitis. Additional studies assessing teaching and implementation of the probe to bone test to improve interobserver reliability were also recommended.



Recommendation 6A

In a person with diabetes and suspected osteomyelitis of the foot, if a plain X-ray and clinical and laboratory findings are most compatible with osteomyelitis, we recommend no further imaging of the foot to establish the diagnosis. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence but a strong (strength of) recommendation for the recommendation given the lack of need for more expensive and less available imaging if a diagnosis is evident. The recommendation was considered compatible with most patients' values, applicable to the Australian context and feasible in most Australian locations, although it was noted that in some patients additional imaging may be needed to determine the extent or complications, and thus the management of the osteomyelitis.

Subgroup considerations

Geographically remote people

The panel noted that plain X-rays and laboratory assessment may not be available in remote locations in a timely and feasible manner.

Aboriginal and Torres Strait Islander Peoples

Similar to people in geographically remote locations it was noted that some Aboriginal and Torres Strait Islander Peoples may be located in remote locations restricting access to plain X-rays and laboratory assessment.

Future research considerations

The panel noted that additional research could be undertaken to determine the sensitivity and specificity of a panel of low cost clinical, laboratory and radiological methods to diagnose osteomyelitis.



Recommendation 6B

If the diagnosis of osteomyelitis remains in doubt, consider ordering an advanced imaging study, such as magnetic resonance imaging scan, 18F-FDG-positron emission tomography (PET)/computed tomography (CT) or leukocyte scintigraphy (with or without CT). (Strong; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a moderate quality of evidence and a strong (strength of) recommendation for the recommendation. There is considerable evidence to support the use of these investigations to diagnose osteomyelitis which all demonstrate good sensitivity and specificity. The recommendation was considered compatible and applicable to the Australian context, with the appropriate expertise and resources available to undertake these tests in most tertiary healthcare settings in Australia.

Implementation considerations

The panel noted that the imaging techniques are generally available in tertiary healthcare settings in Australia, however, they are regularly not available in rural and remote settings. Furthermore, PET-CT is not reimbursed through the Pharmaceutical Benefits Scheme for this indication, restricting accessibility to those unable or unwilling to pay the associated costs.

Subgroup considerations

Geographically remote people

The panel noted that the imaging techniques are regularly not available in rural and remote settings, restricting access unless patients travel to a tertiary centre.

Aboriginal and Torres Strait Islander Peoples

Similar to people in geographically remote locations it was noted that some Aboriginal and Torres Strait Islander Peoples may be located in remote areas restricting access to the imaging techniques.



Recommendation 7

In a person with diabetes and suspected osteomyelitis of the foot, in whom making a definitive diagnosis or determining the causative pathogen is necessary for selecting treatment, collect a sample of bone (percutaneously or surgically) to culture clinically relevant bone microorganisms and for histopathology (if possible). (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence but a strong (strength of) recommendation for the recommendation given that biopsy is considered the gold-standard for diagnosis of osteomyelitis and there is substantial benefit of using directed antibiotic therapy in individuals with recalcitrant infection or in those that are at higher risk of antibiotic resistance. The recommendation was considered compatible with most patients' values given the increased chance of cure of infection, however, it was noted that there is the theoretical risk of introducing infection and a potential risk of fracture. The recommendation was considered applicable to the Australian context and feasible in most Australian locations, although expertise for percutaneous biopsy was noted to be low in many Australian locations.

Implementation considerations

The panel noted that the availability of percutaneous bone biopsy is variable across the Australian healthcare system. In many locations, experience and skill with this technique are not available, which potentially reduces the ability to implement this recommendation.

Subgroup considerations

Geographically remote people

The patchy availability of percutaneous biopsy identified in the Implementation section is considered likely to be greater in rural and remote locations. Furthermore, in remote locations there is reduced access to specialist surgical services to enable surgical biopsy and there may be delays in the time to results of microbiological and histological specimens.

Aboriginal and Torres Strait Islander Peoples

It was noted that some Aboriginal and Torres Strait Islander Peoples may be located in remote locations and encounter the same issues identified for people in geographically remote locations. The panel also noted that some Aboriginal and Torres Strait Islander Peoples may object to bone being taken as described in Recommendation 5. There should also be consideration of language barriers as described in Recommendation 2.

Future research considerations

The panel identified that research on the availability and usage of percutaneous bone biopsy in patients with diabetes-related foot osteomyelitis across Australia would enable an assessment of current expertise and usage and inform future education and implementation of this procedure.



Recommendation 8A

Collect an appropriate specimen for culture for almost all clinically infected wounds to determine the causative pathogens. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence but a strong (strength of) recommendation for the recommendation given the benefit of identifying the microbiological cause of infection in directing antibiotic therapy. Culture was noted to not only be important for pathogen identification but also to determine the susceptibility profile of these pathogens. The recommendation was considered compatible with most patients' values, applicable to the Australian context and feasible in most Australian locations.

Subgroup considerations

Geographically remote people

The panel noted that there will be a potential delay in time to results in microbiological testing in some remote locations.

Aboriginal and Torres Strait Islander Peoples

Some Aboriginal and Torres Strait Islander Peoples located in remote locations may encounter delayed time to results similar to people in geographically remote locations. The panel also noted that some Aboriginal and Torres Strait Islander Peoples may object to tissue being taken as described in Recommendation 5. There should also be consideration of language barriers as described in Recommendation 2.

Monitoring considerations

It is suggested that services consider recording whether microbiological specimens are taken for each patient with a diabetes-related foot infection, to enable evaluation of the proportion of patients receiving microbiological diagnoses.

Future research considerations

The panel noted that studies to assess infection outcomes in patients from remote locations where access to microbiology diagnosis is difficult could be undertaken to compare treatment with directed antibiotic therapy versus treatment with empiric antibiotic therapy.



Recommendation 8B

For a soft tissue diabetes-related foot infection, obtain a sample for culture by aseptically collecting a tissue specimen (by curettage or biopsy) from the ulcer. (Strong; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a moderate quality of evidence and a strong (strength of) recommendation for the recommendation. In general tissue biopsy is the most appropriate specimen for soft tissue diabetes-related foot infections, given that biopsy is considered the gold-standard for diagnosis of infection and there is substantial benefit of using directed antibiotic therapy in individuals with recalcitrant infection or in those that are at higher risk of antibiotic resistance. The recommendation was considered compatible with most patients' values, applicable to the Australian context and feasible in most Australian locations.

Implementation considerations

The panel noted that although expertise for soft tissue biopsy is available in most Australian healthcare settings, this may be reduced in some rural and remote settings. Furthermore, in some locations, tissue specimens may potentially be processed more slowly than tissue swabs.

Subgroup considerations

Geographically remote people

The panel noted that there may be reduced expertise in soft tissue biopsy and a potential delay in time to results in microbiological testing in some rural and remote locations.

Aboriginal and Torres Strait Islander Peoples

Similar issues to those identified for geographically remote populations may exist for Aboriginal and Torres Strait Islander Peoples located in remote locations. The panel also noted that some Aboriginal and Torres Strait Islander Peoples may object to tissue being taken as described in Recommendation 5. There should also be consideration of language barriers as described in Recommendation 2.

Monitoring considerations

It is suggested that services consider recording whether tissue specimens are taken for each patient with a diabetes-related foot infection, and the type of specimen collected, to enable evaluation of the proportion of patients receiving microbiological diagnoses based on tissue samples compared with superficial swabs.

Future research considerations

The panel noted that additional studies are needed to identify the likelihood of deep infection caused by a specific organism identified on a superficial swab. Furthermore, the panel suggests that the relative benefit of tissue samples versus swabs be assessed in clinical trials looking at patient outcomes.



Recommendation 9

Do not use molecular microbiology techniques (instead of conventional culture) for the first-line identification of pathogens from samples in a patient with a diabetes-related foot infection. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence and a strong (strength of) recommendation against the recommendation given the lack of evidence for benefit of molecular microbiology techniques. The recommendation was considered compatible with patients' values, applicable to the Australian context and feasible in most Australian locations given molecular microbiology techniques are rarely available.

Implementation considerations

There is low availability of molecular microbiology in the Australian context and the techniques are still relatively new and expensive.

Subgroup considerations

Geographically remote people

The panel considers the barriers identified to implementation in the Implementation considerations section even more relevant to geographically remote peoples.

Aboriginal and Torres Strait Islander Peoples

The panel considers the barriers identified to implementation in the Implementation considerations section even more relevant to many Aboriginal and Torres Strait Islander Peoples.

Future research considerations

The panel noted that there is a need for further development and investigation of molecular microbiology techniques including studies that compare results with standard cultures according to IWGDF grade of infection and assess patient-related outcomes.



Recommendation 10

Treat a person with a diabetes-related foot infection with an antibiotic agent that has been shown to be effective in a published randomised controlled trial and is appropriate for the individual patient. Some agents to consider include penicillins, cephalosporins, carbapenems, metronidazole (in combination with other antibiotic[s]), clindamycin, linezolid, daptomycin, fluoroquinolones, or vancomycin, but not tigecycline. (Strong; high)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a high quality of evidence and a strong (strength of) recommendation for the recommendation. Although evidence is based on good quality randomised controlled trials (RCTs), it was noted that the majority of these demonstrated that agents were non-inferior to each other, raising the possibility that other agents that have not been tested in RCTs may be similarly effective (i.e. agents such as cotrimoxazole and doxycycline which are commonly used for diabetes-related foot infections in Australia). The recommendation was considered compatible and applicable to the Australian context, where there is appropriate expertise and resources available to use these antibiotics in most primary, secondary and tertiary healthcare settings. The recommendation was consistent with existing Australian antibiotic guidelines (33).

Implementation considerations

The panel noted that multiple additional factors are important in determining the appropriate antibiotic to use for a patient, similar to those described in Recommendation 11, including severity of infection, route of administration, adverse drug reactions, current and prior microbiological results, local antibiotic resistance patterns, appropriate antimicrobial stewardship, antibiotic restrictions, cost and access. Specifically, some antibiotics will only be available in tertiary settings, and even then, more restricted antibiotics such as daptomycin may not be widely accessible.

Subgroup considerations

Geographically remote people

The panel noted that the use of intravenous antibiotics may be difficult in some rural and remote locations, requiring patient transfer to a tertiary centre.

Aboriginal and Torres Strait Islander Peoples

Similar to people in geographically remote locations it was noted that some Aboriginal and Torres Strait Islander Peoples may be located in remote areas restricting access to intravenous antibiotics.

Monitoring considerations

The panel recommends that individual services should collaborate with their local antimicrobial stewardship team to evaluate their local antibiotic usage and compare it to similar services and centres where possible.

Future research considerations

The panel noted there is a need for studies comparing regularly used empiric antibiotic regimens (rather than new antibiotics) in order to identify the best empiric regimen for different severity infections.



Recommendation 11

Select an antibiotic agent for treating a diabetes-related foot infection based on: the likely or proven causative pathogen(s) and their antibiotic susceptibilities; the clinical severity of the infection; published evidence of efficacy of the agent for diabetes-related foot infections; risk of adverse events, including collateral damage to the commensal flora; likelihood of drug interactions; agent availability; and, financial costs. (Strong; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a moderate quality of evidence and a strong (strength of) recommendation for the recommendation. The recommendation was considered compatible with most patients' values, applicable to the Australian context and feasible in most Australian locations. It was noted that the list of considerations in the recommendation is not exhaustive and there are many additional patient-related considerations including patient acceptance of antibiotic frequency or administration type, patient adherence to a regimen, and patient preference to be treated in the outpatient setting or on country where possible. In addition, there should be a preference for narrower spectrum antibiotics where possible from an antimicrobial stewardship perspective. Conversely, at times it may be appropriate to use broader spectrum antibiotics if there is a history of recent infection or colonisation with multidrug resistant organisms or if local antimicrobial susceptibility profiles demonstrate an increased risk of such organisms.

Implementation considerations

As described in the Summary justification, the panel identified a number of additional implementation considerations, many of which are patient-related. These are described in additional detail in the Subgroup considerations below.

Subgroup considerations

Geographically remote people

The panel noted that people in geographically remote locations may have a greater preference to be treated in the outpatient setting to avoid travel away from home. This led to variation in the importance that they place on the use of some antibiotics over others. For example, they may prefer to trial oral antibiotics rather than intravenous antibiotics.

Aboriginal and Torres Strait Islander Peoples

The panel noted that Aboriginal and Torres Strait Islander Peoples may have a greater preference to be treated in the outpatient setting with oral antibiotics or prefer to use intravenous antibiotics through outpatient parenteral services if available to enable them to stay on country or avoid inpatient hospital admissions. There should also be consideration of language barriers as described in Recommendation 2.

Other subgroup considerations

The panel noted that an increased preference to be treated in the outpatient setting with oral antibiotics or use intravenous antibiotics through outpatient parenteral services may exist for many other patient groups, including carers and those with dependants. In addition, broader spectrum antibiotics may be commenced if patients have a history of recent infection or colonisation with multidrug resistant organisms (such as methicillin-resistant *Staphylococcus aureus* (MRSA)) or if local antimicrobial susceptibility profiles demonstrate an increased risk of multidrug resistant organisms. Risk factors for MRSA infection in the Australian context have been described (34).

Future research considerations

The panel noted that qualitative studies to explore and rank the factors most important for patients would assist clinicians in understanding patients' preferences and providing the most balanced options when discussing treatment with patients. In addition, preferences could be assessed for specific patient subgroups such as those in geographically remote locations or Aboriginal and Torres Strait Islander Peoples.



Recommendation 12

Administer antibiotic therapy initially by the parenteral route to any patient with a severe (grade 4) skin and soft tissue diabetes-related foot infection. Switch to oral therapy if the patient is clinically improving and has no contraindications to oral therapy and if there is an appropriate oral agent available. (Strong; very low)

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation after full assessment based on having differences in judgements to IWGDF for quality of evidence (Table 2) and due to a lack of clarity around the population it referred to. The changes made to the original IWGDF recommendation included downgrading the quality of evidence from low to "very low" and including the phrase "skin and soft tissue" to define the relevant population of patients with diabetes-related foot infection (Table 3).

Summary justification

Although the panel downgraded the quality of evidence to very low, they agreed with the IWGDF that diabetes-related foot infections were an important health problem in Australia, and that the balance of effects favoured the use of initial intravenous antibiotics for severe (grade 4) skin and soft tissue diabetes-related foot infections. It was noted that a switch to oral therapy when the patient was clinically improving was appropriate for severe (grade 4) skin and soft tissue infections but may not always be appropriate for infection of bones and joints. The panel were unsure whether the critical outcome of clinical cure of infection would be consistently valued above others by all patients. They noted that the recommendation was likely acceptable and feasible in the Australian setting. Detailed justifications from the panel's full assessment are provided in Supplementary Table S1.

Subgroup considerations

Geographically remote people

Individuals in geographically remote populations may require initial intramuscular administration of antibiotics or once off intravenous antibiotics before transfer to a larger facility. As such, treatment may be unable to be undertaken in a remote location. For the majority of individuals, the potential for clinical cure facilitated through such a transfer would likely outweigh the potential suboptimal care in a less equipped environment and the need for transfer.

Aboriginal and Torres Strait Islander Peoples

Aboriginal and Torres Strait Islander Peoples living in remote locations are likely to require similar considerations to people living in geographically remote locations.

Future research considerations

One of the key research priorities identified by IWGDF was whether oral antibiotic therapy alone is as effective as parenteral treatment for diabetes-related foot infections, including diabetes-related foot osteomyelitis. The panel noted a need for studies to evaluate whether all patients with severe (grade 4) infections require initial parenteral antibiotic therapy. Furthermore, they identified a need for studies to explore the duration of initial parenteral antibiotics that is needed prior to oral switch for patients with severe (grade 4) diabetes-related foot infections and the factors that influence this decision.



Recommendation 13

Treat patients with a mild (grade 2) diabetes-related foot infection, and most with a moderate (grade 3) diabetes-related foot infection, with oral antibiotic therapy, either at presentation or when clearly improving with initial intravenous therapy. (Weak; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence and a weak (strength of) recommendation for the recommendation. The recommendation was considered compatible with patients' values, applicable to the Australian context and feasible in most Australian locations.

Future research considerations

IWGDF highlighted a need to further understand whether complete oral therapy is as effective as parenteral treatment for diabetes-related foot infections. The panel agreed that studies are needed to compare the use of complete oral therapy with initial intravenous therapy in infections of moderate (grade 3) severity and that they should assess patient outcomes.



Recommendation 14

We suggest not using any currently available topical antimicrobial agent for treating a mild (grade 2) diabetes-related foot infection. (Weak; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that when specifically considering the use of topical antibiotic agents for mild bacterial infection there was a moderate quality of evidence and a weak (strength of) recommendation against using currently available topical antimicrobial agents given a lack of evidence demonstrating efficacy of these agents, and their potential to increase the risk of antimicrobial resistance. The panel also noted that the use of anti-septic agents is considered separately in recommendation 27b. The recommendation was considered compatible with most patients' values, and applicable and feasible in the Australian setting.

Future research considerations

The panel noted that topical antimicrobial agents remain an important area of future research which have the potential to alter the treatment pathways of diabetes-related foot infections if efficacious and safe agents are identified.



Recommendation 15A

Administer antibiotic therapy to a patient with a skin or soft tissue diabetes-related foot infection for a duration of 1 to 2 weeks. (Strong; high)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a high quality of evidence and a strong (strength of) recommendation for the recommendation. The recommendation was consistent with existing Australian antibiotic guidelines (33), and considered compatible with patients' values, applicable to the Australian context and feasible in primary, secondary and tertiary healthcare settings in Australia.

Monitoring considerations

The panel recommends that services record the duration of antibiotic treatment provided to patients to enable an audit of treatment duration by infection severity compared with the guidelines.

Future research considerations

The IWGDF identified a need for further studies to determine the optimal duration of treatment for skin and soft tissue infections. The panel noted that such studies should be categorised by infection severity and infecting microorganisms and should consider additional confounders such as severe peripheral artery disease.



Recommendation 15B

Consider continuing treatment, perhaps for up to 3 to 4 weeks, if the infection is improving but is extensive and is resolving slower than expected or if the patient has severe peripheral artery disease. (Weak; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence and a weak (strength of) recommendation for the recommendation. The recommendation was noted to be pragmatic and generally consistent with existing Australian antibiotic guidelines (33). It was considered compatible with patients' values, applicable to the Australian context and feasible in primary, secondary and tertiary healthcare settings in Australia.

Monitoring considerations

See Recommendation 15A.

Future research considerations

See Recommendation 15A.



Recommendation 15C

If evidence of infection has not resolved after 4 weeks of apparently appropriate therapy, re-evaluate the patient, and reconsider the need for further diagnostic studies or alternative treatments. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence but a strong (strength of) recommendation for the recommendation. The recommendation was noted to be pragmatic and generally consistent with existing Australian practice. It was considered compatible with patients' values, applicable to the Australian context and feasible in primary, secondary and tertiary healthcare settings in Australia.

Monitoring considerations

See Recommendation 15A.

Future research considerations

See Recommendation 15A.



Recommendation 16

For patients who have not recently received antibiotic therapy and have an acute infection, consider targeting empiric antibiotic therapy at just aerobic Gram positive pathogens (beta-haemolytic streptococci and *Staphylococcus aureus*) in cases of a mild (grade 2) diabetes-related foot infection. (Weak; low)

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation after full assessment based on having differences in judgements to IWGDF for balance of effects and the population impacted (Table 2). The changes made to the original IWGDF recommendation included downgrading the balance of effects from strong to "weak", extending the recommendation to all locations in Australia by excluding the need for patients to reside in a temperate climate area and narrowing the population by adding the phrase "and have an acute infection" (Table 3).

Summary justification

The panel agreed with the IWGDF that diabetes-related foot infections were an important health problem in Australia, that the use of empiric narrower spectrum antibiotics had more desirable benefits than undesirable benefits, and that the quality of the evidence supporting this was low. However, the panel felt the balance of effects was weak, consistent with a conditional recommendation for narrower spectrum antibiotics in the described circumstances and consistent with the use of the word consider in the recommendation. The panel also noted that although the recommendation was likely acceptable and feasible in the Australian setting, Australian practice and guidelines (33) do not distinguish use of narrow spectrum antibiotics by climate and there is no local evidence to support such a distinction. However, both local guidelines (33) and studies (35) support use of narrower spectrum agents in acute infections. The panel noted that the definition of acute infection in the published literature has varied from less than 2 to 6 weeks and suggest that, in concordance with local guidelines (33), duration of infective symptoms of less than 4 weeks could be considered acute while noting broader therapy may be required for those with a duration of ulceration of greater than 6 weeks (35) and in those with recent antibiotic exposure (36). Detailed justifications are described in Supplementary Table S2.

Subgroup considerations

The panel noted that there is no evidence from the Australian context to suggest individuals living in tropical regions with acute infections cannot be treated with narrow spectrum antibiotics and current practice in Australia is to treat such individuals with narrow spectrum antibiotics. They also noted that in patients known to be colonised with MRSA or in areas with a high prevalence, prescribers should consider empiric coverage of MRSA. Many tropical regions of Australia are also remote and increased rates of MRSA may exist in some of these remote populations. Similarly, many Aboriginal and Torres Strait Islanders live in tropical regions of Australia and there is an increased rate of MRSA in some Aboriginal and Torres Strait Islander populations (5).

Future research considerations

The panel identified a need for further studies to investigate whether a difference in patient outcomes exists between patients treated with narrow compared with broad spectrum antibiotics in patients with acute infections. They also highlighted the need for further studies comparing pathogens in acute infections between temperate and tropical regions of Australia.



Recommendation 17

For patients who have been treated with antibiotic therapy within a few weeks, have a chronic infection, have a severely ischaemic affected limb, or a moderate (grade 3) or severe (grade 4) infection, we suggest selecting an empiric antibiotic regimen that covers Gram positive pathogens, commonly isolated Gram negative pathogens, and possibly obligate anaerobes in cases of moderate (grade 3) to severe (grade 4) diabetes-related foot infections. Then, reconsider the antibiotic regimen based on both the clinical response and culture and sensitivity results. (Weak; low)

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation after full assessment based on having differences in judgements to IWGDF for the population impacted in the Australian setting (Table 2). This was achieved by extending the recommendation to all locations in Australia by excluding the need for patients to reside in a tropical/subtropical climate and including patients with chronic infections by adding the phrase "who have a chronic infection" (Table 3).

Summary justification

The panel agreed with the IWGDF that diabetes-related foot infections were an important health problem in Australia, that the use of empiric narrower spectrum antibiotics had more desirable benefits than undesirable benefits, that the quality of the evidence supporting this was low and the balance of effects was weak. The panel also noted that although the recommendation was likely acceptable and feasible in the Australian setting, similar to Recommendation 16, Australian practice and guidelines (33) do not distinguish use of antibiotic spectrum by climate and there is no local evidence to support such a distinction. However, both local guidelines (33) and studies (35) support use of broader spectrum agents in chronic infections and in the presence of chronic ulceration. As described in Recommendation 16, the panel noted that the definition of acute infection and thus chronic infection varies in the published literature and suggest that, in concordance with local guidelines (33), duration of infective symptoms of four or more weeks could be considered chronic while noting broader therapy may also be required for those with a duration of ulceration of greater than 6 weeks (35). Detailed justifications are described in Supplementary Table S3.

Subgroup considerations

See Recommendation 16.

Future research considerations

See Recommendation 16.



Recommendation 18

Empiric treatment aimed at *Pseudomonas aeruginosa* is not usually necessary but consider it if *P. aeruginosa* has been isolated from cultures of the affected site within the previous few weeks, or in tropical/subtropical climates (at least for moderate (grade 3) or severe (grade 4) infection). (Weak; low)

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation after full assessment based on minor differences in judgements to IWGDF for the population impacted in the Australian setting (Table 2). This was achieved by extending the recommendation to all locations in Australia by excluding the phrase "in temperate climates" (Table 3).

Summary justification

The panel agreed with the IWGDF that diabetes-related foot infections were an important health problem in Australia, that the use of empiric antibiotic treatment to cover *P. aeruginosa* in certain circumstances had more desirable benefits than undesirable benefits, that the quality of the evidence supporting this was low and the balance of effects was weak. The panel also noted that although the recommendation was likely acceptable and feasible in the Australian setting, *P. aeruginosa* can be a pathogen in temperate as well as tropical regions (35). Detailed justifications are described in Supplementary Table S4.

Implementation considerations

The panel noted that in Australia, many clinicians obtain cultures via superficial swabs. Thus, increased weight should be given to treatment covering *P. aeruginosa* if it has been previously isolated from tissue samples from the affected site compared with superficial swabs.

Future research considerations

The panel identified a number of potential areas for future research that related to this recommendation including:

1. Studies to investigate differences in the prevalence of *P. aeruginosa* in diabetes-related foot infections in temperate and tropical regions of Australia and how this differs by severity of infection.
2. Studies to investigate differences in outcomes of diabetes-related foot infections treated with empiric *P. aeruginosa* coverage versus those that are not.
3. Studies to investigate differences in outcomes of diabetes-related foot infections that culture *P. aeruginosa* and are treated with antibiotics that target this bacteria versus those that do not.

Q6

In a person with diabetes and a foot infection, is any particular antibiotic regimen (specific agent[s], route, duration) better than any other for treating soft tissue or bone infection?



Recommendation 19

Do not treat clinically uninfected foot ulcers with systemic or local antibiotic therapy with the goal of reducing the risk of infection or promoting ulcer healing. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence but a strong (strength of) recommendation for the recommendation. The recommendation was considered to be consistent with antimicrobial stewardship principles. It was considered compatible with patients' values, applicable to the Australian context and feasible in primary, secondary and tertiary healthcare settings in Australia.



PART A

Recommendation 20

Non-surgeons should urgently consult with a surgical specialist in cases of severe (grade 4) infection or of moderate (grade 3) infection complicated by extensive gangrene, necrotising infection, signs suggesting deep (below the fascia) abscess or compartment syndrome, or severe lower limb ischaemia. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence but a strong (strength of) recommendation for the recommendation. The recommendation was considered compatible with patients' values, applicable to the Australian context and feasible in most secondary and tertiary healthcare settings in Australia.

Subgroup considerations

Geographically remote people

The panel noted that there is disparate access to specialist diabetes-related foot surgical services across Australia. Many remote and rural locations and some regional locations may not have nearby access to such services. Such centres need to have clear referral pathways (including criteria for referral and who to contact) and access to timely advice and transfer mechanisms.

Aboriginal and Torres Strait Islander Peoples

Aboriginal and Torres Strait Islander Peoples living in remote, rural and some regional centres may not have access to specialist surgical services as described for geographically remote people.

Future research considerations

The panel noted that mixed methods research to identify differences between rural and metropolitan services in time between first presentation and surgery and to identify barriers to timely surgery would likely assist in improving the referral pathways and processes for diabetes-related foot infections requiring surgery.



PART A

Recommendation 21A

In a patient with diabetes and uncomplicated forefoot osteomyelitis, for whom there is no other indication for surgical treatment, consider treating with antibiotic therapy without surgical resection of bone. (Strong; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation after full assessment based on having no substantial differences in judgements to IWGDF.

Summary justification

The panel agreed with the IWGDF that there was a moderate quality of evidence and a strong (strength of) recommendation for the recommendation. The recommendation was considered compatible with patients' values, applicable to the Australian context and feasible in primary, secondary and tertiary healthcare settings in Australia. The panel noted that according to the exclusion criteria in the sole RCT assessing this issue (37), uncomplicated forefoot osteomyelitis should be defined as osteomyelitis without severe (grade 4) infection, and without any of the following: necrotising tissue infection, bone exposed in the base of the ulcer, kidney injury, or peripheral artery disease. Detailed justifications are described in Supplementary Table S5.

Implementation considerations

The panel noted that the need to be able to identify an indication for surgical intervention requires a level of specialist surgical knowledge that may not be available in all locations.

Subgroup considerations

Geographically remote people

As identified in the Implementation considerations section, the panel noted that the need to be able to identify an indication for surgical intervention requires a level of specialist surgical knowledge that may be less commonly available in remote and rural locations. There is a need for services in such locations to have networks with which they can discuss cases to receive timely advice.

Future research considerations

The IWGDF highlighted the need for additional research to determine the optimal duration of antibiotic therapy in patients with diabetes-related foot osteomyelitis who are treated without surgery. The panel noted that additional well-designed studies on subgroups of patients with diabetes-related foot osteomyelitis would be beneficial to further characterise the expected outcomes of non-surgical versus surgical approaches in different patient groups.



PART A

Recommendation 21B

In a patient with probable diabetes-related foot osteomyelitis with concomitant soft tissue infection, urgently evaluate for the need for surgery as well as intensive post-operative medical and surgical follow-up. (Strong; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a moderate quality of evidence and a strong (strength of) recommendation for the recommendation. The recommendation was considered compatible with patients' values, applicable to the Australian context and feasible in most secondary and tertiary healthcare settings in Australia.

Subgroup considerations

Geographically remote people

As described in Recommendation 20, there is disparate access to specialist diabetes-related foot surgical services across Australia. In addition, intensive post-operative medical and surgical follow up may be difficult in some locations and may require relocation for a period of time. The use of technology such as telehealth appointments and patient-centred co-management arrangements such as joint appointments with general practitioners and specialists should be considered where feasible.

Aboriginal and Torres Strait Islander Peoples

Aboriginal and Torres Strait Islander Peoples living in remote, rural and some regional centres may not have access to specialist surgical services as described for geographically remote people.

Future research considerations

The panel noted that further studies assessing outcomes such as amputation, wound healing, resolution of infection and mortality are needed for comparison of surgery versus no surgery for different subgroups of patients with diabetes-related foot infections.



PART A

Recommendation 22

Select antibiotic agents for treating diabetes-related foot osteomyelitis from among those that have demonstrated efficacy for osteomyelitis in clinical studies. (Strong; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence but a strong (strength of) recommendation for the recommendation. The recommendation was considered compatible with patients' values, applicable to the Australian context and feasible in primary, secondary and tertiary healthcare settings in Australia. However, it was noted by the panel that there have been few clinical trials that have compared different antibiotic regimens for diabetes-related foot osteomyelitis and it would be reasonable to use antibiotics that are used for osteomyelitis that is not associated with diabetes-related foot infections.

Implementation considerations

As described in the Summary justification, few antibiotic regimens have been tested in clinical trials for diabetes-related foot osteomyelitis and it would be reasonable to use antibiotics that are used for osteomyelitis that is not associated with diabetes-related foot infections. Such antibiotics include beta-lactams, beta-lactam/beta-lactamase inhibitors, (fluoro)quinolones, glycopeptides and lipoglycopeptides, oxazolidinones, sulfonamides, lincosamides, rifamycins and fusidic acid (38-41). Trials into the benefit of adjunctive rifampicin are ongoing (42). The panel noted that a single substudy in an RCT of tigecycline versus ertapenem +/- vancomycin found tigecycline had a statistically non-significant chance of cure but a higher adverse event rate (43). The factors identified as important in choosing an antibiotic for skin and soft tissue infections in Recommendations 10 and 11 should also be considered when choosing an antibiotic for osteomyelitis.

Subgroup considerations

Geographically remote people

The panel noted that the use of intravenous antibiotics may be difficult in some rural and remote locations, requiring patient transfer to a tertiary centre.

Aboriginal and Torres Strait Islander Peoples

Similar to people in geographically remote locations it was noted that some Aboriginal and Torres Strait Islander Peoples may be located in remote areas restricting access to intravenous antibiotics.

Monitoring considerations

As identified in Recommendation 10, the panel recommends that individual services should collaborate with their local antimicrobial stewardship team to evaluate their local antibiotic usage and compare it to similar services and centres where possible.

Future research considerations

The panel noted there is a need for studies comparing regularly used empiric antibiotic regimens (rather than new antibiotics) when culture results are unknown in order to identify the best empiric regimen for different types and severity of osteomyelitis. This should include comparison of oral-only antibiotic regimens compared with regimens with initial intravenous antibiotics. In addition, there is a need to compare different regularly used antibiotics in patients with known pathogens to determine which are the most effective.



PART A

Recommendation 23A

Treat diabetes-related foot osteomyelitis with antibiotic therapy for no longer than 6 weeks. If the infection does not clinically improve within the first 2 to 4 weeks, reconsider the need for collecting a bone specimen for culture, undertaking surgical resection, or selecting an alternative antibiotic regimen. (Strong; moderate)

DECISION: EXCLUDED

Rationale

The panel decided to exclude this recommendation after full assessment based on having substantial differences in judgements to IWGDF for the certainty of evidence and balance of effects (Table 2) and due to inclusion of a heterogeneous population. The population addressed (person with diabetes and osteomyelitis of the foot) was considered to be too heterogeneous for the recommendation to treat with antibiotic therapy for no longer than 6 weeks to be broadly applied. The highly select subgroup for which there is some evidence to support a shorter duration of therapy is targeted in Recommendation 21(a). The second sentence of the recommendation was considered to reflect expert opinion of good practice supported by extensive experience and considered to be a general principle rather than remain as an evidence-based recommendation.

Summary justification

The panel disagreed with the IWGDF on a number of aspects relating to this recommendation. The population of patients with diabetes-related foot osteomyelitis was considered too heterogeneous, impacting on a number of aspects of the assessment. Given the poor representation of the breadth of clinical presentations of diabetes-related foot osteomyelitis in the literature the panel downgraded the certainty of evidence to low. Similarly, the heterogeneity of diabetes-related foot osteomyelitis meant that the balance of effects was considered to vary. The panel were unsure whether the critical outcome of clinical cure of infection would be consistently valued above others by all patients. The acceptability of the recommendation by patients and providers in the Australian setting was considered likely to vary substantially based on the subgroup of osteomyelitis being treated. The recommendation was considered likely to be feasible in the Australian setting. Detailed justifications are described in Supplementary Table S6.

Future research considerations

The panel noted that exclusion of this recommendation highlights the need for further well-designed studies to better characterise and define subsets of diabetes-related foot osteomyelitis and then investigate different durations of antibiotic therapy for these subgroups.



PART A

Recommendation 23B

Treat diabetes-related foot osteomyelitis with antibiotic therapy for just a few days if there is no soft tissue infection and all the infected bone has been surgically removed. (Weak; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence and a weak (strength of) recommendation for the recommendation. The recommendation was noted to be consistent with existing Australian infection guidelines (33) where it is recommended that antibiotics are continued for 2 to 5 days after definitive surgery for osteomyelitis. It was considered compatible with patients' values, applicable to the Australian context and feasible in primary, secondary and tertiary healthcare settings in Australia.

Implementation considerations

As described in the Summary justification, the panel believe that the duration that antibiotic therapy should be continued, described as 'just a few days' in the recommendation should be defined as 2 to 5 days. This is consistent with Australian infection guidelines and allows clinicians to await histopathology and culture results from tissue samples taken from the presumed uninfected residual bone margin to verify adequate surgical removal of infection.

Monitoring considerations

The panel recommends that services record the duration of antibiotic treatment provided to patients post definitive surgery and whether tissue samples were sent from the presumed clean wound post-surgical debridement.

Future research considerations

The panel noted that further studies on the duration of antibiotics post definitive surgery for osteomyelitis would be beneficial including identifying factors associated with poorer outcomes that may indicate a need for more prolonged antibiotic therapy. Standardisation of terminology, sampling technique and processing methods would aid research goals.



PART A

Recommendation 24

For people with diabetes-related foot osteomyelitis that initially require parenteral therapy, consider switching to an oral antibiotic regimen that has high bioavailability after perhaps 5 to 7 days, if the likely or proven pathogens are susceptible to an available oral agent and the patient has no clinical condition precluding oral therapy. (Weak; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a moderate quality of evidence and a weak (strength of) recommendation for considering transition to oral antibiotics after 5 to 7 days. The panel noted that uncertainty remains regarding the best timing of switch to oral agents and that clinician practice may differ. This recommendation reflects a change from previous practice and Australian guidelines but is consistent with emerging evidence suggesting early switch to bioavailable oral agents is equally efficacious to longer antibiotic therapy (44). It is likely that some of the current uncertainty around best practice will be resolved in the short to medium term as further evidence and experience of early oral switch for bone and joint infections becomes available. It was considered applicable to the Australian context and feasible in most secondary and tertiary healthcare settings in Australia. The panel also noted that an earlier switch to oral agents would be considered preferable for most patients if clinically appropriate and as such the recommendation was considered compatible with patients' values.

Implementation considerations

The panel noted that earlier transition to oral agents would potentially allow patients to return home more quickly and reduce the challenges that are associated with treatment.

Subgroup considerations

Geographically remote people

As described in the Implementation considerations, earlier transition to oral agents would potentially allow patients to return home more quickly, reducing the time that patients from remote locations need to remain away from home or an inpatient. This benefit would likely be valued highly by many people in remote locations.

Aboriginal and Torres Strait Islander Peoples

As described in the Implementation considerations, earlier transition to oral agents would potentially allow Aboriginal and Torres Strait Islander Peoples to return home to country more quickly, reducing the time that patients are away from or an inpatient. This benefit would likely be valued highly by many Aboriginal and Torres Strait Islander Peoples.

Monitoring considerations

The panel recommends that individual services record the duration of intravenous and oral antibiotic therapy to allow comparison of patient outcomes and between services.

Future research considerations

The panel notes that this remains an area of active research and there is a need for further randomised trials to compare antibiotic regimens with early oral transition with longer intravenous regimens for diabetes-related foot osteomyelitis in different patient subgroups. Selection of effective oral agents requires a particular focus to understand the relative importance of bioavailability, bone penetration, biofilm activity and therapeutic drug monitoring.



PART B

Recommendation 25A

During surgery to resect bone for diabetes-related foot osteomyelitis, consider obtaining a specimen of bone for culture (and, if possible, histopathology) at the stump of the resected bone to identify if there is residual bone infection. (Weak; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a moderate quality of evidence and a weak (strength of) recommendation for the recommendation. It was considered compatible with patients' values, applicable to the Australian context and feasible in most tertiary healthcare settings in Australia.

Monitoring considerations

The panel recommends that services record whether tissue samples were sent from the presumed clean wound post-surgical debridement.

Future research considerations

The panel noted that additional studies comparing outcomes in patients with positive and negative stump cultures would be beneficial.



PART B

Recommendation 25B

If an aseptically collected culture specimen obtained during the surgery grows pathogen(s), or if the histology demonstrates osteomyelitis, administer appropriate antibiotic therapy for up to 6 weeks. (Strong; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation after full assessment based on having no substantial differences in judgements to IWGDF.

Summary justification

The panel agreed with the IWGDF that there was a moderate quality of evidence and a strong (strength of) recommendation to continue antibiotics if proximal surgical samples suggested residual infection. The recommendation was considered compatible with patients' values, applicable to the Australian context and feasible in secondary and tertiary healthcare settings in Australia. Detailed justifications are described in Supplementary Table S7

Subgroup considerations

Geographically remote people

The panel noted that there may be longer turn-around times for laboratory results from bone sampling (microbiology and anatomical pathology) when sent from remote sites and that this should be considered in the treatment algorithm. Antibiotics should be continued until the results are available.

Monitoring considerations

See Recommendation 25A.

Future research considerations

The IWGDF highlighted that there is a lack of an agreed definition of osteomyelitis in the diabetes-related foot, highlighting the need for consensus definitions of (1) stages of diabetes-related foot osteomyelitis and (2) outcome assessment, in addition to standardised collection and reporting methods for bone samples. The panel noted that additional studies comparing outcomes in patients with positive and negative stump cultures would be beneficial. In addition, there is a need for studies to investigate the optimal duration of antibiotics in patients with diabetes-related foot osteomyelitis treated with bone resection surgery.



Recommendation 26

For a diabetes-related foot infection, do not use hyperbaric oxygen therapy or topical oxygen therapy as an adjunctive treatment if the only indication is specifically for treating the infection. (Weak; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence and a weak (strength of) recommendation against the use of hyperbaric oxygen or topical oxygen therapy for treating infection. The recommendation was considered compatible with patients' values, applicable to the Australian context and feasible in tertiary healthcare settings in Australia.

Implementation considerations

The panel noted that hyperbaric oxygen therapy is not widely available throughout Australia and is generally only available in selected metropolitan and regional centres.

Future research considerations

The panel noted that there is a need for further randomised studies with infection outcomes to assess the role of hyperbaric oxygen therapy in diabetes-related foot infections.



Recommendation 27A

To *specifically* address infection in a diabetes-related foot ulcer do not use adjunctive granulocyte colony stimulating factor treatment (Weak; moderate).

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a moderate quality of evidence and a weak (strength of) recommendation against the use of adjunctive granulocyte colony stimulating factor treatment for diabetes-related foot infection. It was considered compatible with patients' values, applicable to the Australian context and feasible in primary, secondary and tertiary healthcare settings in Australia.



Recommendation 27B

To *specifically* address infection in a diabetes-related foot ulcer do not *routinely* use topical antiseptics, silver preparations, honey, bacteriophage therapy, or negative pressure wound therapy (with or without instillation). (Weak; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation unchanged following screening as judgements were consistent with the IWGDF and the recommendation was considered acceptable and applicable in the Australian setting (Table 1).

Summary justification

The panel agreed with the IWGDF that there was a low quality of evidence and a weak (strength of) recommendation to not use these topical therapies routinely as sole therapy or instead of antibiotics for established clinical infection. However, the panel noted that these may be used as an adjunct in combination with good wound care principles and that there may be a potential benefit to using adjunctive non-harmful traditional or complementary therapies, if only to maintain a therapeutic relationship in some patients. With these caveats, the recommendation was considered compatible with patients' values, applicable to the Australian context and feasible in most primary, secondary and tertiary healthcare settings in Australia.

Implementation considerations

The panel noted that while these therapies should not be used as the primary treatment for treating infection, many clinicians use these therapies as an adjunct to wound care and as they generally have minimal evidence for efficacy or harm they may be considered following discussion between the patients and clinician. Further implementation considerations are detailed in the Subgroup considerations section below.

Subgroup considerations

Aboriginal and Torres Strait Islander Peoples

The panel noted that some Aboriginal and Torres Strait Islanders may prefer to use a combination of traditional medicine (i.e. honey) and western medicine and that clinicians should recognise the importance of maintaining traditional practices where possible. Even without published evidence for their use, there may be additional benefits beyond those that are directly related to improving the infection, including the development of a supportive therapeutic relationship. The clinician should raise the potential for ceasing traditional medicines if there are concerns about drug interactions or adverse events.

Other subgroup considerations

As described for Aboriginal and Torres Strait Islander Peoples, the panel noted that some people may wish to use complementary medicine or adjunctive wound healing measures in combination with western medicine and that clinicians should recognise that there may be additional benefits beyond those that are directly related to improving the infection, including the development of a supportive therapeutic relationship. The clinician should raise the potential for ceasing complementary medicines if there are concerns about drug interactions, adverse events and/or inappropriate financial costs.

Monitoring considerations

The panel suggests that the use of such therapies should be recorded by each service and a regular evaluation performed to review patient outcomes and adverse events in those using such therapies.

Future research considerations

The panel noted that there is a need for additional high quality studies of adjunctive topical treatments in diabetes-related foot infections to determine whether there is added benefit from these therapies.



DISCUSSION

Recommendations summary

Best-practice adaptation of the 2019 IWGDF Working Group's Infection Guidelines for the Australian national context was undertaken by an expert panel, leading to the development of the first multi-disciplinary, evidence-based Australian diabetes-related foot infection guideline since 2011. A total of 27 recommendations, including 36 sub-recommendations, were screened, with 29 sub-recommendations adopted without further review and seven undergoing full assessment. Of the seven undergoing full assessment, four were adapted, two were adopted and one was excluded. All 36 original sub-recommendations were further assessed for specific considerations related to their implementation, specific subgroups (including Aboriginal and Torres Strait Islander and geographically remote populations), monitoring and future research.

Adaptation of an existing guideline has the benefit of substantially reducing the cost of guideline development, thus enabling this guideline to be developed in a timely manner. However, this process is limited by a reduced ability to assess new evidence published since the original guidelines were completed.

Justifications summary

Recommendation 23(a) was excluded based on substantial differences in judgements to the IWGDF for the certainty of evidence and balance of effects (Table 2) and due to inclusion of a heterogeneous population that was considered too broad for the recommendation. In addition, Recommendation 21(a) was considered to already cover the subgroup of patients where evidence exists to support a shorter duration of therapy for diabetes-related foot osteomyelitis.

Recommendations 12, 16, 17 and 18 were adapted in large part due to differences in the population. In particular, there is no local evidence to suggest a need for a difference in empiric antibiotic management in patients in temperate or tropical locations, however, the chronicity of infection does impact the bacteria identified on culture.

Implementation considerations summary

Beyond the implementation considerations identified for specific patient subgroups, key themes that were identified as relating to implementation included variable accessibility and variable expertise. Specific diagnostic techniques and treatment approaches identified as having variable availability across geographical locations and secondary and tertiary centres included procalcitonin, percutaneous bone biopsy, advanced imaging studies, restricted antibiotics, and surgical expertise. Furthermore, there is reduced expertise in the use of some diagnostic tests such as procalcitonin and percutaneous bone biopsy. While alternative options for procalcitonin such as CRP and ESR are widely available, the panel recommended that expertise in percutaneous bone biopsy be developed more widely.

The panel highlighted that choice of antibiotic regimen should include multiple considerations including a number that are patient-related. Considerations include likely or proven causative pathogen(s) and their antibiotic susceptibilities, expected efficacy, severity of infection, route of administration, adverse drug reactions, local antibiotic resistance patterns, appropriate antimicrobial stewardship, antibiotic restrictions, cost, access, likelihood of drug interactions, and patient preferences for route of administration and risk of adverse reactions



Subgroup considerations summary

Geographically remote people

People living in geographically remote areas face a number of barriers to effective implementation of this guideline. Barriers include reduced access to diagnostic services including basic services such as X-ray and advanced services such as MRI or PET scan, delays in time to results for biomarkers or pathological sampling and reduced access to surgical and specialist foot expertise. In addition, options for treatment may be impacted with hospitalisation unavailable locally and reduced local access to intravenous antibiotics or surgery.

An inability to undergo local treatment may impact the choice of treatment for some patients who wish to be treated in their local community, with an increased preference given to non-surgical interventions, outpatient parenteral therapy, oral antibiotics or use of telehealth by some individuals. In many circumstances, treatment will still be required, and it is important that remote centres have clear referral pathways (including criteria for referral and who to contact) to ensure access to timely advice and transfer mechanisms. In addition, the use of technology such as telehealth appointments and patient-centred co-management arrangements such as joint appointments with general practitioners and specialists should be considered where feasible

Aboriginal and Torres Strait Islander Peoples

Given the increased risk of complications from diabetes-related foot infections, including amputations, in Aboriginal and Torres Strait Islander Peoples, it is vital that guidelines be adjusted to ensure inclusivity of this population. Cultural and language barriers need to be carefully assessed and mitigated through the support of Aboriginal health workers, Aboriginal liaison officers and interpreters as much as possible. Clinicians should aim to explore each patient's understanding of their diabetes-related foot infection including predisposing factors, prognosis and potential treatment options.

As described in the section above, many of the potential barriers to implementation of the guideline that relate to geographically remote people also relate to a substantial proportion of Aboriginal and Torres Strait Islander Peoples due to 20% of Aboriginal and Torres Strait Islander Peoples living rurally (45) and a substantial proportion living in remote locations. An inability to undergo treatment locally may impact the choice of treatment for some patients who wish to be treated on country and/or near their local community, and clinicians should discuss alternative treatment options with patients including associated benefits and risks.

The panel highlighted that some Aboriginal and Torres Strait Islanders may wish to use a combination of traditional and western medicine and that clinicians should approach this with an open mind that positively fosters the therapeutic relationship and encourages engagement with medical services. In certain circumstances traditional medicine may be a potential harm, however, this should be addressed in a sensitive and culturally appropriate manner.

Prescribers should consider empiric MRSA coverage in patients known to be colonised with MRSA or those living in areas with a high prevalence of MRSA. An increased rate of MRSA has been identified in some Aboriginal and Torres Strait Islanders populations. For example, a study from Darwin found over 40% of Aboriginal and Torres Strait Islander patients with a diabetes-related foot infection had associated MRSA (5).

Other subgroup considerations

Prescribers should consider empiric MRSA coverage in patients known to be colonised with MRSA or those living in areas with a high prevalence of MRSA.



Monitoring considerations summary

The panel recognises that different services will undertake this process differently, however, they noted that monitoring and evaluation forms a vital component of best-practice clinical management of diabetes-related foot infections and the principles followed should be similar for all services. The panel suggests that services undertake an audit of patient outcomes every 12 months at a minimum. To facilitate this, minimum data (46) should be collected on patients' treatment approaches (including antibiotic and surgical management) and outcomes. Outcomes should be compared over time and to external units where possible.

Future research considerations summary

The adaptation and development of this guideline highlights the low number of clinically relevant high quality studies that exist to assess the diagnostic and in particular the treatment options for diabetes-related foot infections. Of the 35 new sub-recommendations only two were rated as having a high quality of evidence and 12 as moderate quality of evidence. A need for future research was identified for the majority of the 35 guideline recommendations. In particular there is a need, where possible, for future research to follow strong methodological processes such as RCTs, with uniform patient-centred outcome measures.

Clinical researchers need to continue to evolve consensus definitions for the diagnosis, monitoring and resolution of both soft tissue and deep structure infections. There is a need for robust validation of assessment tools that focus on the specific clinical signs and symptoms of infection within the complex environment of diabetes-related foot disease. These should be accompanied by standardised microbiological sampling and processing as well as radiological reporting methods. Alongside this, the broader community must identify appropriate patient reported outcomes to ensure large studies can be designed that are pragmatic and relevant; comparing diagnostic techniques, antibiotic route, duration and type, surgical intervention and adjunctive therapies.

In addition, future research should consider clinically relevant questions. For example, although a number of randomised controlled trials have assessed antibiotic therapy for diabetes-related foot infections, most have been non-inferiority studies comparing a new antibiotic with standard therapy and few have directly compared commonly used antibiotics and thus have not impacted daily clinical practice.



CONCLUSION

Adaptation of the 2019 IWGDF's Infection Guidelines has enabled the development of 35 evidence-based diabetes-related foot infection recommendations to assist practitioners in secondary and tertiary settings in the Australian context from the multiple disciplines that diagnose and treat diabetes-related foot infections. In combination with simplified clinical pathway tools, they provide an evidence-based framework to ensure best management of individuals with diabetes-related foot infections across Australia and highlight considerations that are needed in specific patient subgroups, such as Aboriginal and Torres Strait Islander Peoples and geographically remote populations.

LIST OF ABBREVIATIONS

CRP	C-reactive protein
CT	Computed tomography
ESR	Erythrocyte sedimentation ration
EtD	Evidence to Decision
GRADE	Grading of Recommendations Assessment, Development and Evaluation
IDSA	Infectious Diseases Society of America
IWGDF	International Working Group of the Diabetic Foot
MDT	Multidisciplinary team
MRSA	methicillin resistant <i>Staphylococcus aureus</i>
NHMRC	National Health and Medical Research Council
PICO	Population, intervention, control and outcomes
RCT	Randomised controlled trial
SIRS	Systematic inflammatory response syndrome



DECLARATIONS

Ethical approval

Not applicable.

Consent for publication

Not applicable.

Availability of data and materials

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Competing interests

The funding/supporting bodies below provided oversight and final approval for this guideline, however, did not have any input into the decisions on recommendations and rationale contained in these guidelines or in the writing of these guidelines. JChe is employed by Diabetes Victoria and is fully funded by the National Diabetes Services Scheme. MM was an author of the IWGDF Infection Guidelines and Systematic Review on which this manuscript is based. MM was specifically involved with the development and drafting recommendations 5 to 9 in the IWGDF Infection Guideline and addressed this conflict by not screening, assessing, deciding on or drafting any of these recommendations as part of this Australian Guideline project. All other authors declare that they have no relevant competing interests

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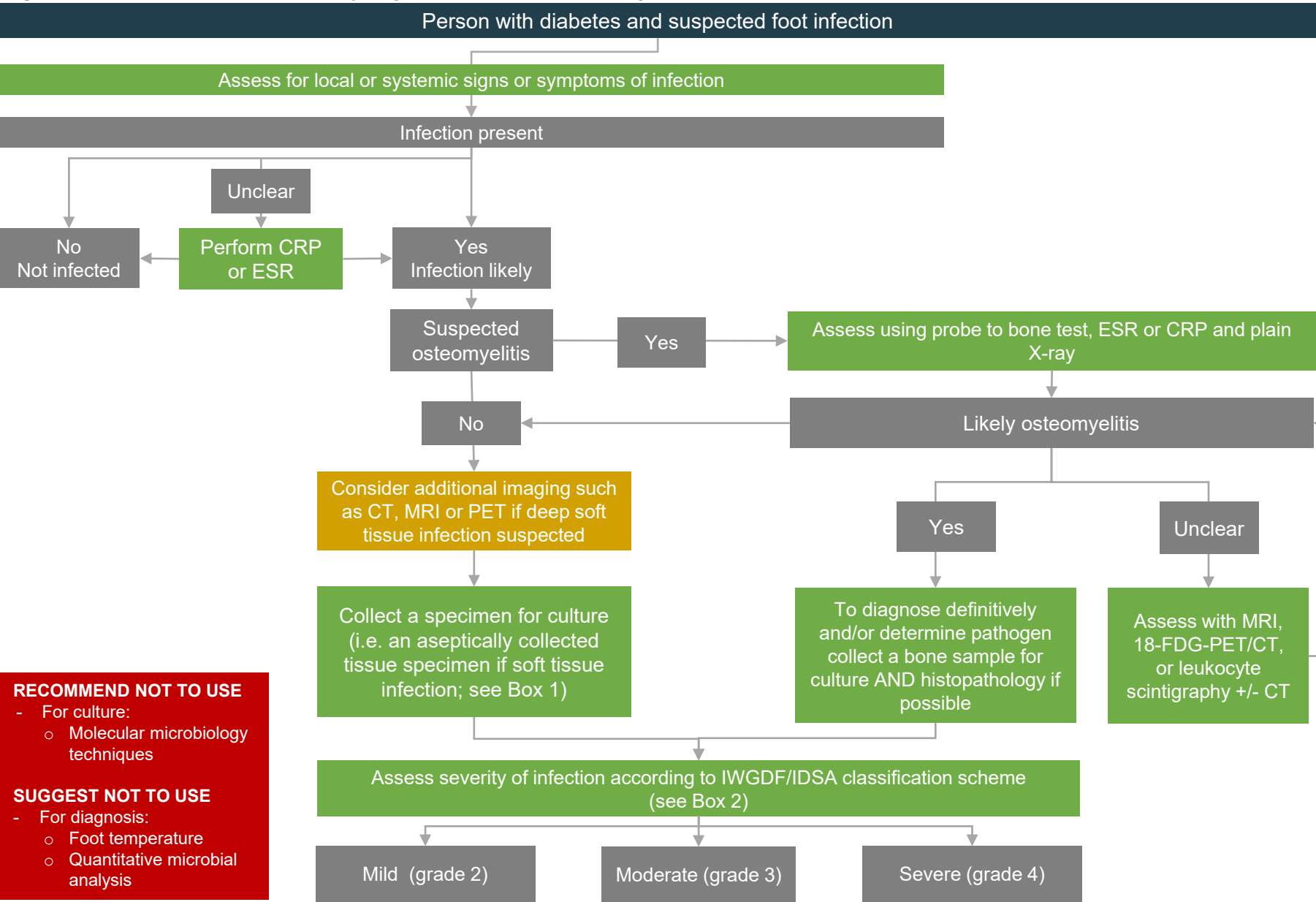
Authors' contributions

RC screened, assessed, and drafted recommendations and rationales, and drafted and critically reviewed the manuscript. SL, MM and ER screened, assessed, and drafted recommendations and rationales, and critically reviewed the manuscript. JCha provided Aboriginal and Torres Strait Islander and end-user intellectual input and content into the screening, assessment and drafting of all recommendations and rationale, and critically reviewed the manuscript. JChe provided lived experience and consumer intellectual input and content into the screening, assessment and drafting of all recommendations and rationale, and critically reviewed the manuscript. RC acted as the chair of the author/chapter group. RC takes full responsibility for the content of the manuscript and all authors approved the manuscript for submission.

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Figure 1a: Australian clinical pathway to guide evidence-based diagnosis of infection in people with diabetes



RECOMMEND NOT TO USE

- For culture:
 - o Molecular microbiology techniques

SUGGEST NOT TO USE

- For diagnosis:
 - o Foot temperature
 - o Quantitative microbial analysis

Box 1. Tips for collecting diagnostic samples

- Wherever possible collect tissue, bone or pus using an aseptic technique for culture.
- Histopathology should also be requested on bone specimens.
- Avoid taking superficial swabs of ulcers as they will more likely identify colonising organisms than infecting pathogens.
- Before collecting a sample, debride and clean (using saline) the ulcer base.
- Do not sample areas of necrotic or non-viable tissue.

Box 2. IWGDF severity classification scheme

Mild (grade 2) diabetic foot infection:

- Involves only the skin or subcutaneous tissue.
- Erythema extends <2cm from the wound margin.
- No systemic features of infection.

Moderate (grade 3) diabetic foot infection:

Infection is not associated with systemic inflammatory response syndrome (SIRS) and either:

- Involves structures deeper than the skin and subcutaneous tissues (e.g., tendon, muscle, joint, bone) OR
- Erythema extends ≥2cm from the wound margin.

Severe (grade 4) diabetic foot infection:

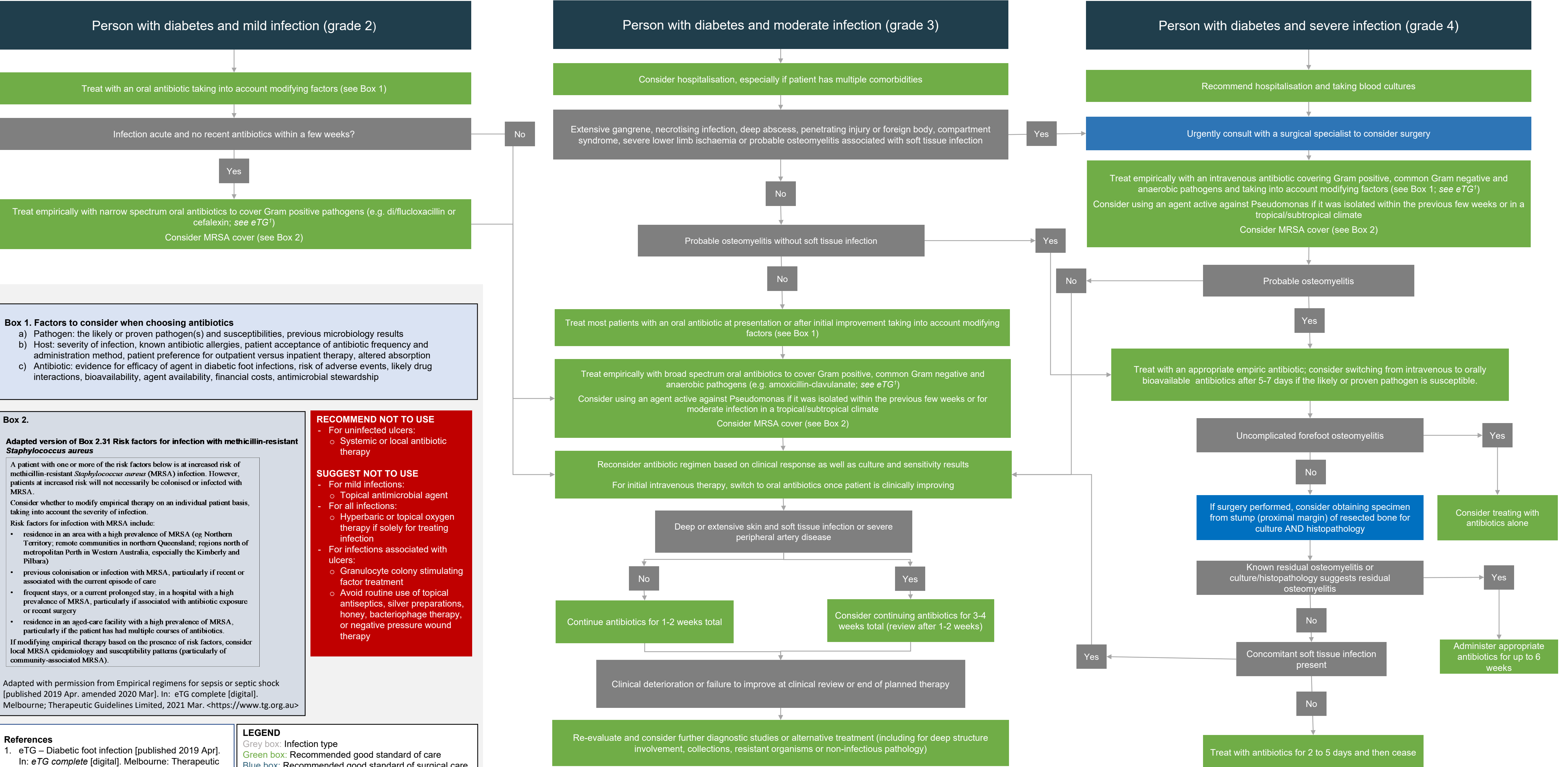
Any infection associated with systemic inflammatory response syndrome (SIRS), as manifested by ≥2 of the following:

- Temperature, >38°C or <36 °C
- Heart rate, >90 beats/min
- Respiratory rate, >20 breaths/min or PaCO₂ <32 mmHg
- White blood cell count >12 x 10⁹/L or <4 x 10⁹/L, or >10% immature (band) forms

Osteomyelitis:

Infection involving bone (add ‘O’ after grade)

Figure 1b: Australian clinical pathway to guide evidence-based management of infection in people with diabetes



Box 1. Factors to consider when choosing antibiotics

- a) Pathogen: the likely or proven pathogen(s) and susceptibilities, previous microbiology results
- b) Host: severity of infection, known antibiotic allergies, patient acceptance of antibiotic frequency and administration method, patient preference for outpatient versus inpatient therapy, altered absorption
- c) Antibiotic: evidence for efficacy of agent in diabetic foot infections, risk of adverse events, likely drug interactions, bioavailability, agent availability, financial costs, antimicrobial stewardship

Box 2.

Adapted version of Box 2.31 Risk factors for infection with methicillin-resistant *Staphylococcus aureus*

A patient with one or more of the risk factors below is at increased risk of methicillin-resistant *Staphylococcus aureus* (MRSA) infection. However, patients at increased risk will not necessarily be colonised or infected with MRSA.

Consider whether to modify empirical therapy on an individual patient basis, taking into account the severity of infection.

Risk factors for infection with MRSA include:

- residence in an area with a high prevalence of MRSA (eg Northern Territory; remote communities in northern Queensland; regions north of metropolitan Perth in Western Australia, especially the Kimberly and Pilbara)
- previous colonisation or infection with MRSA, particularly if recent or associated with the current episode of care
- frequent stays, or a current prolonged stay, in a hospital with a high prevalence of MRSA, particularly if associated with antibiotic exposure or recent surgery
- residence in an aged-care facility with a high prevalence of MRSA, particularly if the patient has had multiple courses of antibiotics.

If modifying empirical therapy based on the presence of risk factors, consider local MRSA epidemiology and susceptibility patterns (particularly of community-associated MRSA).

Adapted with permission from Empirical regimens for sepsis or septic shock [published 2019 Apr. amended 2020 Mar]. In: eTG complete [digital]. Melbourne; Therapeutic Guidelines Limited, 2021 Mar. <<https://www.tg.org.au>>

References

1. eTG – Diabetic foot infection [published 2019 Apr]. In: eTG complete [digital]. Melbourne: Therapeutic Guidelines Limited; 2021 Mar. <<https://www.tg.org.au>>

LEGEND

- Grey box: Infection type
- Green box: Recommended good standard of care
- Blue box: Recommended good standard of surgical care
- Red box: Contraindication



TABLE 1

Summary of screening ratings for acceptability and applicability in the Australian context for all IWGDF Infection recommendations.

RECOMMENDATION	ACCEPTABILITY			APPLICABILITY				FULL	COMMENTS
	1	2	3	4	5	6	7	ASSESSMENT	
1a	+	+	+	+	+	+	+	No	
1b	+	+	+	+	+	+	+	No	
2	+	+	+	+	+	+	+	No	
3	+	+	+	+	+	+	+	No	
4	+	+	+	+	+	+	+	No	
5	+	+	+	+	+	+	+	No	
6a	+	+	+	+	+	+	+	No	
6b	+	+	+	+	+	+	+	No	
7	+	+	+	+	+	+	+	No	
8	+	+	+	+	+	+	+	No	
9	+	+	+	+	+	+	+	No	
10	+	+	+	+	+	+	+	No	
11	+	+	+	+	+	+	+	No	
12	+	+	+	-	+	+	+	Yes	Assess applicability to patient population
13	+	+	+	+	+	+	+	No	
14	+	+	+	+	+	+	+	No	
15a	+	+	+	+	+	+	+	No	
15b	+	+	+	+	+	+	+	No	
15c	+	+	+	+	+	+	+	No	
16	+	+	+	?	+	+	+	Yes	Assess applicability to patient population
17	+	+	+	?	+	+	+	Yes	Assess applicability to patient population
18	+	+	+	?	+	+	+	Yes	Assess applicability to patient population
19	+	+	+	+	+	+	+	No	
20	+	+	+	+	+	+	+	No	
21a	+	+	+	?	+	+	+	Yes	Assess applicability to patient population
21b	+	+	+	+	+	+	+	No	
22	+	+	+	+	+	+	+	No	
23a	+	+	+	+	+	-	-	Yes	Assess expertise availability & policy constraints
23b	+	+	+	+	+	+	+	No	
24	+	+	+	+	+	+	+	No	
25a	+	+	+	+	+	+	+	No	
25b	+	?	+	+	+	+	+	Yes	Assess strength of recommendation
26	+	+	+	+	+	+	+	No	
27a	+	+	+	+	+	+	+	No	
27b	+	+	+	+	+	+	+	No	
TOTAL	36	35	36	31	36	35	35	7	
%	100	97	100	86	100	97	97	19	

Note: +, yes item is met; -, no item is not met; ? unsure if item is met

TABLE 2 Summary of final panel judgements compared with IWGDF judgements for all IWGDF Infection recommendations.

NO	PROBLEM	DESIRABLE EFFECTS	UNDESIRABLE EFFECTS	QUALITY OF EVIDENCE	VALUES	BALANCE OF EFFECTS	ACCEPTABILITY	APPLICABILITY/FEASIBILITY	DECISION	COMMENT
1a	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
1b	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
2	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
3	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
4	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
5	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
6a	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
6b	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
7	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
8	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
9	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
10	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
11	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
12	Probably yes	Moderate	Trivial	Very low	Possibly important uncertainty	Probably favours the intervention	Probably yes	Yes	Adapt	Adapted QoE & population
13	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
14	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
15a	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
15b	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
15c	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
16	Probably yes	Small	Trivial	Low	Possibly important uncertainty	Probably favours the intervention	Probably yes	Probably yes	Adapt	Adapted strength of recommendation and population
17	Probably yes	Moderate	Trivial	Low	Possibly important uncertainty	Probably favours the intervention	Probably yes	Probably yes	Adapt	Adapted population

Note: +, panel agreed with original IWGDF judgement; -, panel disagreed with original IWGDF judgement; ?, panel unsure if agreed with original IWGDF judgement due to lack of IWGDF information on judgement; =, panel agreed with original IWGDF judgements during screening (see Table 1); QoE: Quality of evidence.

TABLE 2 (cont.) Summary of final panel judgements compared with IWGDF judgements for all IWGDF Infection recommendations.

NO	PROBLEM	DESIRABLE EFFECTS	UNDESIRABLE EFFECTS	QUALITY OF EVIDENCE	VALUES	BALANCE OF EFFECTS	ACCEPTABILITY	APPLICABILITY/FEASIBILITY	DECISION	COMMENT
18	Probably yes	Small	Trivial	Low	Possibly important uncertainty	Probably favours the intervention	Probably yes	Probably yes	Adapt	Adapted population
19	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
20	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
21a	Probably yes	Moderate	Trivial	Moderate	Possibly important uncertainty	Favours the intervention	Probably yes	Probably yes	Adopt	Adopted with full assessment
21b	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
22	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
23a	Probably yes	Trivial	Varies	Low	Probably no important uncertainty	Varies	Varies	Probably yes	Exclude	Excluded due to balance of effects, quality of evidence and population
23b	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
24	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
25a	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
25b	Probably yes	Small	Trivial	Moderate	Possibly important uncertainty	Probably favours the intervention	Probably yes	Probably yes	Adopt	Adopted with full assessment
26	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
27a	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
27b	=	=	=	=	=	=	=	=	Adopt	Adopt in screening

Note: +, panel agreed with original IWGDF judgement; -, panel disagreed with original IWGDF judgement; ?, panel unsure if agreed with original IWGDF judgement due to lack of IWGDF information on judgement; =, panel agreed with original IWGDF judgements during screening (see Table 1); QoE: Quality of evidence.

TABLE 3 Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for diabetes-related foot infections

NO	ORIGINAL IWGDF RECOMMENDATION	DECISION	NEW AUSTRALIAN RECOMMENDATION
1a	Diagnose a soft tissue diabetic foot infection clinically, based on the presence of local or systemic signs and symptoms of inflammation. (Strong; low)	Adopted	Diagnose a soft tissue <u>diabetes-related</u> foot infection clinically, based on the presence of local or systemic signs and symptoms of inflammation. (Strong; low)
1b	Assess the severity of any diabetic foot infection using the Infectious Diseases Society of America/International Working Group on the Diabetic Foot classification scheme. (Strong, moderate)	Adopted	Assess the severity of any <u>diabetes-related</u> foot infection using the <u>International Working Group on the Diabetic Foot / Infectious Diseases Society of America</u> classification scheme. (Strong; moderate)
2	Consider hospitalising all persons with diabetes and a severe (grade 4) foot infection and those with a moderate (grade 3) infection that is complex or associated with key relevant morbidities. (Strong; low)	Adopted	As stated in original IWGDF Recommendation
3	In a person with diabetes and a possible foot infection for whom the clinical examination is equivocal or uninterpretable, consider ordering an inflammatory serum biomarker, such as C-reactive protein, erythrocyte sedimentation rate, and perhaps procalcitonin, as an adjunctive measure for establishing the diagnosis. (Weak; low)	Adopted	As stated in original IWGDF Recommendation
4	As neither electronically measuring foot temperature nor using quantitative microbial analysis has been demonstrated to be useful as a method for diagnosing diabetic foot infection, we suggest not using them. (Weak; low)	Adopted	As neither electronically measuring foot temperature nor using quantitative microbial analysis has been demonstrated to be useful as a method for diagnosing <u>diabetes-related</u> foot infection, we suggest not using them. (Weak; low)
5	In a person with diabetes and suspected osteomyelitis of the foot, we recommend using a combination of the probe-to-bone test, the erythrocyte sedimentation rate (or C-reactive protein and/or procalcitonin), and plain X-rays as the initial studies to diagnose osteomyelitis. (Strong; moderate)	Adopted	As stated in original IWGDF Recommendation
6a	In a person with diabetes and suspected osteomyelitis of the foot, if a plain X-ray and clinical and laboratory findings are most compatible with osteomyelitis, we recommend no further imaging of the foot to establish the diagnosis. (Strong; low)	Adopted	As stated in original IWGDF Recommendation
6b	If the diagnosis of osteomyelitis remains in doubt, consider ordering an advanced imaging study, such as magnetic resonance imaging scan, 18F-FDG-positron emission tomography/computed tomography (CT) or leukocyte scintigraphy (with or without CT). (Strong; moderate)	Adopted	If the diagnosis of osteomyelitis remains in doubt, consider ordering an advanced imaging study, such as magnetic resonance imaging scan, 18F-FDG-positron emission tomography (PET)/computed tomography (CT) or leukocyte scintigraphy (with or without CT). (Strong; moderate)
7	In a person with diabetes and suspected osteomyelitis of the foot, in whom making a definitive diagnosis or determining the causative pathogen is necessary for selecting treatment, collect a sample of bone (percutaneously or surgically) to culture clinically relevant bone microorganisms and for histopathology (if possible). (Strong; low)	Adopted	As stated in original IWGDF Recommendation

Note: underlined wording indicates the specific adapted changes to the original IWGDF recommendation

TABLE 3 (cont.) Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for diabetes-related foot infections.

NO	ORIGINAL IWGDF RECOMMENDATION	DECISION	NEW AUSTRALIAN RECOMMENDATION
8a	Collect an appropriate specimen for culture for almost all clinically infected wounds to determine the causative pathogens. (Strong; low)	Adopted	As stated in original IWGDF Recommendation
8b	For a soft tissue diabetic foot infection, obtain a sample for culture by aseptically collecting a tissue specimen (by curettage or biopsy) from the ulcer. (Strong; moderate)	Adopted	For a soft tissue <u>diabetes-related</u> foot infection, obtain a sample for culture by aseptically collecting a tissue specimen (by curettage or biopsy) from the ulcer. (Strong; moderate)
9	Do not use molecular microbiology techniques (instead of conventional culture) for the first-line identification of pathogens from samples in a patient with a diabetic foot infection. (Strong; low)	Adopted	Do not use molecular microbiology techniques (instead of conventional culture) for the first-line identification of pathogens from samples in a patient with a <u>diabetes-related</u> foot infection. (Strong; low)
10	Treat a person with a diabetic foot infection with an antibiotic agent that has been shown to be effective in a published randomized controlled trial and is appropriate for the individual patient. Some agents to consider include penicillins, cephalosporins, carbapenems, metronidazole (in combination with other antibiotic[s]), clindamycin, linezolid, daptomycin, fluoroquinolones, or vancomycin, but not tigecycline. (Strong; high)	Adopted	Treat a person with a <u>diabetes-related</u> foot infection with an antibiotic agent that has been shown to be effective in a published <u>randomised</u> controlled trial and is appropriate for the individual patient. Some agents to consider include penicillins, cephalosporins, carbapenems, metronidazole (in combination with other antibiotic[s]), clindamycin, linezolid, daptomycin, fluoroquinolones, or vancomycin, but not tigecycline. (Strong; high)
11	Select an antibiotic agent for treating a diabetic foot infection based on: the likely or proven causative pathogen(s) and their antibiotic susceptibilities; the clinical severity of the infection; published evidence of efficacy of the agent for diabetic foot infections; risk of adverse events, including collateral damage to the commensal flora; likelihood of drug interactions; agent availability; and, financial costs. (Strong; moderate)	Adopted	Select an antibiotic agent for treating a <u>diabetes-related</u> foot infection based on: the likely or proven causative pathogen(s) and their antibiotic susceptibilities; the clinical severity of the infection; published evidence of efficacy of the agent for <u>diabetes-related</u> foot infections; risk of adverse events, including collateral damage to the commensal flora; likelihood of drug interactions; agent availability; and, financial costs. (Strong; moderate)
12	Administer antibiotic therapy initially by the parenteral route to any patient with a severe (grade 4) diabetic foot infection. Switch to oral therapy if the patient is clinically improving and has no contraindications to oral therapy and if there is an appropriate oral agent available. (Strong; low)	Adapted	Administer antibiotic therapy initially by the parenteral route to any patient with a severe (grade 4) <u>skin and soft tissue diabetes-related</u> foot infection. Switch to oral therapy if the patient is clinically improving and has no contraindications to oral therapy and if there is an appropriate oral agent available. (Strong; <u>very low</u>)
13	Treat patients with a mild (grade 2) diabetic foot infection, and most with a moderate (grade 3) diabetic foot infection, with oral antibiotic therapy, either at presentation or when clearly improving with initial intravenous therapy. (Weak; low)	Adopted	Treat patients with a mild (grade 2) <u>diabetes-related</u> foot infection, and most with a moderate (grade 3) <u>diabetes-related</u> foot infection, with oral antibiotic therapy, either at presentation or when clearly improving with initial intravenous therapy. (Weak; low)
14	We suggest not using any currently available topical antimicrobial agent for treating a mild (grade 2) diabetic foot infection. (Weak; moderate)	Adopted	We suggest not using any currently available topical antimicrobial agent for treating a mild (grade 2) <u>diabetes-related</u> foot infection. (Weak; moderate)
15a	Administer antibiotic therapy to a patient with a skin or soft tissue diabetic foot infection for a duration of 1 to 2 weeks. (Strong; high)	Adopted	Administer antibiotic therapy to a patient with a skin or soft tissue <u>diabetes-related</u> foot infection for a duration of 1 to 2 weeks. (Strong; high)

Note: underlined wording indicates the specific adapted changes to the original IWGDF recommendation

TABLE 3 (cont.) Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for diabetes-related foot infections.

NO	ORIGINAL IWGDF RECOMMENDATION	DECISION	NEW AUSTRALIAN RECOMMENDATION
15b	Consider continuing treatment, perhaps for up to 3 to 4 weeks, if the infection is improving but is extensive and is resolving slower than expected or if the patient has severe peripheral artery disease. (Weak; low)	Adopted	As stated in original IWGDF Recommendation
15c	If evidence of infection has not resolved after 4 weeks of apparently appropriate therapy, re-evaluate the patient, and reconsider the need for further diagnostic studies or alternative treatments. (Strong; low)	Adopted	As stated in original IWGDF Recommendation
16	For patients who have not recently received antibiotic therapy and who reside in a temperate climate area, target empiric antibiotic therapy at just aerobic gram-positive pathogens (beta-haemolytic streptococci and <i>S. aureus</i>) in cases of a mild (grade 2) diabetic foot infection. (Strong; low)	Adapted	For patients who have not recently received antibiotic therapy and <u>have an acute infection</u> , consider targeting empiric antibiotic therapy at just aerobic Gram positive pathogens (beta-haemolytic streptococci and <i>Staphylococcus aureus</i>) in cases of a mild (grade 2) <u>diabetes-related</u> foot infection. (Weak; low)
17	For patients residing in a tropical/subtropical climate, or who have been treated with antibiotic therapy within a few weeks, have a severely ischemic affected limb, or a moderate (grade 3) or severe (grade 4) infection, we suggest selecting an empiric antibiotic regimen that covers gram positive pathogens, commonly isolated gram-negative pathogens, and possibly obligate anaerobes in cases of moderate (grade 3) to severe (grade 4) diabetic foot infections. Then, reconsider the antibiotic regimen based on both the clinical response and culture and sensitivity results. (Weak; low)	Adapted	For patients who have been treated with antibiotic therapy within a few weeks, <u>have a chronic infection</u> , have a severely <u>ischaemic</u> affected limb, or a moderate (grade 3) or severe (grade 4) infection, we suggest selecting an empiric antibiotic regimen that covers Gram positive pathogens, commonly isolated <u>Gram</u> negative pathogens, and possibly obligate anaerobes in cases of moderate (grade 3) to severe (grade 4) <u>diabetes-related</u> foot infections. Then, reconsider the antibiotic regimen based on both the clinical response and culture and sensitivity results. (Weak; low)
18	Empiric treatment aimed at <i>Pseudomonas aeruginosa</i> is not usually necessary in temperate climates, but consider it if <i>P. aeruginosa</i> has been isolated from cultures of the affected site within the previous few weeks, or in tropical/subtropical climates (at least for moderate (grade 3) or severe (grade 4) infection). (Weak; low)	Adapted	Empiric treatment aimed at <i>Pseudomonas aeruginosa</i> is not usually <u>necessary but</u> consider it if <i>P. aeruginosa</i> has been isolated from cultures of the affected site within the previous few weeks, or in tropical/subtropical climates (at least for moderate [grade 3] or severe [grade 4] infection). (Weak; low)
19	Do not treat clinically uninfected foot ulcers with systemic or local antibiotic therapy with the goal of reducing the risk of infection or promoting ulcer healing. (Strong; low)	Adopted	As stated in original IWGDF Recommendation
20	Nonsurgeons should urgently consult with a surgical specialist in cases of severe (grade 4) infection or of moderate (grade 3) infection complicated by extensive gangrene, necrotizing infection, signs suggesting deep (below the fascia) abscess or compartment syndrome, or severe lower limb ischemia. (Strong; low)	Adopted	Nonsurgeons should urgently consult with a surgical specialist in cases of severe (grade 4) infection or of moderate (grade 3) infection complicated by extensive gangrene, <u>necrotising</u> infection, signs suggesting deep (below the fascia) abscess or compartment syndrome, or severe lower limb <u>ischaemia</u> . (Strong; low)
21a	In a patient with diabetes and uncomplicated forefoot osteomyelitis, for whom there is no other indication for surgical treatment, consider treating with antibiotic therapy without surgical resection of bone. (Strong; moderate)	Adopted	As stated in original IWGDF Recommendation
21b	In a patient with probable diabetic foot osteomyelitis with concomitant soft tissue infection, urgently evaluate for the need for surgery as well as intensive post-operative medical and surgical follow-up. (Strong; moderate)	Adopted	In a patient with probable <u>diabetes-related</u> foot osteomyelitis with concomitant soft tissue infection, urgently evaluate the need for surgery as well as intensive post-operative medical and surgical follow-up. (Strong; moderate)

Note: underlined wording indicates the specific adapted changes to the original IWGDF recommendation



TABLE 3 (cont.) Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for diabetes-related foot infections.

NO	ORIGINAL IWGDF RECOMMENDATION	DECISION	NEW AUSTRALIAN RECOMMENDATION
22	Select antibiotic agents for treating diabetic foot osteomyelitis from among those that have demonstrated efficacy for osteomyelitis in clinical studies. (Strong; low)	Adopted	Select antibiotic agents for treating <u>diabetes-related</u> foot osteomyelitis from among those that have demonstrated efficacy for osteomyelitis in clinical studies. (Strong; low)
23a	Treat diabetic foot osteomyelitis with antibiotic therapy for no longer than 6 weeks. If the infection does not clinically improve within the first 2 to 4 weeks, reconsider the need for collecting a bone specimen for culture, undertaking surgical resection, or selecting an alternative antibiotic regimen. (Strong; moderate)	Excluded	
23b	Treat diabetic foot osteomyelitis with antibiotic therapy for just a few days if there is no soft tissue infection and all the infected bone has been surgically removed. (Weak; low)	Adopted	Treat <u>diabetes-related</u> foot osteomyelitis with antibiotic therapy for just a few days if there is no soft tissue infection and all the infected bone has been surgically removed. (Weak; low)
24	For diabetic foot osteomyelitis cases that initially require parenteral therapy, consider switching to an oral antibiotic regimen that has high bioavailability after perhaps 5 to 7 days, if the likely or proven pathogens are susceptible to an available oral agent and the patient has no clinical condition precluding oral therapy. (Weak; moderate)	Adopted	For people with <u>diabetes-related</u> foot osteomyelitis that initially require parenteral therapy, consider switching to an oral antibiotic regimen that has high bioavailability after perhaps 5 to 7 days, if the likely or proven pathogens are susceptible to an available oral agent and the patient has no clinical condition precluding oral therapy. (Weak; moderate)
25a	During surgery to resect bone for diabetic foot osteomyelitis, consider obtaining a specimen of bone for culture (and, if possible, histopathology) at the stump of the resected bone to identify if there is residual bone infection. (Weak; moderate)	Adopted	During surgery to resect bone for <u>diabetes-related</u> foot osteomyelitis, consider obtaining a specimen of bone for culture (and, if possible, histopathology) at the stump of the resected bone to identify if there is residual bone infection. (Weak; moderate)
25b	If an aseptically collected culture specimen obtained during the surgery grows pathogen(s), or if the histology demonstrates osteomyelitis, administer appropriate antibiotic therapy for up to 6 weeks. (Strong; moderate)	Adopted	As stated in original IWGDF Recommendation
26	For a diabetic foot infection, do not use hyperbaric oxygen therapy or topical oxygen therapy as an adjunctive treatment if the only indication is specifically for treating the infection. (Weak; low)	Adopted	For a <u>diabetes-related</u> foot infection, do not use hyperbaric oxygen therapy or topical oxygen therapy as an adjunctive treatment if the only indication is specifically for treating the infection. (Weak; low)
27a	To specifically address infection in a diabetic foot ulcer do not use adjunctive granulocyte colony stimulating factor treatment (Weak; moderate)	Adopted	As stated in original IWGDF Recommendation
27b	To specifically address infection in a diabetic foot ulcer do not routinely use topical antiseptics, silver preparations, honey, bacteriophage therapy, or negative pressure wound therapy (with or without instillation). (Weak; low)	Adopted	To <i>specifically</i> address infection in a <u>diabetes-related</u> foot ulcer do not <u>routinely</u> use topical antiseptics, silver preparations, honey, bacteriophage therapy, or negative pressure wound therapy (with or without instillation). (Weak; low)

Note: underlined wording indicates the specific adapted changes to the original IWGDF recommendation



REFERENCES

1. Lazzarini PA, Pacella RE, Armstrong DG, van Netten JJ. Diabetes-related lower-extremity complications are a leading cause of the global burden of disability. *Diabet Med*. 2018.
2. Lazzarini PA, van Netten JJ, Fitridge RA, Griffiths I, Kinnear EM, Malone M, et al. Pathway to ending avoidable diabetes-related amputations in Australia. *Med J Aust*. 2018;209(7):288-90.
3. Jia L, Parker CN, Parker TJ, Kinnear EM, Derhy PH, Alvarado AM, et al. Incidence and risk factors for developing infection in patients presenting with uninfected diabetic foot ulcers. *PLoS One*. 2017;12(5):e0177916.
4. Lazzarini PA, O'Rourke SR, Russell AW, Clark D, Kuys SS. What are the key conditions associated with lower limb amputations in a major Australian teaching hospital? *J Foot Ankle Res*. 2012;5(1):12.
5. Commons RJ, Robinson CH, Gawler D, Davis JS, Price RN. High burden of diabetic foot infections in the top end of Australia: An emerging health crisis (DEFINE study). *Diabetes Res Clin Pract*. 2015;110(2):147-57.
6. Lynar SA, Robinson CH, Boutlis CS, Commons RJ. Risk factors for mortality in patients with diabetic foot infections: a prospective cohort study. *Intern Med J*. 2019;49(7):867-73.
7. O'Rourke S, Steffen C, Raulli A, Tulip F. Diabetic major amputation in Far North Queensland 1998-2008: what is the Gap for Indigenous patients? *Aust J Rural Health*. 2013;21(5):268-73.
8. Norman PE, Schoen DE, Gurr JM, Kolybaba ML. High rates of amputation among Indigenous people in Western Australia. *Med J Aust*. 2010;192(7):421.
9. National Indigenous Australians Agency. National Agreement on Closing the Gap. Canberra, Australia: National Indigenous Australians Agency; 2020.
10. Lipsky BA, Senneville E, Abbas ZG, Aragon-Sanchez J, Diggle M, Embil JM, et al. Guidelines on the diagnosis and treatment of foot infection in persons with diabetes (IWGDF 2019 update). *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3280.
11. Baker IDI Heart and Diabetes Institute. National evidence-based guideline on prevention, identification and management of foot complications in diabetes (Part of the National Health & Medical Research Council Approved Guidelines on Management of Type 2 Diabetes). Melbourne: Baker IDI Heart and Diabetes Institute; 2011.
12. National Health & Medical Research Council (NHMRC). Australian Clinical Practice Guidelines Portal Search Canberra, Australia: National Health & Medical Research Council (NHMRC); 2020 [Available from: <https://www.clinicalguidelines.gov.au/portal>].
13. National Health & Medical Research Council (NHMRC). Guidelines for Guidelines: Project planning - Version 5.0; Last updated 5 September 2019. Canberra, Australia: National Health & Medical Research Council (NHMRC); 2019.
14. Lazzarini PA, Raspovic A, Prentice J, Commons RJ, Fitridge RA, Charles J, et al. Guidelines development protocol and findings: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
15. National Health & Medical Research Council (NHMRC). Guidelines for Guidelines: Adopt, adapt or start from scratch - Version 5.2; Last updated 22 November 2018. Canberra, Australia: National Health & Medical Research Council (NHMRC); 2018.
16. The ADAPTE Collaboration. The ADAPTE Process: Resource Toolkit for Guideline Adaptation - Version 2.0. Perthshire, Scotland; 2009.
17. Schunemann HJ, Wiercioch W, Brozek J, Etzeandía-Ikobaltzeta I, Mustafa RA, Manja V, et al. GRADE Evidence to Decision (EtD) frameworks for adoption, adaptation, and de novo development of trustworthy recommendations: GRADE-ADOLOPMENT. *J Clin Epidemiol*. 2017;81:101-10.
18. Bus SA, Armstrong DG, Gooday C, Jarl G, Caravaggi C, Viswanathan V, et al. Guidelines on offloading foot ulcers in persons with diabetes (IWGDF 2019 update). *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3274.
19. Bus SA, Lavery LA, Monteiro-Soares M, Rasmussen A, Raspovic A, Sacco ICN, et al. Guidelines on the prevention of foot ulcers in persons with diabetes (IWGDF 2019 update). *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3269.
20. Bus SA, Van Netten JJ, Hinchliffe RJ, Apelqvist J, Lipsky BA, Schaper NC, et al. Standards for the development and methodology of the 2019 International Working Group on the Diabetic Foot guidelines. *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3267.
21. Hinchliffe RJ, Forsythe RO, Apelqvist J, Boyko EJ, Fitridge R, Hong JP, et al. Guidelines on diagnosis, prognosis, and management of peripheral artery disease in patients with foot ulcers and diabetes (IWGDF 2019 update). *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3276.
22. Monteiro-Soares M, Russell D, Boyko EJ, Jeffcoate W, Mills JL, Morbach S, et al. Guidelines on the classification of diabetic foot ulcers (IWGDF 2019). *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3273.
23. Rayman G, Vas P, Dhataria K, Driver V, Hartemann A, Londahl M, et al. Guidelines on use of interventions to enhance healing of chronic foot ulcers in diabetes (IWGDF 2019 update). *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3283.
24. Alonso-Coello P, Oxman AD, Moher J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 2: Clinical practice guidelines. *BMJ*. 2016;353:i2089.



REFERENCES

25. Alonso-Coello P, Schunemann HJ, Moher J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 1: Introduction. *BMJ*. 2016;353:i2016.
26. Flores EJ, Mull NK, Lavenberg JG, Mitchell MD, Leas BF, Williams A, et al. Using a 10-step framework to support the implementation of an evidence-based clinical pathways programme. *BMJ Qual Saf*. 2019;28(6):476-85.
27. Kaminski MR, Golledge J, Lasschuit JWW, Heinz-Schott K, Charles J, Cheney J, et al. Australian guideline on prevention of foot ulceration: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
28. Fernando ME, Horsley MW, Jones S, Martin B, Nube VL, Charles J, et al. Australian guideline on offloading treatment for foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
29. Chen P, Carville K, Swanson T, Lazzarini PA, Charles J, Cheney J, et al. Australian guideline on wound healing interventions to enhance healing of foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
30. Hamilton EJ, Scheepers J, Ryan H, Perrin BM, Charles J, Cheney J, et al. Australian guideline on wound classification of diabetes-related foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
31. Chuter VH, Quigley F, Tosenovsky P, Ritter JC, Charles J, Cheney J, et al. Australian guideline on diagnosis and management of peripheral artery disease: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
32. Mills JL, Sr., Conte MS, Armstrong DG, Pomposelli FB, Schanzer A, Sidawy AN, et al. The Society for Vascular Surgery Lower Extremity Threatened Limb Classification System: risk stratification based on wound, ischemia, and foot infection (WIFI). *J Vasc Surg*. 2014;59(1):220-34 e1-2.
33. eTG complete [digital]. Melbourne: Therapeutic Guidelines Limited; 2019 Jun.
34. Empirical regimens for sepsis or septic shock [published 2019 Apr. amended 2020 Mar]. eTG complete [digital]. Melbourne: Therapeutic Guidelines Limited; 2021 Mar.
35. Yates C, May K, Hale T, Allard B, Rowlings N, Freeman A, et al. Wound chronicity, inpatient care, and chronic kidney disease predispose to MRSA infection in diabetic foot ulcers. *Diabetes Care*. 2009;32(10):1907-9.
36. Barwell ND, Devers MC, Kennon B, Hopkinson HE, McDougall C, Young MJ, et al. Diabetic foot infection: Antibiotic therapy and good practice recommendations. *Int J Clin Pract*. 2017;71(10).
37. Lazaro-Martinez JL, Aragon-Sanchez J, Garcia-Morales E. Antibiotics versus conservative surgery for treating diabetic foot osteomyelitis: a randomized comparative trial. *Diabetes Care*. 2014;37(3):789-95.
38. Stengel D, Bauwens K, Sehoul J, Ekkernkamp A, Porzolt F. Systematic review and meta-analysis of antibiotic therapy for bone and joint infections. *Lancet Infect Dis*. 2001;1(3):175-88.
39. Conterno LO, Turchi MD. Antibiotics for treating chronic osteomyelitis in adults. *Cochrane Database Syst Rev*. 2013(9):CD004439.
40. Xing K, Huang G, Hua S, Xu G, Li M. Systematic review of randomized controlled trials on antibiotic treatment for osteomyelitis in diabetes. *Diabet Med*. 2019;36(5):546-56.
41. Karamanis EM, Matthaïou DK, Moraitis LI, Falagas ME. Fluoroquinolones versus beta-lactam based regimens for the treatment of osteomyelitis: a meta-analysis of randomized controlled trials. *Spine (Phila Pa 1976)*. 2008;33(10):E297-304.
42. Bessesen MT, Doros G, Henrie AM, Harrington KM, Hermos JA, Bonomo RA, et al. A multicenter randomized placebo controlled trial of rifampin to reduce pedal amputations for osteomyelitis in veterans with diabetes (VA INTREPID). *BMC Infect Dis*. 2020;20(1):23.
43. Lauf L, Ozsvar Z, Mitha I, Regoly-Merei J, Embil JM, Cooper A, et al. Phase 3 study comparing tigecycline and ertapenem in patients with diabetic foot infections with and without osteomyelitis. *Diagn Microbiol Infect Dis*. 2014;78(4):469-80.
44. Li HK, Rombach I, Zambellas R, Walker AS, McNally MA, Atkins BL, et al. Oral versus Intravenous Antibiotics for Bone and Joint Infection. *N Engl J Med*. 2019;380(5):425-36.
45. Australian Bureau of Statistics. 2011.0 - Census of Population and Housing: Reflecting Australia - Stories from the Census, 2016. Canberra, Australia: Australian Bureau of Statistics; 2019.
46. Diabetic Foot Australia. Australian Diabetic Foot Ulcer Minimum Dataset Dictionary. West End, Australia: Diabetic Foot Australia; 2016.
47. Peters EJG, Lipsky BA, Senneville E, Abbas ZG, Aragon-Sanchez J, Diggle M, et al. Interventions in the management of infection in the foot in diabetes: a systematic review. *Diabetes Metab Res Rev*. 2020;36 Suppl 1:e3282.



REFERENCES

48. Jeffcoate WJ, Bus SA, Game FL, Hinchliffe RJ, Price PE, Schaper NC, et al. Reporting standards of studies and papers on the prevention and management of foot ulcers in diabetes: required details and markers of good quality. *Lancet Diabetes Endocrinol.* 2016;4(9):781-8.
49. Commons RJ, Raby E, Athan E, Bhally H, Chen S, Guy S, et al. Managing diabetic foot infections: a survey of Australasian infectious diseases clinicians. *J Foot Ankle Res.* 2018;11:13.
50. Dawson-Hahn EE, Mickan S, Onakpoya I, Roberts N, Kronman M, Butler CC, et al. Short-course versus long-course oral antibiotic treatment for infections treated in outpatient settings: a review of systematic reviews. *Fam Pract.* 2017;34(5):511-9.
51. Royer S, DeMerle KM, Dickson RP, Prescott HC. Shorter Versus Longer Courses of Antibiotics for Infection in Hospitalized Patients: A Systematic Review and Meta-Analysis. *J Hosp Med.* 2018;13(5):336-42.
52. Tansarli GS, Andreatos N, Pliakos EE, Mylonakis E. A Systematic Review and Meta-analysis of Antibiotic Treatment Duration for Bacteremia Due to Enterobacteriaceae. *Antimicrob Agents Chemother.* 2019;63(5).



OFFLOADING

Australian guideline on offloading treatment
for foot ulcers

Part of the 2021 Australian
evidence-based guidelines for
diabetes-related foot disease

VERSION 1.0 | 21021

AUTHORS

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Disclaimer

These Australian Evidence-based Guidelines are a general guide to appropriate practice, to be followed subject to the clinician's judgment and the patient's preference in each individual case. The Guidelines are designed to provide information to assist decision-making and are based on the best evidence available at the time of development.

Diabetes Feet Australia would like to thank and acknowledge Mikaela Cameron who has created the artwork to represent the guidelines. Mikaela Cameron (M. J. Badagarang) is a proud Dharug saltwater woman from the Hawkesbury River in New South Wales, Australia. She's worked the past 4 years as a cultural educator delivering cultural workshops and creating murals. "Worimi, I am a proud Dharug woman. My totem is the Badagarang (Eastern Grey Kangaroo), and Waroo (the brown-eyes crow). I pay my respects to all Elders past, present and emerging, and extend this acknowledgment to you and your people. Welcome, let's walk together."



ABSTRACT

Background

Pressure offloading treatment is critical for healing diabetes-related foot ulcers (DFU). Yet there are no current Australian guidelines on the offloading treatment of DFU. A national expert panel aimed to develop a new Australian guidelines on offloading treatment for people with DFU by adapting suitable international guidelines to the Australian context.

Methods

National Health and Medical Research Council procedures were used to adapt International Working Group on the Diabetic Foot (IWGDF) guidelines to the Australian context. We systematically screened, assessed and judged all IWGDF offloading recommendations using best practice ADAPTE and GRADE frameworks to decide which recommendations should be adopted, adapted or excluded in the Australian context. For each recommendation, we re-evaluated the wording, quality of evidence, strength of recommendation and provided rationale, justifications and implementation considerations, including for geographically remote and Aboriginal and Torres Strait Islander Peoples. This guideline underwent public consultation, further revision and approval by ten national peak bodies.

Results

Of the 13 original IWGDF offloading treatment recommendations, we adopted four and adapted nine. Reasons for adapting included, downgrading the quality of evidence, adapting the intervention(s) and adding comparison control treatment(s). For people with plantar DFU, we recommend a step-down offloading treatment approach based on their contraindications and tolerance. We strongly recommend non-removable knee-high offloading devices as first line treatment, removable knee-high offloading devices as second line, removable ankle-high offloading devices third, and medical grade footwear as last line. We recommend considering using felted foam in combination with the chosen offloading device or footwear to further reduce plantar pressure. If offloading device options fail to heal a person with plantar DFU, we recommend considering various surgical offloading procedures. For people with non-plantar DFU, depending on the type and location of the DFU, we recommend using a removable offloading device, felted foam, toe spacers or orthoses, or medical grade footwear.

Conclusions

We have developed a new Australian evidence-based guideline on offloading treatment for people with DFU that has been endorsed by ten key national peak bodies. Health professionals implementing these offloading recommendations in Australia should produce better DFU healing outcomes for their patients, communities, and country.

Keywords

Cast; diabetes-related foot ulceration; diabetic foot; footwear; foot ulcer; guidelines; offloading; offloading device; surgery; treatment.



OFFLOADING

AUSTRALIAN RECOMMENDATIONS LIST

PREVENTION

WOUND CLASSIFICATION

PERIPHERAL ARTERY
DISEASE

INFECTION

OFFLOADING

WOUND HEALING
INTERVENTIONS

In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer:

- 1A** In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, use a non-removable knee-high offloading device rather than a removable offloading device to promote healing of the ulcer (GRADE strength of recommendation: Strong; Quality of evidence: Moderate).
- 1B** When using a non-removable knee-high offloading device to heal a neuropathic plantar forefoot or midfoot ulcer in a person with diabetes, consider using either a total contact cast or non-removable knee-high walker, with the choice dependent on the local resources and technical skills available, and the person's preference and extent of foot deformity (Weak; Low).
- 2** In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, when non-removable knee-high offloading devices are contraindicated or not tolerated, consider using a removable knee-high offloading device (and explain the importance of using) during all weight-bearing activities rather than a removable ankle-high offloading device to reduce plantar pressure and promote healing of the ulcer (Weak; Low).
- 3** In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, when knee-high offloading devices are contraindicated or not tolerated, use a removable ankle-high offloading device (and explain the importance of using) during all weight-bearing activities rather than medical grade footwear to promote healing of the ulcer (Strong; Very low)
- 4** In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, when ankle-high offloading devices are contraindicated or not tolerated, use medical grade footwear rather than other footwear types or no footwear to promote healing of the ulcer (Strong; Low).
- 5** In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, consider using felted foam in combination with an offloading device or footwear rather than using the offloading device or footwear alone to further reduce plantar pressure and promote healing of the ulcer (Weak; Very Low).

If the best recommended offloading device option fails to heal a person with diabetes and:

- 6A** If the best recommended offloading device option fails to heal a person with diabetes and a neuropathic plantar metatarsal head ulcer, consider using Achilles tendon lengthening or Gastrocnemius recession, metatarsal head resection(s), or joint arthroplasty to promote healing of the ulcer (Weak; Low).
- 6B** If the best recommended offloading device option fails to heal a person with diabetes and a neuropathic plantar or apical ulcer on a non-rigid toe, consider using digital flexor tenotomy to promote healing of the ulcer (Weak; Low)

In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer (complicated) with:

- 7A** In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer with either mild infection or mild ischemia, consider using a non-removable knee-high offloading device to promote healing of the ulcer (Weak; Low).
- 7B** In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer with both mild infection and mild ischemia, or with either moderate infection or moderate ischaemia, consider using a removable knee-high offloading device to promote healing of the ulcer. (Weak; Low).
- 7C** In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer with both moderate infection and moderate ischaemia, or with either severe infection or severe ischemia, primarily address the infection and/or ischemia, and consider using a removable offloading intervention based on the patient's functioning, ambulatory status and activity level, to promote healing of the ulcer (Weak; Low).

In a person with diabetes and a neuropathic plantar heel ulcer:

- 8** In a person with diabetes and a neuropathic plantar heel ulcer, consider using a knee-high offloading device or other offloading intervention that effectively reduces plantar pressure on the heel and is tolerated by the patient, to promote healing of the ulcer. (Weak; Low).

In a person with diabetes and a non-plantar foot ulcer:

- 9** In a person with diabetes and a non-plantar foot ulcer, use a removable offloading device, medical grade footwear, felted foam, toe spacers or orthoses, depending on the type and location of the foot ulcer, rather than no offloading intervention to promote healing of the ulcer and to prevent further ulceration (Strong; Very Low).



BACKGROUND

Diabetes-related foot ulcers (DFU) are a leading cause of the global hospitalisation, disability and healthcare costs burdens (1-4). In Australia each year, DFU affects an estimated 50,000 people, resulting in around 30,000 hospitalisations, 5,000 amputations and nearly \$AU2 billion in health system costs (3-6). Aboriginal and Torres Strait Islander peoples have up to a 38-fold risk of developing DFU and amputation (3, 6, 7). Thus, improved care for Australians with DFU is critical to reducing a large cause of the national healthcare burden and to closing the gap in health inequality experienced by Aboriginal and Torres Strait Islanders (3, 6, 8).

The most common pathway to developing a DFU is via high plantar tissue stress (due to high plantar pressure and/or high activity) on the foot of a person with a loss of protective sensation due to diabetes-related peripheral neuropathy (DPN) (1, 3, 9). Plantar tissue stress is the result of an accumulation of the repetitive cycles of plantar pressure and shear pressure during daily weight-bearing activity (1, 9, 10). DPN not only causes a loss of protective sensation but can also result in higher plantar tissue stress due to detrimental changes in gait, soft tissue and foot deformities (1, 9, 10). High plantar tissue stress if left untreated leads to subcutaneous tissue damage and eventually a DFU develops (1, 9, 10). Thus, reducing high plantar tissue stress that caused the DFU, or reducing high tissue stress in DFUs from other causes, is critical to healing people with DFU.

Optimal treatment for most effective DFU healing involves a multi-disciplinary team of different health professionals, in collaboration with the patient (person affected by DFU), that collectively address the multiple factors contributing to the DFU aetiology by managing multiple aspects of the wound including infection, ischaemia and plantar tissue stress (1, 9, 11). Pressure offloading aims to reduce high plantar tissue stress and has been found to be critical to achieve timely and complete DFU healing (1, 9, 11). To do this effectively, offloading should maximise the desirable effects (benefits) of minimising high plantar tissue stress, including reducing plantar pressure and weight-bearing activity; whilst also minimising any undesirable effects (risks), including adverse physical and psychosocial events and high costs (10, 12, 13). Various offloading treatments have been used clinically, including offloading devices, footwear and corrective surgery (12, 14). Yet, these different offloading treatments carry differing benefits and risks (9, 15, 16), quality of supporting evidence (9, 15, 16) and feasibility of clinical uptake (13, 17-19), making the clinical decision making for offloading treatments in people with DFU complex.

Evidence-based guidelines have been previously developed to weigh up the benefits, risks, quality of evidence and feasibility of treatments to provide health professionals with best practice recommendations on optimal treatments for people with DFU (16, 20). However, the current 2011 Australian evidence-based DFU guidelines are outdated (3, 16, 21) and have not weighed up the substantial new offloading evidence published over the last decade (15). Conversely, many international evidence-based DFU guidelines have recently been published (9, 22-24), but their applicability to the Australian context is unclear. Here, we aim to systematically adapt suitable international guidelines to the Australian context to become the new Australian evidence-based guideline on offloading treatment for people with DFU.



Each year in Australia

- DFU affects an estimated 50,000 people
- resulting in around 30,000 hospitalisations
- and 5000 amputations



METHODS

The methodology for this guideline followed the recommended National Health and Medical Research Council (NHMRC) procedures for adapting source guidelines (25-27) and has been described in detail in an accompanying guidelines development protocol paper (28). The development protocol reports that the 2019 International Working Group on the Diabetic Foot (IWGDF) guidelines were systematically identified and assessed as suitable international source guidelines to adapt for this new guideline (28). Thus, the subsequent steps for adapting the IWGDF guideline to the Australian context for offloading treatment in people with DFU are summarised below.

National panel

A national expert panel (referred to as “the panel”) was established by the Australian DFD Guidelines working group to develop and author this Australian offloading guideline, and was comprised of recognised multi-disciplinary (inter)national experts in surgical and non-surgical offloading treatments for people with DFU, and consumer and Aboriginal and Torres Strait Islander representatives with expertise in DFD (28). The panel was provided with all offloading recommendations (and supporting rationale and evidence) from the IWGDF guidelines (15, 22) as the basis for developing this guideline (28).

Screening recommendations

The initial step for the panel involved using a customised 7-item ADAPTE evaluation form (26, 28) to screen each IWGDF offloading recommendation (and rationale) for their quality of evidence, strength of recommendation, acceptability and feasibility in the Australian context. Any recommendation in which the panel by consensus were certain that all items agreed with the IWGDF quality of evidence and strength of recommendation ratings and were acceptable and applicable in the Australian national context, were adopted for the Australian context. Whereas any recommendation where the panel did not agree or were unsure on any of these items was fully assessed (26, 28).

Assessing recommendations

The second step involved using a customised GRADE Evidence to Decision (EtD) template tool (27-30) to systematically evaluate all the evidence supporting those recommendations (and all rationale) needing full assessment. This was performed by one panel member, checked by a second, who extracted and populated the EtD tool with all supporting text for the recommendation included in the IWGDF offloading guideline and systematic review (15, 22). Eight important EtD criteria were specifically populated: the problem (a priority), values (of outcomes), desirable effects, undesirable effects, balance of effects, quality of (supporting) evidence, acceptability and feasibility (27-30). The panel then reviewed, discussed and made consensus judgement decisions on all eight EtD criteria (29, 30) and compared their judgements for these criteria with those from the IWGDF (27, 28).

Decisions on recommendations

Based on the level of agreement between the panel and IWGDF judgements, the next step involved the panel making a consensus decision on whether to adopt, adapt or exclude each recommendation for the Australian context (27, 28). These decisions were defined as: adopted, if there were no major differences between the panel and the IWGDF judgements; adapted, if there were differences; and excluded, if there were substantial differences and/or the panel concluded the recommendation was not acceptable or applicable in Australia (27, 28). The recommendations in which the panel decided to adapt then had their quality of evidence rating, strength of recommendation rating (29, 30) and written recommendation re-evaluated via consensus based on the panel's judgements (27, 28). The panel rated the quality of evidence in alignment with the GRADE system as High, Moderate, Low or Very Low, based on the panel's confidence that the findings were from studies that reported consistent effects with low risk of bias and further research was unlikely to change that confidence (29, 30). The panel also rated the strength of recommendation in alignment with the GRADE system, based on weighing up the balance of effects, quality of evidence, applicability and feasibility (29, 30) in the Australian context (28) as: Strong, if there was a large clear difference in the balance of effects between an intervention and control; or Weak, if there was a small and/or uncertain difference (29, 30).



Drafting recommendations

The final step involved re-drafting the guideline recommendations and reasons for the Australian context (28). The panel re-wrote any adapted recommendation to be clear, specific, and unambiguous as per the GRADE system (27, 29, 30). For each recommendation the panel drafted the following reasons for the Australian context: the clinical question originally posed; the recommendation(s) to address that question; the rationale for the decision to adopt, adapt or exclude the original IWGDF recommendation; justifications for the recommendation (and detailed justifications if the recommendation was fully assessed); and implementation considerations for the recommendation in Australia (including a description of the treatment, any contraindications, procedures, monitoring and special considerations for geographically remote and Aboriginal and Torres Strait Islander people) (27-30). The panel collated all recommendations (and reasons), along with suggested future research priorities, into a consultation draft manuscript of the Australian evidence-based guideline on offloading treatment for people with DFU ready for public consultation (28). The finalised recommendations were also developed into an Australian clinical pathway for offloading treatment, using best practice methodology for developing pathways, to help facilitate implementation of these new evidence-based recommendations (31).

Consultation and Endorsement

The consultation draft of this Australian offloading guideline manuscript underwent a formal six-week public consultation period using a 23-item customised consultation survey. The survey was based on ADAPTE examples with additional open ended items for feedback on each recommendation and overall final thoughts (26, 28). Each item employed a 5-point Likert scale from strongly agree to strongly disagree in response to a statement as the answer options for each item. All survey and written feedback formally submitted from the consultation period was collated, analysed and the guideline was subsequently revised accordingly by the authors (26, 28). All de-identified formal feedback and the authors individual responses to the feedback were collated and publicly posted on the Diabetes Feet Australia website. Finally, the authors sought endorsement from the Australian DFD Guidelines Development working group and relevant peak national bodies (28). We refer the reader to the results section below for all final recommendations contained in the new Australian evidenced-based guidelines on offloading treatment for people with DFU. The results and recommendations in our below Australian guideline should be read in conjunction with the respective IWGDF source guideline and systematic review from the IWGDF Offloading Working Group for full descriptions of findings and rationale (15, 22).



RESULTS

Following screening of all 13 IWGDF offloading recommendations, four were adopted and nine required further full assessment (Table 1). Of the nine recommendations which underwent full assessment, all were adapted to the Australian context for the following reasons: six had their quality of evidence rating downgraded, six added the comparison control treatment, three adapted the intervention(s), one adapted the population, and/or one had strength of recommendation rating downgraded (Table 2). A summary of the wording differences between the Australian recommendations and the original IWGDF recommendations can be found in Table 3.

All 13 recommendations (and reasons) for this Australian evidence-based guideline on offloading treatment for people with DFU are grouped into their respective offloading treatment sections: A. Offloading devices; B. Footwear; C. Other (non-surgical) offloading techniques; D. Surgical offloading interventions; and E. Other ulcer types and locations. Each section contains the following sub-sections: question(s) posed; the recommendation(s); decision (and rationale) to adopt, adapt or exclude the recommendation(s); justifications supporting the recommendation(s); and implementation considerations (including descriptions, contraindications, procedures, monitoring and for geographically remote and Aboriginal and Torres Strait Islander people) the recommendation(s). A summary of implementation considerations can be found in Table 4, and detailed justifications and implementation considerations can be found in the eTables (A1-A9, B1-B13) in the Supplementary Material. Finally, all recommendations are incorporated in the Australian evidence-based clinical pathway on offloading treatment for people with DFU in Figure 1

We received 14 responses (nine individuals and five organisations) to the public consultation survey with collated responses displayed in Table 5. No respondents (0%) disagreed with the statements that: there was a need for a new offloading guideline, the methodology used for these guidelines was appropriate, the recommendations were clear, when applied the recommendations should produce more benefits than harms, and they would be comfortable if people with DFU received these recommendations. However, most respondents agreed that to implement the recommendations may require some reorganisation of services (77%), may be technically challenging (77%), may be too expensive (54%), but were likely acceptable to people living with DFD (77%). Overall, 12 of the 14 respondents (85%) (strongly) agreed that the guideline should be approved as the new Australian offloading guideline and none (0%) disagreed that the guideline would be supported by the majority of their colleagues and would encourage its used if approved.

All de-identified comments received during public consultation and the panel's responses were collated and available on the Diabetes Feet Australia website. Based on the collated public consultation feedback, the guideline was revised, approved by the panel and Australian DFD Guidelines working group, and endorsed as the new Australian guideline on offloading treatment for foot ulcers by ten peak national bodies listed below.

GUIDELINE ENDORSEMENT

The Offloading guideline has been endorsed by the following Australian peak bodies and national organisations involved with diabetes-related foot disease.

LISTED IN ALPHABETICAL ORDER

- Aboriginal and Torres Strait Islander Diabetes-related Foot Complications Program (SAHMRI)
- Advanced Practicing Podiatrists - High Risk Foot Group
- Australian and New Zealand Society for Vascular Surgery
- Australian Diabetes Society
- Australian Orthotic Prosthetic Association
- Australian Podiatry Association
- Australasian Society for Infectious Diseases
- Diabetes Feet Australia
- Podiatric Association of Australia
- Wounds Australia





A. OFFLOADING DEVICES

Recommendation 1A

In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, use a non-removable knee-high offloading device rather than a removable offloading device to promote healing of the ulcer (GRADE strength of recommendation: Strong; Quality of evidence: Moderate).

DECISION: ADAPTED

Rationale

The panel decided to adapt the original IWGDF recommendation, based on differing judgements to the IWGDF for the quality of evidence rating and the need to include a comparison control treatment (Table 2). Therefore, we downgraded the quality of evidence from “high” to “moderate”, added “rather than a removable offloading device” as the control treatment, and removed the phrase “appropriate foot-device interface” as we considered this to have only limited indirect evidence to be included in this recommendation, and a term not used in Australia, and thus unnecessary (Table 3). For detailed justification see eTable A1 in the Supplementary Material.

Implementation considerations

For effective implementation we suggest the following considerations:

Description

We agreed with the IWGDF definition that non-removable knee-high offloading device are offloading devices that extend up the leg to just below the knee and cannot be readily removed by the patient, including total contact casts (TCCs) and non-removable walkers (often termed “instant TCCs”) (22).

Contraindications

We also agreed that contraindications for these devices include high falls risk (32), moderate-to-severe infection and/or moderate-to-severe ischaemia (22, 33, 34). For people with these contraindications we instead suggest using Recommendations 3, 7B and 7C, respectively. We also agreed that there are people who due to a range of personal circumstances may not tolerate, or wish to wear, these devices following informed consent (22), such as because of occupation, family care requirements, frequent driving, hot climates, social impacts or infrequent ability to attend follow-up care. For these people we suggest also considering Recommendation 2.

Procedures

Before using any offloading device we strongly advise that the benefits, risks and contraindications are always carefully explained, and people with DFU have an opportunity to discuss and consider their personal circumstances, in order to first gain their full informed consent. This is particularly important in patients with neuropathy with loss of protective sensation and thus difficulty in sensing any benefits (e.g. healing) or risks (e.g. adverse events) to their feet when using offloading devices.

Following informed consent we strongly suggest health professionals always consider the following: appropriate fitting of the device, the pressure offloading material within the device (termed “appropriate foot-device interface” in the IWGDF guideline or “orthoses” in other guidelines, but hereto referred to as a “pressure offloading insole”), a shoe raise for the contralateral side to reduce any limb length difference, advice to limit weight-bearing activity and simple patient-friendly written instructions on safe offloading device use and when and how to seek advice (22, 35, 36). Additionally, health professionals should consider the use of validated (i.e. proven accurate) in-shoe plantar pressure measurements where available and feasible and the use of any additional walking aids, such as walking frames, to support people to safely optimise plantar pressure reduction (22, 35, 36). Finally, in terms of which type of non-removable knee-high offloading device to choose we refer the reader to Recommendation 1B below.

Offloading treatment is always recommended as part of a good standard of DFU care that includes best practice recommendations for DFU classification, local wound debridement, wound dressings, antibiotics (if infected), revascularisation (if ischaemic), and patient-centred education (9, 37). We refer the reader to the specific recommendations for such care in the relevant accompanying guidelines (33, 34, 38-40).



A: OFFLOADING DEVICES

Recommendation 1A

In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, use a non-removable knee-high offloading device rather than a removable offloading device to promote healing of the ulcer (GRADE strength of recommendation: Strong; Quality of evidence: Moderate).

DECISION: ADAPTED

Monitoring considerations

We agreed with the IWGDF that offloading treatment is arguably the most important intervention for healing neuropathic plantar DFU (22). Thus, we suggest all people have their offloading treatment regularly reviewed within ≤ 1 week of initial dispense of the offloading device, and ~ 1 -2 weekly thereafter, to monitor plantar pressure reduction, adverse events and DFU healing. We strongly suggest 4-6 weeks after initial offloading device use, that the person's DFU size and classification is carefully reviewed against the baseline DFU size at the time of initial offloading device dispense to determine if the DFU has reduced in size by $>50\%$ in that time. A $>50\%$ reduction suggests treatment is effective and can be continued, whereas a $<50\%$ reduction in size should prompt formal review of the offloading treatment and wider DFU management plan. (9, 37) For offloading this should include reviewing whether the person is adherent to using the offloading device, limiting their weight-bearing activity, and whether the device is providing optimal plantar pressure reduction at the DFU site (10, 22). If at this review, it is thought that other offloading treatments may improve these factors, we then refer the reader to the subsequent recommendations in this guideline (see Recommendations 2-6).

We suggest organisations routinely managing DFU should include at least one offloading data item/field in their organisation's DFU database monitoring system to enable at least one annual offloading treatment key clinical performance indicator (22, 41) to objectively monitor the proportion of eligible patients (not contraindicated) with plantar DFU that are prescribed non-removable knee-high offloading devices (22, 41) or alternative devices, in-line with local patient preferences, resource utilisation and DFU healing rates (41, 42). We refer the reader to existing national and state-based High Risk Foot Service database monitoring systems and datasets that typically include such offloading treatment items and indicators and are typically available to most Australian organisations to utilise (41-43).

Subgroup considerations

Geographically remote people

In addition to the above considerations, the panel suggests for people from geographically remote locations that the potential infrequent access to follow-up care, hot climates and dusty environments that may result in a higher likelihood of adverse events should also be considered. In these circumstances, the balance of effects may favour Recommendation 2 compared to Recommendation 1.

Aboriginal and Torres Strait Islander Peoples

In addition to all above considerations, the panel suggests for Aboriginal and Torres Strait Islander people that further personal circumstances are also carefully considered as part of the informed consent process, including the person's need to participate in any traditional cultural practices where footwear may need to be removed. Further, we strongly suggest that all above considerations are discussed with the person in collaboration with their family, caregivers and support networks and a local Aboriginal and Torres Strait Islander Health Care Worker(s) where available, to optimise the person's understanding of the benefits, risks, personal circumstances and requirements of these devices, such as length of time the device would need to be worn to heal the DFU. We also suggest health professionals consider facilitating culturally appropriate follow-up care for Aboriginal and Torres Strait Islander people where or if possible, such as via liaising with local Aboriginal and Torres Strait Islander Health Care Worker(s), local Aboriginal Community Controlled Health Services, using Aboriginal Medical Benefit Scheme entitlements and developing culturally-appropriate resources (44). Lastly, we suggest health professionals consider the aesthetic appearance of such devices for Aboriginal and Torres Strait Islander people and whether the user would like their culture represented in the form of artwork or insignia to further personalise the device.

For more detailed considerations see eTable B1 in Supplementary Material.



A: OFFLOADING DEVICES

Recommendation 1B

When using a non-removable knee-high offloading device to heal a neuropathic plantar forefoot or midfoot ulcer in a person with diabetes, consider using either a total contact cast or non-removable knee-high walker, with the choice dependent on the local resources and technical skills available, and the person's preference and extent of foot deformity (Weak; Low).

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation as we had differing judgements for the quality of evidence rating (Table 2). Therefore, we downgraded the quality of evidence from "moderate" to "low", plus, we also downgraded the strength of recommendation from "strong" to "weak" to align with GRADE criteria for strength of recommendation where the recommendation is not favouring either the intervention or control (29, 30), as in this case. Further, we made minor modifications to the "choice dependent" phrasing to group the local organisational and patient factors more intuitively (Table 3). For detailed justifications see eTable A2 in Supplementary Material.

Implementation considerations

For effective implementation we suggest the following considerations:

Description

We agreed with IWGDF that total contact casts (TCCs) are custom-made, knee-high, non-removable casts that can be applied using several different methods and materials (22); whereas non-removable walkers are prefabricated, knee-high devices such as CAM walkers, moonboots or air cast walkers, that are made irremovable by wrapping a layer of plaster of paris, fibreglass, cohesive bandage or tie wrap around the device (22).

Contraindications

The same contraindications in Recommendation 1A apply for this recommendation. Additionally, we agreed with IWGDF that a further contraindication for non-removable walkers are a large foot deformity(s) that cannot be safely accommodated in a walker and may cause further ulcers, such as a very wide foot, plantigrade foot, a large Charcot foot, or extensive bunion (22). For patients where their foot deformity cannot be accommodated in a prefabricated walker, we strongly suggest instead using a TCC (22).

Procedures

The same procedures as in Recommendation 1A apply. Additionally, we agree with IWGDF that the choice between a TCC or non-removable walker should be guided by the local organisation's available resources and technical skills, and the person's foot deformity status and preference (22). As mentioned for those with a large foot deformity(s) a TCC is typically indicated (22). Whereas, non-removable walkers may be preferred in those persons without large foot deformities, or in organisations with less resources, technical skills and time to apply, as they have been found to be equally effective, lighter in weight, quicker and easier to apply, and more cost-effective than TCCs (15, 22, 45). Thus, the panel, strongly suggests that organisations routinely managing DFU should offer, or be able to directly refer for, both types of non-removable knee-high offloading devices to cater for the above situations. Finally, we agree with IWGDF that there is no standard method for manufacturing a TCC or non-removable knee-high walker (22), and instead refer the reader to the papers cited on manufacture to choose a method based on the above considerations and local discretion (46-48), plus, we suggest to consider using Recommendation 5 (i.e. felted foam in combination with the offloading device) for additional plantar pressure reduction if needed.



A: OFFLOADING DEVICES

Recommendation 1B

When using a non-removable knee-high offloading device to heal a neuropathic plantar forefoot or midfoot ulcer in a person with diabetes, consider using either a total contact cast or non-removable knee-high walker, with the choice dependent on the local resources and technical skills available, and the person's preference and extent of foot deformity (Weak; Low).

DECISION: ADAPTED

Monitoring considerations

The same monitoring considerations as outlined in Recommendations 1A apply. Additionally, we suggest that the two types of non-removable offloading device types are included as data items to capture and monitor the organisation's use and impact on DFU healing of these device types in organisational database monitoring systems.

Subgroup considerations

Geographically remote people

In addition to the above considerations and those for geographically remote people in Recommendation 1A, we suggest if choosing a non-removable walker in a person with infrequent access to follow-up care, that health professionals consider using a cohesive bandage (e.g. Coban™) wrap to make non-removable. Such a wrap is potentially "removable" by people using scissors if needed in an emergency, such as for acute onset of moderate-to-severe swelling of the foot or leg from infection or oedema. Evidence of removal of the wrap may also serve as a surrogate indicator to the health professional of device removal and lower adherence to use.

Aboriginal and Torres Strait Islander Peoples

In addition to above, the same considerations for Aboriginal and Torres Strait Islander people outlined in Recommendation 1A apply.

For more detailed considerations see eTable B2 in Supplementary Material.



A: OFFLOADING DEVICES

Recommendation 2

In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, when non-removable knee-high offloading devices are contraindicated or not tolerated, consider using a removable knee-high offloading device (and explain the importance of using) during all weight-bearing activities rather than a removable ankle-high offloading device to reduce plantar pressure and promote healing of the ulcer (Weak; Low).

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation as we had differing judgements for value of outcomes rating, and the need to emphasise the importance of using the device at all times and the control treatment (Table 2). Therefore, we added “(and explain the importance of using) during all weight-bearing activities” as we considered this a critical part of the intervention, “rather than a removable ankle-high offloading device” as the control treatment. The panel also noted that the primary superiority of the intervention was on “reducing plantar pressure” rather than ulcer healing and hence added in this surrogate outcome. We also removed “appropriate foot-device interface” and “second choice” as we considered both unnecessary given that this may be the “first choice” in some person’s circumstances (Table 3). For detailed justifications see eTable A3 in Supplementary Material.

Implementation considerations

For effective implementation we suggest the following considerations:

Description

We agreed with IWGDF that removable knee-high offloading devices are offloading devices that extend up the leg to just below the knee and can be readily removed by the patient, including prefabricated, knee-high, removable cast walkers, such as CAM walkers, moonboots or air cast walkers, or custom-made bi-valved knee-high TCCs (22).

Contraindications

We agreed with IWGDF that contraindications for these devices include high falls risk (32), severe infection and/or severe ischaemia (22, 33, 34). For persons with these contraindications we instead refer to Recommendations 3 and 7C, respectively.

Procedures

The same procedures as in Recommendation 1A apply and we also agree with IWGDF that health professionals should explain the importance of wearing the device consistently. Such an explanation should highlight that wearing such a device for 100% of the person’s weight-bearing activity should provide similar plantar tissue stress reduction, and in turn healing effectiveness, to if using a gold standard non-removable knee-high device (10, 15, 22). However, any non-adherence compromises or negates the effectiveness of the device and will likely lengthen the healing time. Lastly, we suggest to consider using Recommendation 5 (i.e. felted foam in combination with the offloading device) for further plantar pressure reduction and to consider the persons’ capacity to apply and adhere to using removable knee-high offloading devices.

Monitoring considerations

The same monitoring considerations as outlined in Recommendations 1A also apply. In addition, we emphasise the need to review the specific removable knee-high device over time to determine if the device is still optimally reducing plantar pressure and if the person is adhering to wearing the device as much as possible. If either is significantly impacted, we suggest considering using another knee-high offloading device, or potentially an ankle-high device as there is low-quality evidence showing that people may be more adherent to an ankle-high device (15). We also suggest that different removable offloading device types are monitored as data items in organisational DFU database monitoring systems (41, 42).

Subgroup considerations

Geographically remote people

In addition to the above, the same considerations for geographically remote people outlined in Recommendation 1A apply.

Aboriginal and Torres Strait Islander Peoples

In addition to above, the same considerations for Aboriginal and Torres Strait Islander people outlined in Recommendation 1A apply.

For more detailed considerations see eTable B3 in Supplementary Material.



A: OFFLOADING DEVICES

Recommendation 3

In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, when knee-high offloading devices are contraindicated or not tolerated, use a removable ankle-high offloading device (and explain the importance of using) during all weight-bearing activities rather than medical grade footwear to promote healing of the ulcer (Strong; Very low)

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation as we had differing judgements for desirable effects and quality of evidence ratings, and the need to emphasise the importance of using the device and the control treatment (Table 2). Therefore, we downgraded the quality of evidence from “low” to “very low”, added “(and explain the importance of using) during all weight-bearing times” as we considered critical to the intervention, and “rather than medical grade footwear” as the control treatment. We also removed “appropriate foot-device interface” and “third choice” as we considered unnecessary given this may be the “first choice” in some person’s circumstances (Table 3). For detailed justifications see eTable A4 in Supplementary Material.

Implementation considerations

For effective implementation we suggest the following considerations:

Description

We agreed with IWGDF that removable ankle-high offloading devices are offloading devices that extend up the leg no higher than just above the ankle and can be readily removed by the patient (22). We also agree that this definition incorporates a broad range of devices, including ankle-high walkers, forefoot offloading shoes, half shoes, cast shoes, healing sandals, postoperative healing shoes, and custom-made temporary shoes(22).

Contraindications

We agreed with IWGDF that a specific contraindications for removable ankle-high devices are the use of half shoe devices as they have been reported to potentially increase the risk of midfoot fractures (22). Otherwise a further potential contraindication is a very large foot deformity(s) that is unable to be accommodated by any ankle-high device. For persons with these contraindications we instead refer to Recommendation 4.

Procedures

The same procedure considerations as in Recommendation 2 apply. Additionally, we suggest health professionals be aware that there is a broad range of ankle-high devices that may offer a broad range of plantar pressure reduction capabilities. However, it is likely that higher ankle-high devices and those with rocker-soles offer more plantar pressure reduction, such as ankle high walkers. Again, we also suggest considering using Recommendation 5 (i.e. felted foam in combination with the offloading device) to further reduce plantar pressure at the ulcer site. Lastly, we suggest medical grade footwear can be considered an option for this recommendation (see Recommendation 4), but only in circumstances where this footwear can be demonstrated to offer superior plantar pressure reduction at the person’s ulcer site compared to available ankle-high offloading device options. s.

Monitoring considerations

The same monitoring considerations as outlined in Recommendation 2 also apply to this recommendation.

Subgroup considerations

Geographically remote people

In addition to the above, the same considerations for geographically remote people outlined in Recommendation 2 apply.

Aboriginal and Torres Strait Islander Peoples

In addition to above, the same considerations for Aboriginal and Torres Strait Islander people outlined in Recommendation 2 apply.

For more detailed considerations see eTable B4 in Supplementary Material.

Q4 In people with a plantar DFU, are conventional or standard therapeutic footwear compared to other (non-surgical) offloading interventions effective to heal the DFU?



PREVENTION

WOUND CLASSIFICATION

PERIPHERAL ARTERY
DISEASE

INFECTION

OFFLOADING

WOUND HEALING
INTERVENTIONS

B: FOOTWEAR

Recommendation 4

In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, when ankle-high offloading devices are contraindicated or not tolerated, use medical grade footwear rather than other footwear types or no footwear to promote healing of the ulcer (Strong; Low).

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation as we had differing judgements for value of outcomes, desirable effects, undesirable effects and quality of evidence ratings, and the need to emphasise the control treatment and be a positive recommendation (Table 2). Therefore, we downgraded the quality of evidence from “moderate” to “low”, added “rather than other footwear types or no footwear” as the control treatments, and removed “do not use” to change the context from a negative to a positive recommendation as it would be “when ankle-high devices are contraindicated” or where no offloading devices were available. We also replaced “therapeutic footwear” with the Australian term “medical grade footwear” (35), and modified “unless none of the abovementioned offloading devices is available” to “when ankle-high offloading devices are contraindicated or not tolerated” to further emphasise when this recommendation is appropriate and align better with the wording of earlier recommendations (Table 3). For detailed justifications see eTable A4 in Supplementary Material.

Implementation considerations

For effective implementation we suggest the following considerations:

Description

We agreed with IWGDF that therapeutic footwear is a generic term for footwear that is specially designed to have a therapeutic effect on foot health (22). The Australian diabetes footwear guideline’s term for such therapeutic footwear is “medical grade footwear” and incorporates both prefabricated or custom-made types (35). Prefabricated medical grade footwear is typically only available from speciality footwear shops and provides special features designed to accommodate a broader range of foot types than standard off-the-shelf footwear, including extra depth, multiple width fittings, modified soles, fastenings and/or smooth internal linings features (35). Custom-made medical grade footwear is typically uniquely manufactured for one person, by a trained footwear health professional, when the person cannot be safely accommodated in prefabricated medical grade footwear and is typically made to accommodate large foot deformity(s) and/or relieve pressure over at-risk sites on the plantar and dorsal surfaces of the foot (35).

Contraindications

We are unaware of any significant sub-groups who may be contraindicated to correctly fitted medical grade footwear (35). However, a contraindication for prefabricated medical grade footwear are those with a large foot deformity(s) that cannot be safely accommodated in prefabricated medical grade footwear, such as a very wide foot, plantigrade foot, a large Charcot foot, or extensive bunion (22, 35). We strongly suggest using custom-made medical grade footwear instead in these cases.

Procedures

Similar procedure considerations as outlined in Recommendations 1-3 also apply to medical grade footwear, including appropriate fitting, pressure offloading insoles (termed “appropriate foot-device interface” in the IWGDF guideline or “orthoses” in other guidelines, but hereto referred to as a “pressure offloading insole”), shoe raise for the contralateral shoe, advice to limit weight-bearing activity, written patient-centred follow-up care information and to see Recommendation 5 for additional felted foam supports that may be utilised to supplement offloading devices. Additionally, we agree with the Australian diabetes footwear guidelines that custom-made medical grade footwear requires an in-depth assessment by a trained footwear health professional (such as a pedorthist or orthotist/prosthetist) that typically includes multiple measurements, impressions or a mould, and a positive model of a person’s foot for manufacture (35). We again highlight, that medical grade footwear is typically only recommended for treating those with DFU when offloading devices are contraindicated or where no other offloading devices are available, as the balance of effects strongly favours offloading devices rather than medical grade footwear due to the moderate additional desirable effects (for healing, plantar pressure reduction, activity reduction, costs and cost-effectiveness) and trivial undesirable effects (for adverse events and patient preference) to heal people with DFU (15, 22).

Q4 In people with a plantar DFU, are conventional or standard therapeutic footwear compared to other (non-surgical) offloading interventions effective to heal the DFU?



PREVENTION

WOUND CLASSIFICATION

PERIPHERAL ARTERY
DISEASE

INFECTION

OFFLOADING

WOUND HEALING
INTERVENTIONS

B: FOOTWEAR

Recommendation 4

In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, when ankle-high offloading devices are contraindicated or not tolerated, use medical grade footwear rather than other footwear types or no footwear to promote healing of the ulcer (Strong; Low).

DECISION: ADAPTED

Procedures (cont.)

We consider the only exception to this is if the medical grade footwear is demonstrated to offer superior plantar pressure reductions at the person's ulcer site than offloading device options using validated plantar pressure equipment measurements. Therefore, medical grade footwear should nearly always be considered a last, stop-gap offloading treatment to heal a person with DFU until offloading devices can be obtained. However, we do note that as recommended in the accompanying Australian guideline to prevent DFU there is moderate quality of supporting evidence for the use of medical grade footwear to prevent recurrence of DFU once healed (38). Thus, we suggest that health professionals strongly consider arrangements to transition into medical grade footwear when healing is (nearly) achieved as per expert consensus guidelines (49) and refer the reader to the accompanying Australian guideline to prevent DFU (38). Finally, while there is no literature to support their use as treatment to heal people with DFU, wheelchairs, knee scooters or electric scooters may be considered in these rare circumstances.

Monitoring considerations

The same monitoring considerations as outlined in Recommendations 1-3 also apply to this recommendation. Additionally, we suggest that the use of medical grade footwear is perhaps captured and monitored in organisational monitoring systems to try and ensure that medical grade footwear to offload DFU is only used in those rare circumstances.

Subgroup considerations

Geographically remote people

In addition to the above, similar considerations for geographically remote people outlined in Recommendations 1-3 apply. However, we do highlight that often medical grade footwear is more difficult to source in geographically remote settings than removable offloading devices, and thus offloading devices are likely a much practical option for people with DFU (See Recommendations 1-3).

Aboriginal and Torres Strait Islander Peoples

: In addition to above, similar considerations for Aboriginal and Torres Strait Islander people outlined in Recommendation 1-3 apply. Additionally, in situations where Aboriginal and Torres Strait Islander people are not in agreement to use offloading devices, or prefer a different approach, we suggest considering whether offloading devices or medical grade footwear are more culturally appropriate for these circumstances. Only as a very last resort we suggest that health professionals consider the benefits and risk of using well-fitted off-the-shelf footwear rather than no footwear at all if they are the only options available. We refer the reader to the Australian diabetes footwear guidelines in these circumstances (35).

For more detailed considerations see eTable B5 in Supplementary Material.



C: OTHER (NON-SURGICAL) OFFLOADING TECHNIQUES

Recommendation 5

In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, consider using felted foam in combination with an offloading device or footwear rather than using the offloading device or footwear alone to further reduce plantar pressure and promote healing of the ulcer (Weak; Very Low).

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation as we had differing judgements for quality of evidence ratings, and the need to clarify the intervention treatment and emphasise the control treatment (Table 2). Therefore, we downgraded the quality of evidence from "low" to "very low", modified the intervention from "using felted foam in combination with appropriately fitting conventional or standard therapeutic footwear" to "using felted foam in combination with an offloading device or footwear", and added "rather than using the offloading device or footwear alone" as the control treatments. We also replaced "as the fourth choice" as we now conditionally recommend felted foam as an adjunct offloading treatment. Felted foam should therefore be considered to be used in conjunction with other offloading devices or footwear where appropriate (Table 3). Finally, we note for the Australian reader that studies on felted foam and felt only were considered and reported collectively under the category of "felted foam" by IWGDF, and thus felt can be considered as a type of felted foam for this recommendation.

Implementation considerations

For effective implementation we suggest the following considerations:

Description

Felted foam is a term used for another (non-surgical) offloading intervention, that is a made from either a combined felt and foam material, or from felt alone, that has different densities and an adherent backing that enables it to be cut, contoured and fixed to a surface, typically the pressure offloading insole of an existing offloading device or footwear, or the foot (22, 50). The type of felted foam most commonly used in Australia is semi-compressed wool felt with an adhesive backing (19, 51-53).

Contraindications

We agreed with IWGDF that we are unaware of any significant sub-groups who may be contraindicated to correctly fitted felted foam (22). However, we suggest those with severe ischaemia or heavily exudating ulcers are likely to be contraindicated to using felted foam (22). We suggest if choosing to use felted foam to consider adhering the felted foam to the pressure offloading insole in the offloading device or footwear to avoid injury to fragile skin and that felted foam paddings with apertures not be used for large wounds >2cm².

Procedures

Similar procedure considerations as outlined in Recommendations 1-4 also apply to felted foam. Additionally, we suggest the following considerations when using felted foam: ensure there is enough room in the device or footwear to safely accommodate the foot and felted foam and minimise the effect of transferring load to other areas of the foot from the contoured area of the felted foam (around the ulcer site) by bevelling the edge of the felted foam or using in combination with other cushioning material (51). Also, it is important to monitor for adverse events (such as transfer lesions, maceration or infection) and replace the felted foam at least weekly as it has been found to lose >30% of its plantar pressure effects within a week of application (51). Otherwise, we refer the reader to this cited Australian paper on the application and effect of different felted foam on plantar pressure when used within offloading devices in people with DFU (51). Finally, we agree with IWGDF that felted foam is a modality to augment the plantar pressure reduction effect of existing offloading devices or footwear and should not be considered as a standalone intervention (22).

Q5

In people with a plantar DFU, are any other offloading techniques that are not device or footwear-related, effective to heal a DFU?



PREVENTION

WOUND CLASSIFICATION

PERIPHERAL ARTERY
DISEASE

INFECTION

OFFLOADING

WOUND HEALING
INTERVENTIONS

C: OTHER (NON-SURGICAL) OFFLOADING TECHNIQUES

Recommendation 5

In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, consider using felted foam in combination with an offloading device or footwear rather than using the offloading device or footwear alone to further reduce plantar pressure and promote healing of the ulcer (Weak; Very Low).

DECISION: ADAPTED

Monitoring considerations

The same monitoring considerations as outlined in Recommendation 2 also apply. In addition, we suggest that felted foam may be considered as a secondary offloading treatment data item captured and monitored in organisation monitoring systems.

Subgroup considerations

Geographically remote people

No additional considerations to that outlined above apply, except that it is even more important in locations with hot, humid or dusty environments to monitor the DFU and surrounding foot integrity for adverse events.

Aboriginal and Torres Strait Islander Peoples

No additional considerations to those outlined above apply.

For more detailed considerations see eTable B6 in Supplementary Material.



D: SURGICAL OFFLOADING TECHNIQUES

Recommendation 6A

If the best recommended offloading device option fails to heal a person with diabetes and a neuropathic plantar metatarsal head ulcer, consider using Achilles tendon lengthening or Gastrocnemius recession, metatarsal head resection(s), or joint arthroplasty to promote healing of the ulcer (Weak; Low).

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation as we considered the available evidence for desirable and undesirable effects also supported Gastrocnemius Recession procedures being included alongside the three surgical offloading procedures in the original IWGDF recommendation (Table 2). Therefore, we added “or Gastrocnemius recession” and we also moved and modified the phrase “if non-surgical offloading treatment fails” to the start of the recommendation to highlight this important caveat earlier in the recommendation (Table 3). The panel also defined “if the best recommended offloading device option fails to heal” as treatment failure when following a step down approach of using the best recommended offloading devices option that is not contraindicated and is tolerated by the person. The panel defines “fails to heal” as the DFU not reducing in size by >50% of its baseline size after 4-6 weeks of receiving the best recommended offloading device in conjunction with other recommended good standard of DFU care (see procedure in Recommendation 1A for more details). For detailed justifications see eTable A7 in Supplementary Material.

Implementation considerations

For effective implementation we suggest the following considerations:

Description

We agreed with IWGDF that surgical offloading is an overarching term used to describe a surgical procedure undertaken with the intention of relieving mechanical stress from a specific region of the foot, and for this recommendation, is evidenced to include the specific procedures of Achilles tendon lengthening, Gastrocnemius Recession (with or without soleal fascial lengthening) metatarsal head resection, and joint arthroplasty (22).

Contraindications

We agreed with IWGDF that a significant contraindication for these surgical procedures is moderate-to-severe ischaemia (22). Furthermore, we suggest other sub-groups of people are also likely to be contraindicated and include those with moderate-to-severe infection, moderate-to-severe oedema, cognitive impairment that impairs capacity to provide informed consent, or conditions precluding anaesthesia. Lastly, we suggest people with normal (>5 degrees of) ankle dorsiflexion are not likely to benefit from Achilles tendon lengthening or Gastrocnemius Recession procedures, and metatarsal head resections should be the surgical procedure considered instead in these circumstances (54). Otherwise as persons undergoing these procedures will be required to post-operatively use offloading devices, we refer the reader back to contraindications in Recommendations 1-4.

Procedures

We strongly agreed with IWGDF that these surgical offloading procedures should only be considered if the person has failed to heal following 4-6 weeks of a good standard of DFU care (9, 22, 37). We suggest a good standard of DFU care includes best practice recommendations for DFU classification, local wound debridement, wound dressings, antibiotics (if infected), revascularisation (if ischaemic), patient-centred education (see recommendations in those accompanying Australian DFD guidelines (33, 34, 38-40)) and the best available offloading device (see Recommendations 1-4) (9, 37). We suggest failure to heal is defined as the DFU not reducing in size by >50% after receiving 4-6 weeks of such a good standard of DFU care (9, 37).



D: SURGICAL OFFLOADING TECHNIQUES

Recommendation 6A

If the best recommended offloading device option fails to heal a person with diabetes and a neuropathic plantar metatarsal head ulcer, consider using Achilles tendon lengthening or Gastrocnemius recession, metatarsal head resection(s), or joint arthroplasty to promote healing of the ulcer (Weak; Low).

DECISION: ADAPTED

Procedures (cont.)

If the patient has failed to heal, we again strongly advise that the benefits, risks, contraindications and personal circumstances are always carefully discussed first with person to gain their informed consent for any surgical offloading procedure (see general procedure considerations in Recommendation 1A). Following informed consent, we strongly suggest that best practice DFU and general health assessments are re-performed to ensure the patient is indicated and fit for surgery, and that any lower limb surgeon considering performing surgical offloading procedures is appropriately trained, suitably qualified, able to demonstrate competence in the specific procedure concerned and be registered with the appropriate regulatory body. Lastly, we suggest that post-operative management of the patient involves a multi-disciplinary team performing a good standard of DFU care that includes using the best available offloading device until the DFU is healed. Otherwise, we refer the reader to the same general procedure considerations outlined for those offloading devices in Recommendations 1-4.

Monitoring considerations

The same monitoring considerations as outlined in Recommendations 1A also apply to this recommendation. In addition, we suggest that the surgical offloading procedures included in this recommendation are also captured and monitored in offloading indicators and organisational monitoring systems (41, 42). Furthermore, we suggest that organisations could consider engaging their local health information managers to help obtain routinely collected hospital surgical procedure data from their local hospital datasets using Australian Classification of Health Interventions codes for these specific surgical procedures as another method of monitoring the appropriate access and use of these surgical procedures as well (55, 56)

Subgroup considerations

Geographically remote people

In addition to the above, similar considerations for geographically remote people outlined in Recommendations 1-3 apply. Additionally, we suggest when discussing the above benefits, risks, contraindications and personal circumstances for these procedures with geographically remote people, that the likely need for people to travel to large metropolitan tertiary hospitals to receive these procedures and post-operative DFU care are also discussed as part of the informed consent processes.

Aboriginal and Torres Strait Islander Peoples

: In addition to all the above, similar considerations for Aboriginal and Torres Strait Islander people outlined in Recommendation 1-3 apply. We further highlight that all discussions with Aboriginal and Torres Strait Islander persons should be preferably performed in conjunction with family and Aboriginal and Torres Strait Islander Health Care Workers, and allow adequate time to discuss, understand and consider the benefits, risks, contraindications, personal circumstances and travel requirements of such procedures so as to enable the person and their family to make an informed decision. Otherwise, we are unaware of any guidelines for culturally appropriate discussions surrounding surgery with Aboriginal people, however, the panel feels the developments of such guidelines in surgical training would be most useful.

For more detailed considerations see eTable B7 in Supplementary Material.



D: SURGICAL OFFLOADING TECHNIQUES

Recommendation 6B

If the best recommended offloading device option fails to heal a person with diabetes and a neuropathic plantar or apical ulcer on a non-rigid toe, consider using digital flexor tenotomy to promote healing of the ulcer (Weak; Low).

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation as we considered the available evidence only supported performing this procedure in those with a digital flexion deformity (or non-rigid toe) and not in those with a rigid toe deformity (Table 2). Therefore, we added the phrase "on a non-rigid toe" to specify the population that this procedure is evidenced to benefit and again moved and modified the phrase "if non-surgical offloading treatment fails" to the start of the recommendation to highlight this important caveat (Table 3). Failure of "best recommended offloading device option" is defined in Recommendation 6A. For detailed justifications see eTable A8 in Supplementary Material.

Implementation considerations

For effective implementation we suggest the following considerations:

Description

We agreed with IWGDF that surgical offloading is an overarching term used to describe a surgical procedure undertaken with the intention of relieving mechanical stress from a specific region of the foot and for this recommendation is evidenced to include digital flexor tenotomy procedures only (22).

Contraindications

The same contraindications as in Recommendation 6A apply. In addition, we suggest people with a rigid toe deformity are unlikely to benefit from these procedures.

Procedures

The same general procedure considerations as in Recommendation 6A apply. Additionally, we suggest during the DFU assessment that the digital deformity is assessed to confirm it is a flexion deformity (or non-rigid toe).

Monitoring considerations

The same monitoring considerations outlined in Recommendation 6A apply, plus adding digital flexor tenotomies as a surgical offloading item in monitoring systems.

Subgroup considerations

Geographically remote people

The same considerations for geographically remote people outlined in Recommendation 6A apply.

Aboriginal and Torres Strait Islander Peoples

The same considerations for Aboriginal and Torres Strait Islander people outlined in Recommendation 6A apply.

For more detailed considerations see eTable B8 in Supplementary Material.



E: OTHER ULCER TYPES AND LOCATIONS

Recommendation 7A

In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer with either mild infection or mild ischemia, consider using a non-removable knee-high offloading device to promote healing of the ulcer (Weak; Low).

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation without change after screening. This was based on having no differences in judgements to the IWGDF and judging this recommendation to be acceptable and applicable in the Australian context (Table 1).

Recommendation 7B

In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer with both mild infection and mild ischemia, or with either moderate infection or moderate ischaemia, consider using a removable knee-high offloading device to promote healing of the ulcer. (Weak; Low).

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation without change after screening, based on having no differences in judgements to the IWGDF and judging this recommendation to be acceptable and applicable in the Australian context (Table 1).

Recommendation 7C

In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer with both moderate infection and moderate ischaemia, or with either severe infection or severe ischemia, primarily address the infection and/or ischemia, and consider using a removable offloading intervention based on the patient's functioning, ambulatory status and activity level, to promote healing of the ulcer (Weak; Low).

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation without change after screening, based on having no differences in judgements to the IWGDF and judging this recommendation to be acceptable and applicable in the Australian context (Table 1).



E: OTHER ULCER TYPES AND LOCATIONS

Implementation considerations for recommendations 7A, 7B, 7C

For effective implementation we suggest the following considerations:

Description

We agreed with IWGDF that although the evidence is limited, offloading treatment for high plantar tissue stress is also vital to heal people with DFU complicated by infection or ischaemia (22). However, we also agree that health professionals should be more cautious with their offloading treatment due to the risk of swelling (with moderate-to-severe infection) which could render the device too tight, and the need for frequent removal of the device to monitor the foot.(22). Also given the limb threatening nature of severe infection and the associated systemic illness, hospitalisation and bedrest is often indicated, and hence offloading considerations may exist only for transferring in these circumstances. We refer the reader to the accompanying Australian DFD infection and PAD guidelines for definitions and management recommendations (33, 34, 57).

Contraindications

We note these recommendations are specifically recommending offloading treatments to use when patients with DFU have infection or ischaemia and are contraindicated to other offloading devices. However, regardless of those with different infection or ischaemia severity categories, we suggest those at high falls risk are contraindicated for knee-high offloading devices and suggest instead to use Recommendation 7C.

Procedures

We agreed with the IWGDF that an evidence-based DFU assessment should be initially undertaken to determine the infection or ischaemia severity category and in turn which of Recommendations 7A-7C to use (22). We also agree in those assessed with limb-threatening severe infection, severe ischaemia or both moderate infection and moderate ischaemia, that their infection or ischaemia management plan should be of primary concern and instigated urgently. Thus, we refer the reader to the accompanying Australian DFD infection and PAD guideline for assessment and management recommendations (33, 34, 57). However, we also agreed that in those with limb-threatening infection or ischaemia that these persons still importantly need offloading treatment to reduce plantar pressure and facilitate a healing DFU environment (22). Thus, offloading treatment should ideally be provided on the same day as the infection or ischaemia management plan instigated and not delayed waiting for resolution of infection or ischaemia. Otherwise we suggest the same considerations outlined in Recommendations 1 apply for Recommendation 7A, Recommendation 2 applies for Recommendation 7B and Recommendation 3 applies for Recommendation 7C.

Monitoring considerations for recommendations 7A, 7B, 7C

The same monitoring considerations as outlined in Recommendations 1-3 apply. Additionally, we strongly suggest that the offloading treatment be reviewed at the same time as it is recommended to monitor the infection or PAD management and changed in accordance with any change in infection or ischaemia severity category. Lastly, we suggest that infection and PAD severity categories are also collected as part of the routine patient characteristics captured and monitored within organisational data monitoring systems to enable monitoring of patients with complications to ensure they are receiving recommended offloading treatment (41, 42).

Subgroup considerations for recommendations 7A, 7B, 7C

Geographically remote people

The same above considerations for geographically remote people apply.

Aboriginal and Torres Strait Islander Peoples

The same above considerations for Aboriginal and Torres Strait Islander people apply.

For more detailed considerations see eTable B9-B11 in Supplementary Material.



E: OTHER ULCER TYPES AND LOCATIONS

Recommendation 8

In a person with diabetes and a neuropathic plantar heel ulcer, consider using a knee-high offloading device or other offloading intervention that effectively reduces plantar pressure on the heel and is tolerated by the patient, to promote healing of the ulcer. (Weak; Low).

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation without change after screening, based on having no differences in judgements to the IWGDF and judging this recommendation to be acceptable and applicable in the Australian context (Table 1).

Implementation considerations

For effective implementation we suggest the following considerations:

Description

We agreed with IWGDF that the definition of plantar heel ulcer is one on the plantar surface of the rearfoot (or hindfoot) which is composed of the talus, calcaneus and surrounding soft tissue (22, 58). We also agreed that the prevalence of plantar heel DFU is lower than plantar forefoot DFU and the evidence to heal these ulcers is limited, but that these plantar heel DFU are often much more challenging to offload and place a greater risk of amputation of the lower leg (22). Thus, offloading treatment for excessive plantar pressure is arguably even more vital to heal people with these plantar heel ulcers (22). Otherwise we refer the reader to the descriptions of non-removable knee-high offloading devices in Recommendations 1 and removable knee-high offloading devices in Recommendation 2. Finally, we suggest that the ankle-high offloading devices outlined in Recommendations 3 may be used for plantar heel ulcers, but only if they can demonstrate a superior plantar pressure reduction at the ulcer site than knee-high offloading devices.

Contraindications

The same contraindications as outlined in Recommendations 1-2 also apply, depending on the knee-high offloading device chosen.

Procedures

The same general procedures as outlined in Recommendation 1-2 apply, depending on the knee-high offloading device chosen. Additionally, if considering ankle-high devices we highlight that such a device needs to demonstrate it can reduce more plantar pressure at the ulcer site than knee-high devices using validated plantar pressure measuring equipment to be chosen. Lastly, we also suggest that complete offloading of heel ulcers may be considered for severe DFU which fail to heal with knee-high offloading devices. While there is no literature to support their use as treatment to heal people with DFU, wheelchairs, knee scooters or electric scooters may be considered in these circumstances.

Monitoring considerations

The same monitoring considerations as outlined in Recommendations 1-2 apply. Additionally, we suggest that different DFU locations (such as forefoot, midfoot, rearfoot and plantar or dorsal) are also collected as part of routine patient characteristics within organisational data monitoring systems to enable organisations to monitor if their patients are receiving the recommended offloading intervention for their ulcer location (41, 42).

Subgroup considerations

Geographically remote people

The same considerations for geographically remote people in Recommendations 1-2 apply, depending on the knee-high offloading device chosen.

Aboriginal and Torres Strait Islander Peoples

The same considerations for Aboriginal and Torres Strait Islander people in Recommendations 1-2 apply, depending on the knee-high offloading device chosen.

For more detailed considerations see eTable B12 in Supplementary Material.



E: OTHER ULCER TYPES AND LOCATIONS

Recommendation 9

In a person with diabetes and a non-plantar foot ulcer, use a removable offloading device, medical grade footwear, felted foam, toe spacers or orthoses, depending on the type and location of the foot ulcer, rather than no offloading intervention to promote healing of the ulcer and to prevent further ulceration (Strong; Very Low).

DECISION: ADAPTED

Rationale

The panel decided to adapt this recommendation as we had differing judgements for desirable effects, undesirable effects and quality of evidence ratings, and the need to also include other intervention options, the control treatment and to prevent another DFU (Table 2). Therefore, we downgraded the quality of evidence from "low" to "very low", added any "removable offloading device" and "felted foam" as other intervention options, "rather than no offloading intervention" as the comparator, and "to prevent further ulceration" as another outcome of value. We again also replaced "footwear modifications" with the Australian term "medical grade footwear" that covers this definition (Table 3). For detailed justifications see eTable A9 in Supplementary Material.

Implementation considerations

For effective implementation we suggest the following considerations:

Description

We agreed with IWGDF that the definition of non-plantar DFU is for a DFU that is on a surface of the foot other than the plantar (weight-bearing) surface, including dorsal or interdigital surfaces of the foot (22, 58). We also agreed that evidence suggests that non-plantar DFU are similar in prevalence to plantar DFU, however, the evidence to offload non-plantar DFU is nearly non-existent even though the expert opinion is that offloading (or protecting from) pressure from these non-plantar DFU is equally important for healing (22). Otherwise we refer the reader to the descriptions of the various removable non-surgical offloading interventions, including removable offloading devices in Recommendations 2-3, medical grade footwear in Recommendation 4 and felted foam in Recommendation 5. Lastly, we agreed with IWGDF that toe spacers or orthoses are in-shoe orthoses designed to achieve some alteration in function of the toe and are typically customised from material such as silicon, rubber or foam (22).

Contraindications

The same contraindications in Recommendations 2-5 apply, depending on the specific removable non-surgical offloading intervention chosen.

Procedures

The panel agreed with IWGDF that given there is a substantial lack of evidence to guide offloading non-plantar DFUs (15), and until new evidence becomes available, that various removable non-surgical offloading modalities can be considered depending on the location of the nonplantar ulcer (22). Otherwise the same procedures in Recommendation 2-5 apply, depending on the removable non-surgical offloading intervention chosen.

Monitoring considerations

The same monitoring considerations in Recommendations 2-5 & 8 apply.

Subgroup considerations

Geographically remote people

The same considerations for geographically remote people in Recommendations 2-5 apply, depending on the removable non-surgical offloading intervention chosen.

Aboriginal and Torres Strait Islander Peoples

The same considerations for Aboriginal and Torres Strait Islander people in Recommendations 2-5 apply, depending on the removable non-surgical offloading intervention chosen.

For more detailed considerations see eTable B13 in Supplementary Material.



DISCUSSION

Key findings and recommendations

We developed an Australian evidence-based guideline on offloading treatment for people with DFU by systematically adapting high-quality international guidelines to the Australian context. In Australia, we recommend a step-down offloading treatment approach for people with plantar DFU depending on their contraindications and tolerance. We strongly recommend non-removable knee-high offloading devices as first option unless contraindicated or not tolerated, then consider removable knee-high offloading devices second, removable ankle-high offloading devices third and medical grade footwear as last option. We also recommend considering using felted foam (or other pressure offloading insole) in combination with the chosen offloading device or footwear to further reduce plantar pressure. For people with non-plantar DFU we recommend using a removable offloading device, felted foam, toe spacers or orthoses, or medical grade footwear depending on the type and location of the foot ulcer. If offloading device options fail to heal a person with plantar DFU, depending on the location, we recommend considering various surgical offloading procedures. This new guideline, endorsed by ten key national peak bodies, should serve as the new national multi-disciplinary evidence-based offloading guideline and the best practice standard of offloading care for people with DFU in Australia.

Differences to previous guidelines

There are now 13 offloading treatment recommendations in this new 2021 guideline compared with two offloading treatment recommendations in the previous 2011 guideline, i.e.: i) gold standard “use of a total contact cast or other device rendered irremovable”, and ii) where these irremovable devices could not be used then “other removable offloading devices may be considered” (16). The increased number of 2021 guideline recommendations are at least in part due to the substantial new offloading evidence published since the last guideline, including at least 11 RCTs and six meta-analyses (15). In this new 2021 guideline, non-removable knee-high offloading devices remain the gold standard offloading treatment (Recommendations 1). However, the big difference to the previous guideline is the detailed recommendations for circumstances when gold standard non-removable devices are contraindicated or unable to be tolerated. In these situations, we recommend considering removable knee-high or ankle-high offloading devices (Recommendations 2-3), footwear as a last resort (Recommendation 4) and considering felted foam (or pressure offloading insoles) to further reduce plantar pressure in all these devices (Recommendation 5). Furthermore, we recommend surgical offloading procedure options for when the best recommended offloading device treatment fails to heal a DFU (Recommendations 6), and various offloading devices or footwear options in people with DFUs complicated by infection, ischaemic or on a different foot location (Recommendations 7-9). Overall, this new guideline provides specific evidence-based offloading treatment options for nearly all circumstances for people with DFU in Australia.

Implementation considerations

To try and optimise the uptake of these new recommendations into national clinical practice we provided a comprehensive range of implementation considerations for health professionals, including facilitating patients to make an informed decision on which offloading treatment is best for their circumstances and other considerations when prescribing offloading treatments, such as including pressure offloading insoles and contralateral shoe raises (15, 22, 36). We also provided considerations on when and how to monitor the efficacy of offloading treatments for individual patients (22, 36) and for organisations (41, 42). Lastly, we distilled all recommendations into a one-page user-friendly pathway to try and maximise uptake and implementation of these recommendations and considerations by busy Australian multi-disciplinary clinicians (Figure 1).

In addition to these implementation considerations for the general population, we also provided specific implementation considerations for when treating people residing in geographically remote areas and Aboriginal and Torres Strait Islander peoples, such as the impact of limited or infrequent access to DFU care, hot climates, dusty environments and cultural practices. We emphasise that health professionals always consider it important to carefully explain and discuss with Aboriginal and Torres Strait Islander people the benefits and risks of the recommendations in the context of their personal and cultural circumstances, and ideally in collaboration with family, caregivers, support networks and local Aboriginal and Torres Strait Islander health care workers to optimise understanding. Further, we suggest health professionals consider facilitating culturally appropriate follow-up care, such as via liaising with local Aboriginal and Torres Strait Islander Health Care Worker(s), local Aboriginal Community Controlled Health Services, using Aboriginal Medical Benefit Scheme entitlements, developing culturally-appropriate resources and potentially incorporating Aboriginal artworks in the appearance of offloading devices to personalise treatment.



We suggest such culturally appropriate health care through the provision of a safe and welcoming clinical environment that is professional, humble, inclusive, transparent, respectful, empathetic, non-judgemental, and that gives a 'voice' which encourages choice and informed consent, may help result in "Aboriginal and Torres Strait Islander people enjoying long and healthy lives ... and ... high levels of social and emotional wellbeing" by preventing the "psychological distress" caused by DFU hospitalisation and disability (6-8).

Regardless of these implementation considerations for health professionals, we suggest there remains important access challenges to overcome before we see equitable wide-scale implementation of these guidelines throughout Australia. These challenges centre on the vast differences in access to and availability of offloading interventions (especially knee-high offloading devices and surgical procedures) that are governed by local funding restrictions and bureaucratic policies. Unfortunately, the ability to access these critical DFU treatments is still nearly entirely dependent on which Primary Health Network, Hospital and Health Service and/or State Health Department the patient resides as to what offloading treatment is provided and/or subsidised (3, 5, 35). A recent large prospective real-world cohort of nearly 5,000 Australians with DFU highlighted the critical importance to patients and services of overcoming any offloading treatment access challenges, when finding that knee-offloading treatment was one of the only treatment factors that was positively associated with short- and long-term DFU healing after adjustment for multiple other demographic, comorbidity, limb, ulcer and treatment-related factors (11). Whilst it is hoped that access to these offloading treatments should become much more readily available with the introduction of recent Australian High Risk Foot Service standards requiring services to provide these offloading treatments to be accredited (42), we still strongly suggest a nationally equitable scheme for patients to access best practice offloading treatments is urgently needed to reduce the national DFU burden (5, 15). Given multiple (inter)national cost-effectiveness studies consistently demonstrate that gold standard offloading treatments are perhaps the most (cost-)effective intervention to heal people with DFU (45, 59), and reduce what is a leading cause of the national disability burden (4, 6), we suggest that there needs to be equitable national access to recommended offloading devices via a national publicly-funded scheme, such as Medicare Benefits Schedule or National Diabetes Services Scheme (5, 15, 35).

Strengths and limitations

There are several strengths and limitations to note regarding the development of this guideline. The strengths included that we followed NHMRC-recommended ADAPTE and GRADE procedures for best practice adaptation of suitable international source guidelines (25-27), we identified and adapted the most recent international DFU guideline that was independently objectively assessed as being the highest-quality international guideline by ourselves and others (15, 21, 22) and the adaptation procedures were enacted by a transparent independent multi-disciplinary panel of (inter)nationally-recognised offloading experts, consumer and Aboriginal and Torres Strait Islander experts in DFU care (28). Further, unlike the international guideline we adapted (22), we also critically included consumer and Aboriginal and Torres Strait Islander experts in all aspects of guideline decision making, and comprehensively outlined implementation considerations when using the recommendations in this evidence-based guideline in accordance with GRADE (25-27).

However, this guideline is not without limitations, including we were reliant on the IWGDF systematic review identifying all the relevant available evidence in the field for us to review (15), and we were unable to review more recent evidence published since that 2019 review, which may have meant we missed important new evidence as part of our guideline deliberations (28). However, we were able to re-review all identified IWGDF evidence and any additional recent Australian literature in which we were subsequently aware (28). Further, as we followed a process to adapt IWGDF guidelines, we could not address any novel or alternate questions or undertake further systematic reviews. However, by adapting robust, high-quality guidelines, most if not all, of the topical questions can be considered covered in the current guideline. Additionally, although we did use a widely representative (inter)national expert panel in all decision making processes, and we engaged the perspectives of many Australian health professionals, researchers and peak bodies via a public call for consultation (28), we acknowledge that certain opinions and views may have been missed in this process. Lastly, whilst this guideline addresses recommendations in relations to questions regarding the best evidenced offloading treatment for those with a DFU, it does not address, and nor does the accompanying prevention guideline, questions relating to what offloading treatment should be recommended in the vital weeks and months after the patient heals to prevent recurrence (49). We also strongly suggest, that future guideline iterations address recommendations for best practice offloading treatment when transitioning from focussing on healing to prevention (49).



Future research considerations summary

Despite the substantial new evidence published since the 2011 guideline, there is still high-quality evidence lacking for the majority of offloading treatments (15). This is highlighted by the fact, that except for non-removable knee-high offloading devices, we rated all other recommendations as having (very) low quality of supporting evidence. This means the panel had low or very low levels of confidence that all other recommendations were based on studies that reported consistent effects with a low risk of bias and in turn further research was likely to change our confidence (29, 30). Therefore, we agree with the IWGDF that there are multiple future research opportunities to significantly improve our understandings of the key benefits, risks, contraindications and feasibility of using different offloading treatments to heal people with DFU (15, 22).

Like IWGDF, we recommend future high-quality trials are still very much needed to test the effectiveness of all other offloading treatments (including removable offloading devices, footwear, other non-surgical interventions and surgical offloading procedures) against gold standard non-removable knee-high offloading device controls on multiple important outcomes including healing, plantar pressure, weight-bearing activity, adverse events, patient satisfaction, costs and particularly adherence (15, 22). Behavioural interventions aimed at improving patient understanding and motivation regarding the use of offloading devices to improve adherence should also be a key focus of such future research. We also agree that such trials be conducted in accordance with IWGDF international reporting standards for high-quality DFU trials (37) and the CONSORT guideline (60), which should in turn enable future pooling of data for these outcomes and the opportunity for sub-group analyses to determine the patient (and foot) characteristics that benefit most (or least) from these specific interventions, such as in those complicated by infection or ischaemia or on different locations of the foot (15, 22). Unfortunately, with the exception of one trial investigating the use of felted foam to offload and heal plantar DFU (52), to our knowledge no other trials of offloading interventions to heal people with DFU have been performed in Australia (15). Thus, the panel encourages future Australian trials of offloading interventions adhering to the above trial standards and guidelines (37, 60), and particularly in Aboriginal and Torres Strait Islander populations and/or regions that are either geographically remote, have hot climates or dry environments, to determine if the effects found on healing in predominantly European and northern American trials are also found in Australia.

In addition to the above trials, the panel suggests future research into community perceptions of the benefits and risks of different offloading treatments are undertaken, such as those in qualitative studies to truly understand the patient perspective, particularly in geographically remote and Aboriginal and Torres Strait Islander peoples. We lastly suggest investigations into the effectiveness of the implementation of these guidelines in a range of different Australian environments, including in diverse patient groups, such as Aboriginal and Torres Strait Islander people are needed.

CONCLUSION

When combined with other best practice DFU care, pressure offloading is a critical DFU treatment with the strongest evidence available to effectively heal foot ulcers and reduce the national burden of DFU. These new Australian guideline recommendations guide best practice offloading treatment in Australia and have been developed to suit the unique geography, diversity and needs of the Australian health professionals, sectors and patients. We have also outlined implementation strategies and future research priorities for offloading treatments in Australia. Thus, health professionals implementing these recommendations in Australia should impart better DFU knowledge, treatment and healing outcomes on their patients, communities and nation and in turn reduce the footprint of this devastating condition on the lives and livelihoods of Australians living with diabetes today and into the future.



DECLARATIONS

Ethical approvals

Not applicable

Consent for publication

Not applicable

Availability of data and materials

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Competing interests

The funding/supporting bodies below provided oversight and final approval for this guideline, however, did not have any input into the decisions on recommendations contained in these guidelines or in the writing of these guidelines. JChe is employed by Diabetes Victoria and is fully funded by the National Diabetes Services Scheme. PAL was an author of the IWGDF Offloading Guidelines and Systematic Review in which this manuscript is based, has been a speaker consultant with Sanofi Australia, is chair of Diabetes Feet Australia, and is a member of the Journal of Foot & Ankle Editorial Board, Diabetes Australia Research Advisory Panel, National Association of Diabetes Centres Foot Network Committee, Australian Foot Forward Project Committee and Aboriginal and Torres Strait Islander Diabetic Foot Complications Program Expert Advisory Committee. PAL was specifically involved with the development and drafting of non-surgical offloading recommendations in the IWGDF Offloading Guideline and addressed this conflict by not screening, assessing or deciding on any non-surgical offloading recommendations as part of this Australian Guideline project. All other authors declare that they have no relevant competing interests.

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Authors' contributions

MEF screened, assessed, and drafted all recommendations and rationale for non-surgical offloading intervention recommendations, and drafted and critically reviewed the manuscript. MH and BM screened, assessed, and drafted all recommendations and rationale for surgical offloading intervention recommendations, and critically reviewed the manuscript. SJ and VLN screened, assessed, and drafted all recommendations and rationale for non-surgical offloading intervention recommendations, and critically reviewed the manuscript. JCha provided Aboriginal and Torres Strait Islander and end-user intellectual input and content into the screening, assessment and drafting of all recommendations and rationale, and critically reviewed the manuscript. JChe provided lived experience and consumer intellectual input and content into the screening, assessment and drafting of all recommendations and rationale, and critically reviewed the manuscript. PAL screened, assessed, and drafted all recommendations and rationale for all surgical offloading intervention recommendations, and drafted and critically reviewed the manuscript. MEF acted as the secretary and PAL as the chair of the author/chapter group and take full responsibility for the content. All authors approved the manuscript for submission.



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LIST OF ABBREVIATIONS

CONSORT:	Consolidated Standards of Reporting Trials
DFD:	Diabetes-related foot disease
DFU:	Diabetes-related foot ulcers
DPN:	Diabetes-related peripheral neuropathy
EtD:	Evidence to Decision
GRADE:	Grading of Recommendations Assessment, Development and Evaluation
IWGDF:	International Working Group on the Diabetic Foot
NHMRC:	National Health and Medical Research Council
PAD:	Peripheral artery disease
RCT:	Randomised controlled trial
TCC:	Total contact cast

Figure 1. Australian evidence-based clinical pathway on offloading treatment for people with diabetes-related foot ulcers (DFU) ^{*^}



[^]Please refer to the Australian guideline on offloading treatments for foot ulcers for full details


Table 1

Summary of screening ratings for acceptability and applicability in the Australian context for all the IWGDF Offloading recommendations.

RECOMMENDATION	ACCEPTABILITY			APPLICABILITY				FULL ASSESSMENT	COMMENTS
	1	2	3	4	5	6	7		
1a	+	?	+	+	+	?	+	Yes	Assess strength of recommendation & expertise availability
1b	+	?	?	+	?	?	?	Yes	Assess patient preference, equipment availability, expertise availability & legislative/policy constraints
2	+	?	+	+	+	+	+	Yes	Assess strength of recommendation
3	?	-	+	+	+	+	+	Yes	Assess quality of evidence and strength of recommendation
4a	?	-	?	+	?	+	?	Yes	Assess quality of evidence, strength of recommendation, patient preference, equipment availability & legislative/policy constraints
4b	?	+	+	+	+	+	+	Yes	Assess quality of evidence
5	+	?	?	+	+	?	+	Yes	Assess strength of recommendation & expertise availability
6	+	?	+	+	+	+	+	Yes	Assess strength of recommendation
7a	+	+	+	+	+	+	+	No	
7b	+	+	+	+	+	+	+	No	
7c	+	+	+	+	+	+	+	No	
8	+	+	+	+	+	+	+	No	
9	?	-	+	+	+	+	+	Yes	Assess quality of evidence and strength of recommendation
TOTAL	9	5	10	13	11	10	11	9	
%	69	38	77	100	85	77	85	69	

Note: +, yes item is met; -, no item is not met; ? unsure if item is met



OFFLOADING

Table 2: Summary of final panel judgements compared with IWGDF judgements for all IWGDF Infection recommendations.

NO	PROBLEM	DESIRABLE EFFECTS	UNDESIRABLE EFFECTS	QUALITY OF EVIDENCE	VALUES	BALANCE OF EFFECTS	ACCEPTABILITY	APPLICABILITY/ FEASIBILITY	DECISION	COMMENT
1a	Yes	Moderate	Trivial	Moderate	Probably no important uncertainty	Favours the intervention	Probably yes	Probably yes	Adapt	Adapted QoE & control
1b	Yes	Trivial	Trivial	Low	Probably no important uncertainty	Does not favour either intervention or control	Probably yes	Probably yes	Adapt	Adapted QoE & strength of recommendation
2	Yes	Moderate	Varies	Low	Possibly important uncertainty	Probably favours the intervention	Varies	Probably yes	Adapt	Adapted control, patient circumstances & foot-device interface
3	Yes	Varies	Small	Very low	Probably no important uncertainty	Favours the intervention	Yes	Yes	Adapt	Adapted QoE, control, patient circumstances & foot-device interface
4a	Yes	Don't know	Don't know	Low	Possibly important uncertainty	Favours the intervention	Probably yes	Probably yes	Adapt	Adapted QoE & control
4b	Yes	Small	Small	Very low	Probably no important uncertainty	Probably favours the intervention	Probably yes	Probably yes	Adapt	Adapted QoE intervention & control
5	Yes	Moderate	Small	Low	Probably no important uncertainty	Probably favours the intervention	Probably yes	Probably yes	Adapt	Adapted intervention
6	Probably yes	Moderate	Small	Low	Probably no important uncertainty	Probably favours the intervention	Probably yes	Yes	Adapt	Adapted population
7a	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
7b	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
7c	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
8	=	=	=	=	=	=	=	=	Adopt	Adopt in screening
9	Yes	Don't know	Don't know	Very low	Probably no important uncertainty	Favours the intervention	Probably yes	Probably yes	Adapt	Adapted QoE, intervention & control

Note: +, panel agreed with original IWGDF judgement; -, panel disagreed with original IWGDF judgement; ?, panel unsure if agreed with original IWGDF judgement due to lack of IWGDF information on judgement; =, panel agreed with original IWGDF judgements during screening (see Table 1); QoE: Quality of evidence.



OFFLOADING

Table 3: Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for offloading.

NO	ORIGINAL IWGDF RECOMMENDATION	DECISION	NO	NEW AUSTRALIAN RECOMMENDATION
1a	In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, use a non-removable knee-high offloading device with an appropriate foot-device interface as the first-choice of offloading treatment to promote healing of the ulcer. (Strong; High)	Adapted	1a	In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, use a non-removable knee-high offloading device <u>rather than a removable offloading device</u> to promote healing of the ulcer (GRADE strength of recommendation: Strong; Quality of evidence: <u>Moderate</u>).
1b	When using a non-removable knee-high offloading device to heal a neuropathic plantar forefoot or midfoot ulcer in a person with diabetes, use either a total contact cast or non-removable knee-high walker, with the choice dependent on the resources available, technician skills, patient preferences and extent of foot deformity present. (Strong; Moderate)	Adapted	1b	When using a non-removable knee-high offloading device to heal a neuropathic plantar forefoot or midfoot ulcer in a person with diabetes, <u>consider using</u> either a total contact cast or nonremovable knee-high walker, with the choice dependent on the <u>local</u> resources and <u>technical</u> skills <u>available</u> , and person's preferences and extent of foot deformity (<u>Weak; Low</u>).
2	In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer for whom a non-removable knee-high offloading device is contraindicated or not tolerated, consider using a removable knee-high offloading device with an appropriate foot-device interface as the second-choice of offloading treatment to promote healing of the ulcer. Additionally, encourage the patient to wear the device at all times. (Weak; Low)	Adapted	2	In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, <u>when</u> non-removable knee-high offloading devices are contraindicated or not tolerated, consider using a removable knee-high offloading device <u>(and explain the importance of using) during all weight-bearing activities rather than a removable ankle-high offloading device to reduce plantar pressure and</u> promote healing of the ulcer (Weak; Low).
3	In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer for whom a knee-high offloading device is contraindicated or not tolerated, use a removable ankle-high offloading device as the third-choice of offloading treatment to promote healing of the ulcer. Additionally, encourage the patient to wear the device at all times. (Strong; Low)	Adapted	3	In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, <u>when</u> knee-high offloading devices are contraindicated or not tolerated, use a removable ankle-high offloading device <u>(and explain the importance of using) during all weight-bearing activities rather than medical grade footwear</u> to promote healing of the ulcer (Strong; <u>Very low</u>)
4a	In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, do not use, and instruct the patient not to use, conventional or standard therapeutic footwear as offloading treatment to promote healing of the ulcer, unless none of the above-mentioned offloading devices is available. (Strong; Moderate)	Adapted	4	In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, <u>when</u> ankle-high offloading devices are contraindicated or not tolerated, use <u>medical grade footwear rather than other footwear types or no footwear</u> to <u>reduce plantar pressure</u> and promote healing of the ulcer (Strong; <u>Low</u>).
4b	In that case, consider using felted foam in combination with appropriately fitting conventional or standard therapeutic footwear as the fourth choice of offloading treatment to promote healing of the ulcer. (Weak; Low)	Adapted	5	In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer, consider using felted foam in combination with <u>an offloading device or footwear rather than using the offloading device or footwear alone to further reduce plantar pressure</u> and promote healing of the ulcer (<u>Weak; Very Low</u>).
5	In a person with diabetes and a neuropathic plantar metatarsal head ulcer, consider using Achilles tendon lengthening, metatarsal head resection(s), or joint arthroplasty to promote healing of the ulcer, if non-surgical offloading treatment fails. (Weak; Low)	Adapted	6a	<u>If the best recommended offloading device option fails to heal</u> a person with diabetes and a neuropathic plantar metatarsal head ulcer, consider using Achilles tendon lengthening or Gastrocnemius recession, metatarsal head resection(s), or joint arthroplasty to promote healing of the ulcer (Weak; Low).

Note: underlined wording indicates the specific adapted changes to the original IWGDF recommendation



OFFLOADING

Table 3 (cont): Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for offloading.

NO	ORIGINAL IWGDF RECOMMENDATION	DECISION	NO	NEW AUSTRALIAN RECOMMENDATION
6	In a person with diabetes and a neuropathic plantar or apex digital ulcer, consider using digital flexor tenotomy to promote healing of the ulcer, if non-surgical offloading treatment fails. (Weak; Low)	Adapted	6b	<u>If the best recommended offloading device option fails to heal</u> a person with diabetes and a neuropathic plantar or <u>apical</u> ulcer on a <u>non-rigid toe</u> , consider using digital flexor tenotomy to promote healing of the ulcer (Weak; Low).
7a	In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer with either mild infection or mild ischemia, consider using a non-removable knee-high offloading device to promote healing of the ulcer. (Weak; Low)	Adopted	7a	As stated in original the IWGDF Recommendation
7b	In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer with both mild infection and mild ischemia, or with either moderate infection or moderate ischaemia, consider using a removable knee-high offloading device to promote healing of the ulcer. (Weak; Low)	Adopted	7b	As stated in original the IWGDF Recommendation
7c	In a person with diabetes and a neuropathic plantar forefoot or midfoot ulcer with both moderate infection and moderate ischaemia, or with either severe infection or severe ischemia, primarily address the infection and/or ischemia, and consider using a removable offloading intervention based on the patient's functioning, ambulatory status and activity level, to promote healing of the ulcer. (Weak; Low)(Strong; Low)	Adopted	7c	As stated in original the IWGDF Recommendation
8	In a person with diabetes and a neuropathic plantar heel ulcer, consider using a knee-high offloading device or other offloading intervention that effectively reduces plantar pressure on the heel and is tolerated by the patient, to promote healing of the ulcer. (Weak; Low)	Adopted	8	As stated in original the IWGDF Recommendation
9	In a person with diabetes and a non-plantar foot ulcer, use a removable ankle-high offloading device, footwear modifications, toe spacers, or orthoses, depending on the type and location of the foot ulcer, to promote healing of the ulcer. (Strong; Low)	Adapted	9	In a person with diabetes and a non-plantar foot ulcer, use a removable offloading device, <u>medical grade</u> footwear, <u>felted foam</u> , toe spacers or orthoses, depending on the type and location of the foot ulcer, <u>rather than no offloading intervention</u> to promote healing of the ulcer <u>and to prevent further ulceration</u> (Strong; <u>Very Low</u>).

Note: underlined wording indicates the specific adapted changes to the original IWGDF recommendation



OFFLOADING

Table 4: Summary implementation considerations for the Australian evidence-based offloading treatment guidelines

NO	TREATMENT OR SCENARIO	CONTRAINDICATIONS	PROCEDURES	MONITORING	CONSIDERATIONS FOR THE AUSTRALIAN CONTEXT	ADDITIONAL INFORMATION
1a	Irremovable knee-high offloading devices.	For those with high falls risk (32), moderate-to-severe infection and/or moderate-to-severe ischaemia (22, 33, 34) consider Recommendations 3, 7B and 7C, respectively. Consider personal circumstances (22), such as because of occupation, family care requirements, frequent driving, hot climates, social impacts or infrequent ability to attend follow-up care. For these people we suggest also considering Recommendation 2.	We strongly advise that the benefits, risks and contraindications are always carefully explained and people with DFU have an opportunity to discuss their personal circumstances to gain full informed consent. Offloading treatment is always performed in conjunction with a good standard of DFU care that includes DFU measurement, appropriate debridement, wound dressings, antimicrobial treatment if infected, revascularisation considerations if ischaemic (9, 37). We refer the reader to the specific recommendations for such care in the relevant accompanying guidelines (REFS).	We suggest all people have their offloading regularly reviewed within ≤1 week of initial offloading device use and ~1-2 weekly thereafter - to monitor DFU healing, adverse events and plantar pressure where available.	Geographically remote people Aboriginal and Torres Strait Islander Peoples.	See eTable B1 for further detailed information
1b	Total contact casts (TCC) and instant total contact cats (iTCC)	The same contraindications as in Recommendation 1A also apply for this recommendation. Additionally, large foot deformity is likely a contraindication for iTCCs	The same monitoring considerations as outlined in Recommendations 1A apply. Capture as data items/options to monitor the organisations use of either TCC or iTCC in the Australian context for audit and quality review and reporting purposes.			See eTable B2 for further detailed information.
2	Removable knee-high offloading devices	People at high risk of mid-foot fractures if using half-shoe devices, people with very large foot deformity(s). Refer to Recommendation 4.	The same procedures as in Recommendation 1A apply. Additionally, we agree with IWGDF that persons should be strongly advised to wear the device consistently.		Determine if the device is still optimally reducing plantar pressure and if the person is adhering to wearing the device as much as possible.	See eTable B3 for further detailed information.
3	Removable ankle-high offloading devices	People at high risk of mid-foot fractures if using half-shoe devices, people with very large foot deformity(s). Refer to Recommendation 4.	1a The same procedure considerations as in Recommendation 2. it is likely that higher ankle-high devices and those with rocker-soles may offer more plantar pressure reduction.			See eTable B4 for further detailed information
4	Medical grade footwear	People with a large foot deformity(s) that cannot be safely accommodated in prefabricated medical grade footwear.	Similar procedure considerations as outlined in Recommendations 1-3.	The same monitoring considerations as outlined in Recommendations 1-3.	See Recommendations 1-3. Often medical grade footwear is more difficult to source in geographically remote settings than removable offloading devices. Consider whether culturally appropriate.	See eTable B5 for further detailed information.



OFFLOADING

Table 4: Summary implementation considerations for the Australian evidence-based offloading treatment guidelines

NO	TREATMENT OR SCENARIO	CONTRAINDICATIONS	PROCEDURES	MONITORING	CONSIDERATIONS FOR THE AUSTRALIAN CONTEXT	ADDITIONAL INFORMATION
5	Felted foam (adhesive felt)	People with severe ischaemia, very fragile skin or heavily exudating ulcers are likely to be contraindicated to using felted foam that is adhered to the foot itself. Therefore, adhere the felted foam to the pressure offloading insole.	Similar procedure considerations as outlined in Recommendations 1-3. Ensure there is enough room in the device or footwear to safely accommodate the foot and felted foam, use a bevelled technique. Monitor for adverse events.	The same monitoring considerations as outlined in Recommendation 2 also apply.	Geographically remote people Aboriginal and Torres Strait Islander Peoples.	See eTable B6 for further detailed information.
6a	Surgical offloading	A significant contraindication for these surgical procedures is moderate-to-severe ischaemia (22). Relative contraindications include those with moderate-to-severe infection, moderate-to-severe oedema, cognitive impairment impairing capacity to provide informed consent, or conditions precluding anaesthesia. Lastly, we suggest people with normal (>5 degrees of) ankle dorsiflexion are not likely to benefit from Achilles tendon lengthening or Gastrocnemius Recession procedures, and metatarsal head resections should be the surgical procedure considered instead. People with a rigid toe deformity are unlikely to benefit from Recommendation 6b.		The same monitoring considerations as outlined in Recommendations 1A also apply to this recommendation.		See eTable B7 for further detailed information.
6b		People at high risk of mid-foot fractures if using half-shoe devices, people with very large foot deformity(s). Refer to Recommendation 4.	We strongly agreed with IWGDF that these surgical offloading procedures should only be considered if the person has failed to heal following 4-6 weeks of a good standard of DFU care			See eTable B8 for further detailed information.
7a		DFU complicated by infection or ischaemia	NA. The infection or ischaemia treatment plan should be instigated first. Please refer to Australian Guidelines on Infection and PAD (33, 34, 57).			See Recommendation 1
7b	See Recommendation 2					
7c	See Recommendation 3					



OFFLOADING

Table 4: Summary implementation considerations for the Australian evidence-based offloading treatment guidelines

NO	TREATMENT OR SCENARIO	CONTRAINDICATIONS	PROCEDURES	MONITORING	CONSIDERATIONS FOR THE AUSTRALIAN CONTEXT	ADDITIONAL INFORMATION
8	Plantar heel DFU	The same contraindications as outlined in Recommendations 1-2	If considering ankle-high devices we highlight that such a device needs to demonstrate it can reduce more plantar pressure at the ulcer site than knee-high devices	The same monitoring considerations as outlined in Recommendations 1-2. Additionally, collect site of the ulcer as routine characteristics.	Geographically remote people Aboriginal and Torres Strait Islander Peoples.	See eTable B12 for further detailed information.
9	Non-plantar DFU	The same contraindications in Recommendations 2-5 apply.	Given there is a substantial lack of evidence, various removable non-surgical offloading modalities can be considered.	The same monitoring considerations in Recommendations 2-5 & 8 apply.		See eTable B13 for further detailed information.



OFFLOADING

Table 5: Summary public consultation survey responses (n=14)

No.	Item	n	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
Background							
1	You are involved with the care of patients for whom this draft Australian offloading guideline is relevant.	14	11 (78.6%)	0	3 (21.4%)	0	0
2	There is a need for a new Australian offloading guideline in this population.	14	9 (64.3%)	5 (35.7%)	0	0	0
3	The rationale for developing a new Australian offloading guideline on this topic is clear in this draft guideline.	14	9 (64.3%)	5 (35.7%)	0	0	0
Methodology							
4	I agree with the overall methodology used to develop this draft Australian offloading guideline.	14	6 (42.9%)	6 (42.9%)	2 (14.3%)	0	0
5	The search strategy used to identify international guidelines on which this draft Australian offloading guideline was based is relevant and complete	14	5 (35.7%)	7 (50.0%)	2 (14.3%)	0	0
6	The methods used to determine the suitability of identified international source guidelines upon which this draft Australian offloading guideline were based were robust.	14	5 (35.7%)	7 (50.0%)	2 (14.3%)	0	0
7	I agree with the methods used within this draft Australian offloading guideline to interpret the available evidence on this topic.	14	5 (35.7%)	7 (50.0%)	2 (14.3%)	0	0
8	The methods used to decide which recommendations to adopt, adapt or exclude for the Australian context were objective and transparent.	14	5 (35.7%)	8 (57.1%)	1 (7.1%)	0	0
Recommendations							
9	The recommendations in this draft Australian offloading guideline are clear.	14	8 (57.1%)	4 (28.6%)	2 (14.3%)	0	0
10	I agree with the recommendations in this draft Australian offloading guideline as stated.	14	5 (35.7%)	6 (42.9%)	3 (21.4%)	0	0
11	The recommendations are suitable for people living with diabetes-related foot disease.	14	5 (35.7%)	6 (42.9%)	1 (7.1%)	1 (7.1%)	0
12	The recommendations are too rigid to apply for people living with diabetes-related foot disease.	14	2 (14.3%)	1 (7.1%)	3 (21.4%)	6 (42.9%)	2 (14.3%)



OFFLOADING

Table 5: Summary public consultation survey responses (n=14)

13	The recommendations reflect a more effective approach to improving patient outcomes than is current practice.	14	5 (35.7%)	3 (21.4%)	4 (28.6%)	2 (14.3%)	0
14	When applied, the recommendations should produce more benefits than harms for people living with diabetes-related foot disease.	14	7 (50%)	6 (42.9%)	1 (7.1%)	0	0
15	When applied, the recommendations should result in better use of resources than current practice allows.	14	6 (42.9%)	4 (28.6%)	3 (21.4%)	1 (7.1%)	0
16	I would feel comfortable if people living with diabetes-related foot disease received the care recommended in this draft Australian offloading guideline.	14	8 (57.1%)	4 (28.6%)	2 (14.3%)	0	0
Implementation of recommendations							
17	To apply the draft Australian offloading guideline may require reorganisation of services/care.	13	5 (38.5%)	5 (38.5%)	2 (15.4%)	1 (7.7%)	0
18	To apply the draft Australian offloading guideline may be technically challenging.	13	4 (30.8%)	6 (46.2%)	2 (15.4%)	1 (7.7%)	0
19	The draft Australian offloading guideline may be too expensive to apply.	13	4 (30.8%)	2 (23.1%)	3 (23.1%)	3 (23.1%)	1 (7.7%)
20	The draft Australian offloading guideline presents options that will likely be acceptable to people living with diabetes-related foot disease.	13	3 (23.1%)	7 (53.9%)	1 (7.7%)	2 (15.4%)	0
Final thoughts							
21	This draft guideline should be approved as the new Australian offloading guideline.	13	6 (46.2%)	5 (38.5%)	1 (7.7%)	1 (7.7%)	0
22	This draft Australian offloading guideline would be supported by the majority of my colleagues.	13	5 (38.5%)	7 (53.9%)	1 (7.7%)	0	0
23	If this draft guideline was to be approved as the new Australian offloading guideline, I would use or encourage their use in practice.	13	8 (61.5%)	4 (30.8%)	1 (7.7%)	0	0



REFERENCES

1. Armstrong DG, Boulton AJM, Bus SA. Diabetic Foot Ulcers and Their Recurrence. *New England Journal of Medicine*. 2017;376(24):2367-75.
2. Kerr M, Barron E, Chadwick P, Evans T, Kong WM, Rayman G, et al. The cost of diabetic foot ulcers and amputations to the National Health Service in England. *Diabetic Medicine*. 2019;36(8):995-1002.
3. Lazzarini PA, van Netten JJ, Fitridge R, Griffiths I, Kinnear EM, Malone M, et al. Pathway to ending avoidable diabetes-related amputations in Australia. *The Medical Journal Of Australia*. 2018;209(7):288-90.
4. Zhang Y, Lazzarini PA, McPhail SM, van Netten JJ, Armstrong DG, Pacella RE. Global Disability Burdens of Diabetes-Related Lower-Extremity Complications in 1990 and 2016. *Diabetes Care*. 2020;43(5):964-74.
5. van Netten JJ, Lazzarini PA, Fitridge R, Kinnear EM, Griffiths I, Malone M, et al. Australian diabetes-related foot disease strategy 2018-2022: The first step towards ending avoidable amputations within a generation. Brisbane: Wound Management CRC; 2017.
6. Zhang Y, van Netten JJ, Baba M, Cheng Q, Pacella R, McPhail SM, et al. Diabetes-related foot disease in Australia: a systematic review of the prevalence and incidence of risk factors, disease and amputation in Australian populations. *Journal of Foot and Ankle Research*. 2021;14(1):8.
7. West M, Chuter V, Munteanu S, Hawke F. Defining the gap: a systematic review of the difference in rates of diabetes-related foot complications in Aboriginal and Torres Strait Islander Australians and non-Indigenous Australians. *Journal of Foot and Ankle Research*. 2017;10(1):48.
8. NIAA. NATIONAL AGREEMENT ON CLOSING THE GAP Canberra: National Indigenous Australians Agency; 2020.
9. Schaper NC, Van Netten JJ, Apelqvist J, Bus SA, Hinchliffe RJ, Lipsky BA, et al. Practical guidelines on the prevention and management of diabetic foot disease (IWGDF 2019 update). *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3266.
10. Lazzarini PA, Crews RT, van Netten JJ, Bus SA, Fernando ME, Chadwick PJ, et al. Measuring Plantar Tissue Stress in People With Diabetic Peripheral Neuropathy: A Critical Concept in Diabetic Foot Management. *Journal of Diabetes Science and Technology*. 2019;13(5):869-80.
11. Zhang Y, Cramb S, McPhail SM, Pacella RE, Van Netten JJ, Cheng Q, et al. Factors associated with healing of diabetes-related foot ulcers: observations from a large prospective real-world cohort. *Diabetes Care*. 2021;44(7):e143-e5.
12. Bus SA. The Role of Pressure Offloading on Diabetic Foot Ulcer Healing and Prevention of Recurrence. *Plast Reconstr Surg*. 2016;138(3 Suppl):179S-87S.
13. Lazzarini PA, Jarl G. Knee-High Devices Are Gold in Closing the Foot Ulcer Gap: A Review of Offloading Treatments to Heal Diabetic Foot Ulcers. 2021;57(9):941.
14. Bus SA, Valk GD, van Deursen RW, Armstrong DG, Caravaggi C, Hlaváček P, et al. The effectiveness of footwear and offloading interventions to prevent and heal foot ulcers and reduce plantar pressure in diabetes: a systematic review. *Diabetes/Metabolism Research & Reviews*. 2008;24:S162-80.
15. Lazzarini PA, Jarl G, Gooday C, Viswanathan V, Caravaggi CF, Armstrong DG, et al. Effectiveness of offloading interventions to heal foot ulcers in persons with diabetes: a systematic review. *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3275.
16. Baker IDI Heart and Diabetes Institute. National evidence-based guideline on prevention, identification and management of foot complications in diabetes (Part of the National Health & Medical Research Council Approved Guidelines on Management of Type 2 Diabetes). Melbourne: Baker IDI Heart & Diabetes Institute; 2011.
17. Wu SC, Jensen JL, Weber AK, Robinson DE, Armstrong DG. Use of pressure offloading devices in diabetic foot ulcers: do we practice what we preach? *Diabetes Care*. 2008;31(11):2118-9.
18. Raspovic A, Landorf KB. A survey of offloading practices for diabetes-related plantar neuropathic foot ulcers. *Journal of Foot and Ankle Research*. 2014;7(1):35.
19. Quinton T, Lazzarini P, Boyle F, Russell A, Armstrong D. How do Australian podiatrists manage patients with diabetes? The Australian diabetic foot management survey. *Journal of Foot and Ankle Research*. 2015;8(1):16.
20. Bakker K, Schaper NC. The development of global consensus guidelines on the management and prevention of the diabetic foot 2011. *Diabetes/Metabolism Research And Reviews*. 2012;28 Suppl 1:116-8.
21. Parker CN, van Netten JJ, Parker TJ, Jia L, Corcoran H, Garrett M, et al. Differences between national and international guidelines for the management of diabetic foot disease. *Diabetes/Metabolism Research and Reviews*. 2019;35(2):e3101.
22. Bus SA, Armstrong DG, Gooday C, Jarl G, Caravaggi C, Viswanathan V, et al. Guidelines on offloading foot ulcers in persons with diabetes (IWGDF 2019 update). *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3274.



REFERENCES

23. Conte MS, Bradbury AW, Kolh P, White JV, Dick F, Fitridge R, et al. Global vascular guidelines on the management of chronic limb-threatening ischemia. *J Vasc Surg.* 2019;69(6s):3S-125S.e40.
24. International Diabetes Federation. Clinical Practice Recommendation on the Diabetic Foot: A guide for health care professionals. Brussels, Belgium: International Diabetes Federation; 2017.
25. National Health & Medical Research Council (NHMRC). Guidelines for Guidelines: Adopt, adapt or start from scratch - Version 5.2; Last updated 22 November 2018. In: NHMRC, editor. Canberra, Australia 2018 <https://www.nhmrc.gov.au/guidelinesforguidelines/plan/adopt-adapt-or-start-scratch>.
26. The ADAPTE Collaboration. The ADAPTE Process: Resource Toolkit for Guideline Adaptation - Version 2.0. Perthshire, Scotland: Guideline International Network; 2009 <https://g-i-n.net/library/tools>.
27. Schünemann HJ, Wiercioch W, Brozek J, Etzeandía-Ikobaltzeta I, Mustafa RA, Manja V, et al. GRADE Evidence to Decision (EtD) frameworks for adoption, adaptation, and de novo development of trustworthy recommendations: GRADE-ADOLOPMENT. *J Clin Epidemiol.* 2017;81:101-10.
28. Lazzarini PA, Raspovic A, Prentice J, Commons RJ, Fitridge R, Charles J, et al. Guidelines development protocol and findings: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
29. Alonso-Coello P, Schünemann HJ, Moher J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 1: Introduction. 2016;353:i2016.
30. Alonso-Coello P, Oxman AD, Moher J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 2: Clinical practice guidelines. *Bmj.* 2016;353:i2089.
31. Flores EJ, Mull NK, Lavenberg JG, Mitchell MD, Leas BF, Williams A, et al. Using a 10-step framework to support the implementation of an evidence-based clinical pathways programme. *BMJ Quality and Safety.* 2019;28(6):476-85.
32. (ACSQHC) ACoSaQHC. Preventing Falls and Harm From Falls in Older People: Best Practice Guidelines for Australian Community Care. In: ACSQHC, editor. Sydney, Australia: Commonwealth of Australia; 2009.
33. Commons RJ, Charles J, Cheney J, Lynar SA, Malone M, Raby E, et al. Australian guideline on management of diabetes-related foot infection: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
34. Chuter VH, Quigley F, Tosenovsky P, Ritter JC, Charles J, Cheney J, et al. Australian guideline on diagnosis and management of peripheral artery disease: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
35. van Netten JJ, Lazzarini PA, Armstrong DG, Bus SA, Fitridge R, Harding K, et al. Diabetic Foot Australia guideline on footwear for people with diabetes. *Journal of Foot and Ankle Research.* 2018;11(1):2.
36. Jarl G, Gooday C, Lazzarini PA, Bus SA. Practical considerations for implementing the new IWGDF guideline for offloading diabetic foot ulcers. *The Diabetic Foot Journal.* 2020;23(2):34-40.
37. Jeffcoate WJ, Bus SA, Game FL, Hinchliffe RJ, Price PE, Schaper NC. Reporting standards of studies and papers on the prevention and management of foot ulcers in diabetes: required details and markers of good quality. *The Lancet Diabetes & Endocrinology.* 2016;4(9):781-8.
38. Kaminski MR, Golledge J, Lasschuit JWJ, Heinz-Schott K, Charles J, Cheney J, et al. Australian guideline on prevention of foot ulceration: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
39. Hamilton EJ, Scheepers J, Ryan H, Perrin BM, Charles J, Cheney J, et al. Australian guideline on wound classification of diabetes-related foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
40. Chen P, Carville K, Swanson T, Lazzarini PA, Charles J, Cheney J, et al. Australian guideline on wound healing interventions to enhance healing of foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
41. Lazzarini PA VNJ, Fitridge R, Kinnear E, Malone M, Perrin BM, Prentice J, Wraight PR. Australian Diabetic Foot Ulcer Minimum Dataset Dictionary. Brisbane: Diabetic Foot Australia, Wound Management Innovation CRC; 2016.
42. National Association of Diabetes Centres (NADC) and Australian Diabetes Society (ADS). NADC Collaborative Interdisciplinary Diabetes High Risk Foot Services Standards Version 1.1 Sydney, Australia: National Association of Diabetes Centres; 2018 [Available from: <https://nadc.net.au/national-standards/>].



REFERENCES

243. Lazzarini PA, Ng V, Kinnear EM, Kamp MC, Kuys SS, Hurst C, et al. The Queensland high risk foot form (QHRFF) - is it a reliable and valid clinical research tool for foot disease? *Journal Of Foot And Ankle Research*. 2014;7(1):7-.
44. Services Australia. Your guide to Medicare for Indigenous health services: April 2021. Canberra, Australia; 2021 7 May 2021.
45. Health Quality O. Fibreglass total contact casting, removable cast walkers, and irremovable cast walkers to treat diabetic neuropathic foot ulcers: A health technology assessment. *Ontario Health Technology Assessment Series*. 2017;17(12):1-124.
46. Caputo GM, Ulbrecht JS, Cavanagh PR. The total contact cast: a method for treating neuropathic diabetic ulcers. *American family physician*. 1997;55(2):605-11, 15-6.
47. Tamir E, Heim M, Siev-Ner I. Removable fiberglass de-loading cast for the management of neuropathic plantar ulceration of the foot. *The Israel Medical Association journal : IMAJ*. 2005;7(8):507-10.
48. Piaggese A, Macchiarini S, Rizzo L, Palumbo F, Tedeschi A, Nobili LA, et al. An off-the-shelf instant contact casting device for the management of diabetic foot ulcers: a randomized prospective trial versus traditional fiberglass cast. *Diabetes Care*. 2007;30(3):586-90.
49. Fernando ME, Woelfel SL, Perry D, Najafi B, Khan T, DuBourdieu C, et al. Dosing Activity and Returning to Pre-Ulcer Function in Diabetic Foot Remission: Patient Recommendations and Guidance from the Limb Preservation Consortium at USC and The National Rehabilitation Center at Rancho Los Amigos. *Journal of the American Podiatric Medical Association*. 2021;In press 21 March 2021
50. Zimny S, Schatz H, Pfohl U. The effects of applied felted foam on wound healing and healing times in the therapy of neuropathic diabetic foot ulcers. *Diabetic Medicine: A Journal Of The British Diabetic Association*. 2003;20(8):622-5.
51. Raspovic A, Waller K, Wong WM. The effectiveness of felt padding for offloading diabetes-related foot ulcers, at baseline and after one week of wear. *Diabetes Research And Clinical Practice*. 2016;121:166-72.
52. Nubé VL, Molyneaux L, Bolton T, Clingan T, Palmer E, Yue DK. The use of felt deflective padding in the management of plantar hallux and forefoot ulcers in patients with diabetes. *The Foot*. 2006;16(1):38-43.
53. Raspovic A, Landorf KB. A survey of offloading practices for diabetes-related plantar neuropathic foot ulcers. *Journal of Foot and Ankle Research*. 2014;7(1):1-8.
54. Mueller MJ, Sinacore DR, Hastings MK, Strube MJ, Johnson JE. Effect of Achilles tendon lengthening on neuropathic plantar ulcers. A randomized clinical trial. *The Journal Of Bone And Joint Surgery American Volume*. 2003;85-A(8):1436-45.
55. Independent Hospital Pricing Authority (IHPA). Chronicle of The International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM): First Edition to Tenth Edition, 2017. In: IHPA, editor. Darlinghurst, NSW: IHPA; 2017.
56. Queensland Department of Health. Queensland Hospital Admitted Patient Data Collection (QHAPDC) Manual 2019-2020 Version 1.2. In: Branch SS, editor. Brisbane, Queensland: Queensland Health; 2019.
57. Mills JL, Sr., Conte MS, Armstrong DG, Pomposelli FB, Schanzer A, Sidawy AN, et al. The Society for Vascular Surgery Lower Extremity Threatened Limb Classification System: risk stratification based on wound, ischemia, and foot infection (WIFI). *Journal Of Vascular Surgery*. 2014;59(1):220-34.e1-2.
58. van Netten JJ, Bus SA, Apelqvist J, Lipsky BA, Hinchliffe RJ, Game F, et al. Definitions and criteria for diabetic foot disease. *Diabetes/Metabolism Research and Reviews*. 2020;36(S1):e3268.
59. Cheng Q, Lazzarini PA, Gibb M, Derhy PH, Kinnear EM, Burn E, et al. A cost-effectiveness analysis of optimal care for diabetic foot ulcers in Australia. *International Wound Journal*. 2017;14(4):616-28.
60. Schulz KF, Altman DG, Moher D. CONSORT 2010 Statement: updated guidelines for reporting parallel group randomised trials. *BMJ*. 2010;340:c332.



WOUND HEALING INTERVENTIONS

Australian guideline on wound healing to enhance
healing of foot ulcers

Part of the 2021 Australian
evidence-based guidelines for
diabetes-related foot disease

VERSION 1.0191021



AUTHORS

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Disclaimer

These Australian Evidence-based Guidelines are a general guide to appropriate practice, to be followed subject to the clinician's judgment and the patient's preference in each individual case. The Guidelines are designed to provide information to assist decision-making and are based on the best evidence available at the time of development.

Diabetes Feet Australia would like to thank and acknowledge Mikaela Cameron who has created the artwork to represent the guidelines. Mikaela Cameron (M. J. Badagarang) is a proud Dharug saltwater woman from the Hawkesbury River in New South Wales, Australia. She's worked the past 4 years as a cultural educator delivering cultural workshops and creating murals. "Worimi, I am a proud Dharug woman. My totem is the Badagarang (Eastern Grey Kangaroo), and Waroo (the brown-eyes crow). I pay my respects to all Elders past, present and emerging, and extend this acknowledgment to you and your people. Welcome, let's walk together."



ABSTRACT

Background

Diabetes-related foot ulceration (DFU) has a substantial burden on both individuals and healthcare systems both globally and in Australia. There is a pressing need for updated guidelines on wound healing interventions to improve outcomes for people living with DFU. A national expert panel was convened to develop new Australian evidence-based guidelines on wound healing interventions for people with DFU by adapting suitable international guidelines to the Australian context.

Methods

The panel followed National Health and Medical Research Council (NHMRC) procedures to adapt suitable international guidelines by the International Working Group of the Diabetic Foot (IWGDF) to the Australian context. The panel systematically screened, assessed and judged all IWGDF wound healing recommendations using ADAPTE and GRADE frameworks for adapting guidelines to decide which recommendations should be adopted, adapted or excluded in the Australian context. Each recommendation had their wording, quality of evidence, and strength of recommendation re-evaluated, plus rationale, justifications and implementation considerations provided for the Australian context. This guideline underwent public consultation, further revision and approval by ten national peak bodies.

Results

Thirteen IWGDF wound healing recommendations were evaluated in this process. After screening, nine recommendations were adopted and four were adapted after full assessment. Two recommendations had their strength of recommendations downgraded, one intervention was not currently approved for use in Australia, one intervention specified the need to obtain informed consent to be acceptable in Australia, and another was reworded to clarify best standard of care. Overall, five wound healing interventions have been recommended as having the evidence-based potential to improve wound healing in specific types of DFU when used in conjunction with other best standards of DFU care, including sucrose-octasulfate impregnated dressing, systemic hyperbaric oxygen therapy, negative pressure wound therapy, placental-derived products, and the autologous combined leucocyte, platelet and fibrin dressing.

Conclusions

The IWGDF guideline for wound healing interventions has been adapted to suit the Australian context, and in particular for geographically remote and Aboriginal and Torres Strait Islander people. This new national wound healing guideline, endorsed by ten national peak bodies, also highlights important considerations for implementation, monitoring, and future research priorities in Australia.

Keywords

Diabetes-related foot ulcer; diabetic foot; foot ulcer, guideline; recommendations; treatment; wound healing; wound treatment.



WOUND HEALING INTERVENTIONS

AUSTRALIAN RECOMMENDATIONS LIST

PREVENTION

WOUND CLASSIFICATION

PERIPHERAL ARTERY
DISEASE

INFECTION

OFFLOADING

WOUND HEALING
INTERVENTIONS

- 1 Remove slough, necrotic tissue, and surrounding callus of a diabetic foot ulcer with sharp debridement in preference to other methods, taking relative contraindications such as pain or severe ischemia into account (GRADE strength of recommendation: strong; quality of evidence: low)
- 2 Dressings should be selected principally on the basis of exudate control, comfort and cost (strong; low)
- 3 Do not use dressings/applications containing surface antimicrobial agents with the sole aim of accelerating the healing of an ulcer (strong; low)
- 4 Consider the use of the sucrose-octasulfate impregnated dressing as an adjunctive treatment, in addition to best standard of care, in non-infected, neuro-ischaemic diabetic foot ulcers that are difficult to heal (weak; moderate)
- 5 Consider the use of systemic hyperbaric oxygen therapy as an adjunctive treatment in non-healing ischaemic diabetic foot ulcers despite best standard of care (weak; moderate)
- 6 We suggest not using topical oxygen therapy as a primary or adjunctive intervention in diabetic foot ulcers including those that are difficult to heal (weak; low)
- 7 Consider the use of negative pressure wound therapy (NPWT) to reduce wound size, in addition to best standard of care, in patients with diabetes and a post-operative (surgical) wound on the foot (weak; low)
- 8 We suggest not using negative pressure wound therapy in preference to best standard of care in nonsurgical diabetic foot ulcers (weak; low)
- 9 Consider the use of placental derived products with informed consent as an adjunctive treatment, in addition to best standard of care, when the latter alone has failed to reduce the size of the wound (weak; low)
- 10 We suggest not using growth factors, autologous platelet gels, bioengineered skin products, ozone, topical carbon dioxide, and nitric oxide in preference to best standard of care (weak; low)
- 11 Consider the use of autologous combined leucocyte, platelet and fibrin as an adjunctive treatment, in addition to best standard of care, in non-infected diabetic foot ulcers that are difficult to heal only if this adjunctive treatment becomes approved for use in Australia (weak; moderate)
- 12 We suggest not using agents reported to have an effect on wound healing through alteration of the physical environment including through the use of electricity, magnetism, ultrasound and shockwaves in preference to best standard of care (weak; low)
- 13 We suggest not using interventions aimed at correcting the nutritional status (including supplementation of protein, vitamins and trace elements, pharmacotherapy with agents promoting angiogenesis) of patients with a diabetic foot ulcer, with the aim of improving healing, but note that nutritional status should be reviewed, and adequate daily nutritional requirements should be met as part of best standard of care (weak; low).



BACKGROUND

Diabetes-related foot disease causing diabetes-related foot ulceration (DFU) is one of the most devastating complications of diabetes, precedes up to 75% of amputations in people with diabetes and accounts for a significant proportion of the global disability burden(1, 2). In Australia, DFUs cost the healthcare systems an estimated \$1.6 billion(3, 4), affect around 50,000 people, cause 28,000 hospital admissions and 5,000 amputations each year(3, 4). A further 300,000 Australians are living with diabetes-related peripheral neuropathy and thus at risk of DFU. Aboriginal and Torres Strait Islander people are disproportionately affected by DFU, being up to 38 times more likely to have a major amputation compared to their non-Indigenous counterparts(4-6). It is thus critical that interventions to enhance or facilitate healing of DFU are supported by strong evidence of benefit and cost-effectiveness(7), and all communities across Australia should have equitable access to these interventions(6).

Management of DFU has been a global priority with new International Working Group of the Diabetic Foot (IWGDF) Guidelines released every 4 years since 1999 and the most recent released in 2019(7). In contrast, the last national evidence-based guideline in Australia was released in 2011(8), and is now considerably outdated(3, 9). Furthermore, in 2011, the IWGDF Guidelines reported that poor study design and reporting were a key limitation in the evidence base of interventions to enhance healing of DFU(10, 11). However, in 2016 with the subsequent IWGDF publication of international best practice reporting standards for DFU studies(12), several well-designed clinical trials involving interventions to enhance wound healing in DFU have since been published(13,14).

With this in mind, not only did the Australian Guideline (2011) urgently need updating, but experts suggested there was a 'renaissance in DFU wound healing intervention studies'(15) that provided considerable new robust evidence to support different wound healing interventions with significantly improved outcomes for people with DFU. Thus, this was a timely opportunity to adapt the 2019 IWGDF Guideline to the Australian context to become the new Australian guideline on wound healing interventions to heal DFU, which should help guide health professionals address the large national DFU burden and mitigate existing inequalities amongst Australians living with DFU.





METHODS

The methods to develop this guideline have been described in detail in the accompanying guidelines development protocol authored by the Australian Diabetes-related Foot Disease (DFD) Guideline Development Working Group(16). Eight overarching steps recommended by the National Health and Medical Research Council (NHMRC) for adapting source guidelines(16-18) were followed and they were: 1) defining the scope, 2) identifying potential source guidelines, 3) assessing the suitability of source guidelines, 4) assessing and deciding which source guideline recommendations to adopt, adapt or exclude, 5) drafting new recommendations and rationale for the context, 6) collating recommendations and rationales into new guidelines, 7) developing clinical pathway(s) to aide implementation, and 8) consultation and endorsement of the final guideline(18). Steps 1-3 were performed by the Guideline Development Working Group(16) who systematically searched for and identified all available potential source guidelines, and assessed the 2019 IWGDF Guideline(7) as the only suitable international sourced guideline to adapt to the Australian context. The remaining methodological steps are the subject of this paper and are described below.

National panel

The authors ('the panel') of this Australian wound healing interventions guideline are all national experts with recognised inter-disciplinary expertise in wound healing for people with DFU. They were invited along with a consumer, and an Aboriginal Torres Strait Islander DFU representative by the Australian DFD Guidelines Development Working Group to systematically adapt the IWGDF recommendations on wound healing interventions to the Australian context(16). . The panel was provided with the IWGDF Guideline (2019), systematic review(19) and supplementary documentation for wound healing interventions to screen, assess and decide on the applicability and acceptability of all 13 IWGDF Guideline (2019) wound healing intervention recommendations to the Australian context (7, 19).

Screening recommendations

Each of the thirteen IWGDF (2019) recommendations were initially independently screened by two panel members to assess the quality of evidence, strength of recommendation, acceptability and applicability in the Australian context using a customised 7-item ADAPTE evaluation format(16, 20). Any disagreement amongst the two panel members was discussed until consensus was reached and if this was not possible a third panel member was invited to aid decision making. The full panel subsequently met to discuss and reach consensus on all item ratings for all recommendations. Each recommendation where the panel agreed unanimously with the IWGDF on all quality of evidence and strength of recommendation item ratings, as well as deeming the recommendation applicable and acceptable to the Australian context, were adopted for use. Any recommendations where the panel were unsure if they agreed with the IWGDF on any of those items were referred for a full assessment at the next stage(16).

Assessing recommendations

The GRADE Evidence to Decision (EtD) tool template was used for recommendations necessitating a full assessment(16, 17, 21, 22). The EtD template facilitates judgements to be made on eight criteria: the problem, desirable effects, undesirable effects, quality (or certainty) of evidence, values (of importance of outcomes), balance of effects, acceptability and feasibility(17, 21, 22). One panel member extracted all relevant evidence that supported the recommendation concerned from the IWGDF Guideline (2019) and/or systematic review to populate the EtD tool(7, 19). The member then added any Australian literature or expert opinion considerations that were not included in the IWGDF Guideline (2019) that they considered necessary. Once populated, the EtD tool was checked by a second panel member and disagreements were discussed and resolved until consensus was achieved. All detailed and summary judgement items for each criterion were then rated in the populated EtD tool by a panel member and checked by another, and disagreements were once again discussed until a majority consensus was achieved. At this stage, the full panel met again to discuss and achieve consensus on the summary judgement ratings for all eight EtD criteria and then compared those judgements with those of the IWGDF Guideline (2019)(21, 22).



Decisions on recommendations

The decision to adopt, adapt or exclude each original IWGDF Guideline (2019) recommendation was based on the level of agreement between the panel and the IWGDF judgements(21, 22). If there was agreement between the panel and IWGDF across all or the vast majority of the eight criteria the recommendation was adopted. If there was disagreement, the recommendation could be adapted and if there were substantial disagreement and/or the panel concluded the acceptability or applicability was not adequate for the Australian context, it could be excluded(21, 22). Where consensus was not achieved amongst the panel, the Australian DFD Guideline Development Working Group were consulted and assisted with this process if required.

Recommendations adapted at this stage of the process were re-evaluated on their quality of evidence and strength of recommendation until consensus, based on the panel's summary judgements of the eight EtD criteria(21, 22). GRADE defines quality of evidence as: high, if the panel were confident the findings from the supporting evidence were from studies with low risk of bias with reported consistent effects and further research was unlikely to change that confidence; moderate, if the panel had moderate confidence in the findings being of low risk of bias and/or with consistency of effects and further research was likely to impact that further; low, if the panel had low confidence in the findings being of risk of bias and with consistent effects; and very low, if there was very low confidence in the supporting evidence(21, 22). The strength of recommendation was made taking into consideration the balance of effects, quality of evidence, values, applicability and acceptability in the Australian context(21, 22). In brief, it was rated as strong, if there was a moderate-to-large difference in the balance of effects between the intervention and control; and weak, if there was a mild-to-moderate difference or any major uncertainty(21, 22). The redrafted wording for adapted recommendations were based on the original IWGDF Guideline (2019) recommendations wording and adapted to reflect the Australian context in line with the panel's specific judgement and the GRADE system.

Drafting recommendations

Lastly, the panel drafted clear rationales for final decisions, summary justifications for the recommendations and detailed justifications on each EtD criteria if the recommendation was fully assessed. The panel also specified considerations for implementation of each recommendation in Australia as well as applicability to special subgroups, including geographically remote individuals and Aboriginal and Torres Strait Islander populations. Final considerations were given to monitoring of outcomes and potential future research priorities(21, 22). The wound healing intervention guideline manuscript was drafted for inclusion as part of the Australian DFD Guideline (2021) and in preparation for public consultation(16).

Consultation and Endorsement

The draft guideline manuscript underwent a four-week public consultation period where all interested health professionals and peak national bodies were able to provide feedback on the draft via the completion of a 23-item customised consultation survey. The survey was designed based on ADAPTE examples with additional open ended items for feedback on each recommendation and overall final comments(16, 20). At the completion of the four-week period, all consultation survey feedback was collated, analysed and reviewed to determine any necessary revisions to the guideline. Finally, the authors sought endorsement from the Australian DFD Guidelines Development Working Group and other relevant peak national bodies. The results of this paper detailed below contain all final recommendations in the new Australian guideline on wound healing interventions to enhance healing of foot ulcers.



RESULTS

After screening 13 IWGDF wound healing-related recommendations, nine were adopted and four required full assessment (see Table 1). Of the four recommendations undergoing full assessment, all were adapted for the following reasons: two recommendations had their strength of recommendation downgraded, one intervention was not currently approved for use in Australia, one intervention specified the need to obtain informed consent to be acceptable in Australia, and another was reworded to clarify best standard of care (see Table 2). The exact wording differences between the IWGDF Guideline (2019) and the new Australian Guideline (2021) recommendations are summarised in Table 3.

We received four responses (one individual and three organisations) to the public consultation survey with three (75%) responding that they agreed that the guideline should be approved as the new Australian wound healing guideline, that the guideline would be supported by the majority of their colleagues and if approved they would encourage its use in practice. All de-identified feedback comments received during public consultation and the panel's responses to each comment were collated and are available on the Diabetes Feet Australia website. Based on the collated public consultation feedback, the guideline was revised, approved by the panel and Australian DFD Guidelines working group, and endorsed as the new Australian guideline on wound healing interventions to enhance healing of foot ulcers by ten peak national bodies including Wounds Australia, Australian Podiatry Association, Australian and New Zealand Society for Vascular Surgery, Australasian Society for Infectious Diseases, Australian Orthotic Prosthetic Association, Pedorthic Association of Australia, Australian Advanced Practicing Podiatrists - High Risk Foot Group, Australian Aboriginal and Torres Strait Islander Diabetes-related Foot Complications Program, Australian Diabetes Society and Diabetes Feet Australia.

Outlined below are each of the thirteen Australian recommendations for wound healing interventions to enhance healing of DFU. In each section, the panel has detailed the question addressed by the recommendation, the Australian recommendation(s), the panel's decision on adopting, adapting or excluding the recommendation, and the summarised (and detailed justifications if applicable) for each recommendation. Also included are considerations for implementation of the recommendation in Australia, including for the subgroups of geographically remote and Aboriginal and Torres Strait Islander people. Lastly, we addressed monitoring and potential further priorities for research for each recommendation. A glossary of definitions is available at the end of this paper.

GUIDELINE ENDORSEMENT

The Wound Healing interventions guideline has been endorsed by the following Australian peak bodies and national organisations involved with diabetes-related foot disease.

LISTED IN ALPHABETICAL ORDER

- Aboriginal and Torres Strait Islander Diabetes-related Foot Complications Program (SAHMRI)
- Advanced Practicing Podiatrists - High Risk Foot Group
- Australian and New Zealand Society for Vascular Surgery
- Australian Diabetes Society
- Australian Orthotic Prosthetic Association
- Australian Podiatry Association
- Australasian Society for Infectious Diseases
- Diabetes Feet Australia
- Pedorthic Association of Australia
- Wounds Australia





Recommendation 1

Remove slough, necrotic tissue, and surrounding callus of a diabetic foot ulcer with sharp debridement in preference to other methods, taking relative contraindications such as pain or severe ischemia into account (GRADE strength of recommendation: strong; quality of evidence: low)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation as our judgements agreed with all the IWGDF judgements for this recommendation, including for the strength of recommendation, quality of evidence, patient values, and that sharp debridement is widely acceptable and applicable in the Australian context.

Summary justification

The panel agreed with the IWGDF that although the quality of supporting evidence for this recommendation was low, the strength of recommendation was strong for debridement in general as the balance of effects favoured removing slough, necrotic tissue and callus over not removing it for healing of DFU. We also agreed with the IWGDF that there is limited evidence supporting alternative forms of debridement (e.g., larval, ultrasonic, mechanical) as being beneficial to wound healing, and all were at high risk of bias(7). Furthermore, sharp debridement is now widely considered to be part of best standard of DFU care based on broad international expert opinion that it is superior to other forms of debridement(7, 19) and that the resources and expertise to perform sharp debridement are readily available in Australia and at relatively low cost.

Implementation considerations

Debridement is widely acknowledged to be beneficial in removing surface debris, slough and nonviable tissue, which leaves clean and viable tissue, and new bleeding can trigger a new inflammatory phase, and subsequent angiogenesis, formation of granulation tissue, and epithelialisation(19). The IWGDF Guideline (2019) description of debridement is "the removal of callus or dead tissue that can be surgical ("sharp") or nonsurgical (e.g., abrasion, chemical)"(7). However, the panel considered that the definition of sharp debridement still required further clarification for the Australian context. We suggest in this Australian Guideline (2021) that sharp debridement should be defined as "the removal of callus or non-viable tissue that can be surgical (performed in a theatre), or conservative (performed in a clinic), using an aseptic technique with sterilised scalpel or scissors". Non-sharp debridement techniques may include autolytic, mechanical, larval (bio surgical), ultrasonic, hydro surgical abrasion or chemical methods(23). We agree with the IWGDF that in the presence of gas-forming infection, abscesses or necrotising fasciitis, that surgical debridement is likely to be urgently required(7).

In Australia, training in sharp debridement of DFU in undergraduate and postgraduate health professional programs is limited. Similarly, formal programs for debridement that are accredited by professional associations, as is present in some countries like the USA are also lacking. Therefore, the panel strongly suggests that sharp debridement should be limited to those who are suitably trained and can demonstrate competence in performing debridement for DFU whilst adhering to local policies and protocols. In addition, that professional peak associations or similar bodies should consider accreditation processes for sharp debridement training courses in vocational wound management programs.



Recommendation 1

Remove slough, necrotic tissue, and surrounding callus of a diabetic foot ulcer with sharp debridement in preference to other methods, taking relative contraindications such as pain or severe ischemia into account (GRADE strength of recommendation: strong; quality of evidence: low)

DECISION: ADOPTED

Subgroup considerations

Geographically remote people

The panel considers that limited access to healthcare professionals competent in performing sharp debridement in rural and remote communities may exist for some sites. Thus, health professionals in rural and remote communities who lack competence or confidence in performing sharp debridement of DFU should instead establish contacts and referral pathways to health professions competent in debridement in their local areas. The panel similarly encourage health professionals to establish contacts for onsite clinical teaching or consider travelling to metropolitan centers to acquire the necessary knowledge and training to competently perform sharp debridement of DFU.

Aboriginal and Torres Strait Islander Peoples

The panel considers this recommendation is widely applicable to Aboriginal and Torres Strait Islander people if health professionals are trained and competent in sharp debridement, and the procedure of debridement is explained clearly to the recipient.

Other subgroup considerations

The panel agree with the IWGDF that sharp debridement may be contraindicated in individuals with pain or severe ischaemia(7). Should sharp debridement be clinically contraindicated after comprehensive assessment in these individuals, alternative methods of debridement such as autolytic debridement may be applicable. Considerations for assessment and management of severe peripheral artery disease (PAD) are detailed in the accompanying Australian DFD Guideline on PAD (2021).

Monitoring considerations

Regular sharp debridement to remove non-viable or infected tissue is both an important adjunct offloading (from or adjacent to a plantar DFU, where indicated) and wound healing treatment to facilitate DFU healing. Therefore, the panel proposes that organisations monitor the frequency of sharp debridement treatments as a key clinical performance indicator for patients with DFU, and consider benchmarking these treatments to clinical outcomes such as DFU healing rates. Although this is not currently an item in existing national High Risk Foot Service database monitoring systems(24), the panel recommend consideration for inclusion in future iterations as there are likely considerable clinical and health service implications and variations in terms of costs and benefits in time to healing with different debridement regimens.

Future research considerations

The panel agrees with the IWGDF Guideline (2019) recommendation that although backed strongly by expert opinion, the quality of evidence for sharp debridement over alternative methods of debridement is low. Therefore, high-quality randomised controlled trials (RCT) are still required for direct comparison of the efficacy of different types, frequency and regimens of debridement to better inform clinical decisions and patient outcomes.



Recommendation 2

Dressings should be selected principally on the basis of exudate control, comfort and cost (strong; low)

DECISION: ADOPTED

Rationale

After screening each of these three recommendations which address the original question (Question 2), the panel agreed with all IWGDF judgements on strength of recommendations, quality of evidence and patient values ratings, plus, that all recommendations were broadly acceptable and applicable in the Australian context.

Summary justification

The panel agreed with the relevant evidence statement in the IWGDF systematic review that there does not seem to be any evidence to support the balance of effects favouring any wound dressing product over another to achieve ulcer healing across all different types of DFU(19), in addition to the quality of evidence overall being low. Thus, with no dressing product demonstrated to be superior to another for all DFU types, the panel also agreed with IWGDF's strong strength of recommendation, that dressings should be primarily selected based on the principles of exudate control, comfort and preferably low cost. The panel agreed that such a recommendation based on these principles would be widely acceptable and applicable in the Australian context. Most Australian health services will have the resources and expertise to provide such wound dressings that meet these basic principles for dressing selection. Otherwise, further considerations on how to use this recommendation are provided in the subsequent implementation sub-section below.

Implementation considerations

In the absence of evidence supporting superiority of one dressing product over another for healing DFUs, dressing selection is paramount as part of a good standard of DFU care. The panel suggests that a good standard of DFU care includes a comprehensive DFU assessment, appropriate debridement, appropriate wound dressings, antimicrobial management if infected, revascularisation considerations if ischaemic and the best available offloading device provided for the patient (12, 30) (see recommendations for other treatments in those accompanying Australian DFD Guidelines)(31-34).

Regarding the wound dressing aspect of this good standard of DFU care, the short-term goals to principally address exudate levels, comfort and cost, along with the overall goals of care and preferences of the patient should be considered when deciding on which wound dressing to select. For example, for a patient with a low exuding non-infected neuropathic DFU, an inexpensive, less absorbent dressing may suffice. Conversely, for a heavily exuding neuropathic DFU, super absorbent foams or polymer dressings may be preferred as they would readily absorb higher amounts of exudate, are comfortable and whilst slightly more expensive, may be more cost-effective, which relates to the dressing efficacy on DFU healing along with the costs of frequency of dressing change. Dressings should be changed when soiled or when strikethrough is observed, and not placed on wounds for periods exceeding manufacturer's recommendations for use. The ability of the dressing to conform comfortably to the anatomical location is also a high priority. The panel additionally suggests clinicians consider the TIME principle of chronic wound bed preparation and treatment in selecting an appropriate dressing(35).



Recommendation 2

Dressings should be selected principally on the basis of exudate control, comfort and cost (strong; low)

DECISION: ADOPTED

Subgroup considerations

Geographically remote people

There are no additional considerations for geographical remote people than for those mentioned above.

Aboriginal and Torres Strait Islander Peoples

There are no additional considerations for Aboriginal and Torres Strait Islander people than for those mentioned above.

Other subgroup considerations

Recommendations 2 and 3 are generic recommendations and there are no specific subgroups that will find this unacceptable or are contraindicated.

Monitoring considerations

The panel suggests that along with maintaining a good standard of DFU care, dressings should be monitored and changed when soiled or when strikethrough is observed, and not placed on wounds for periods exceeding the manufacturer's recommendations for use. Otherwise, the panel encourage the inclusion and capture of different dressing types in High Risk Foot Service database monitoring systems(24) to benchmark the different dressing types' efficacy on local DFU healing.

Future research considerations

The panel agreed with the IWGDF that further high quality RCTs, in accordance with IWGDF standards for conducting and reporting DFU trials, on the clinical utility and effectiveness of most non-antimicrobial and antimicrobial dressings compared with a good standard of DFU care are needed.



Recommendation 3

Do not use dressings/applications containing surface antimicrobial agents with the sole aim of accelerating the healing of an ulcer (strong; low)

DECISION: ADOPTED

Rationale

After screening each of these three recommendations which address the original question (Question 2), the panel agreed with all IWGDF judgements on strength of recommendations, quality of evidence and patient values ratings, plus, that all recommendations were broadly acceptable and applicable in the Australian context.

Summary justification

The panel agreed with the IWGDF that there are studies that seemingly indicate some benefit of individual antimicrobial agents on accelerating DFU healing in locally infected wounds, such as potassium permanganate(25), superoxidised antiseptic solution(26), topical phenytoin(27-29) and herbal extracts. However, all these studies had a high risk of bias based on sub-standard methodology and/or incomplete reporting of data on participant characteristics. Furthermore, the higher quality of these studies mostly reported no difference in DFU healing rates compared to a control of a good (or best) standard of DFU care. Therefore, the quality of supporting evidence is low and current available evidence does not support any additional desirable effect from using antimicrobial dressings over a good standard of DFU care for the primary aim of DFU healing. The panel also agreed with the IWGDF that there are additional undesirable effects of using antimicrobial dressings indiscriminately with most requiring some additional wound healing expertise and expense as compared to a good standard of DFU care. Thus, the balance of effects instead favours using a good standard of DFU care compared with using an antimicrobial dressing, and, supports a strong strength of the recommendation not to use antimicrobial dressings when the primary intention is to accelerate DFU healing.

Implementation considerations

Please refer to Recommendation 2 for similar implementation considerations, as well as the panel's definition of a good standard of wound care for DFU.

Subgroup considerations

Please refer to Recommendation 2.

Monitoring considerations

Please refer to Recommendation 2.

Future research considerations

Please refer to Recommendation 2.



Recommendation 4

Consider the use of the sucrose-octasulfate impregnated dressing as an adjunctive treatment, in addition to best standard of care, in non-infected, neuro-ischaemic diabetic foot ulcers that are difficult to heal (weak; moderate)

DECISION: ADOPTED

Rationale

After screening each of these three recommendations which address the original question (Question 2), the panel agreed with all IWGDF judgements on strength of recommendations, quality of evidence and patient values ratings, plus, that all recommendations were broadly acceptable and applicable in the Australian context.

Summary justification

The panel agreed with the IWGDF that firstly, there is at least a moderate quality of supporting evidence for this recommendation. This is based on one high-quality adequately powered RCT demonstrating effectiveness of using a sucrose-octasulfate impregnated dressing over a control dressing to heal DFU that were non-infected, neuro-ischaemic and hard to heal despite best standard of care. However, it is acknowledged that there may be some perception of industry bias in this study due to industry funding of this trial(7). Thus, the panel agreed that the quality of supporting evidence is moderate until further high quality RCTs support or refute these findings. Secondly, the panel agreed that the balance of effects probably favoured the intervention, based on the one RCT suggesting moderate likely desirable effects on healing based on significantly more DFUs healing at 20 weeks in the intervention group compared to the control group (adjusted odds ratio of 2.6 (95% CI 1.43 – 4.73)) with a significantly faster mean time to healing; and small likely undesirable effects with quality of life and adverse event outcomes similar in both groups, and cost effectiveness not reported but possibly higher in the intervention group (13). Subsequently, the strength of this recommendation should remain weak in favour of the sucrose-octasulfate impregnated dressing over control dressings specifically in non-infected neuro-ischaemic DFUs. Lastly, the panel agreed that the intervention is probably acceptable and applicable in the Australian context given increased availability in most services treating DFU, the expertise required to apply these dressings is minimal, and it is approved for use in Australia.

Implementation considerations

The panel notes that the study population for this recommendation is limited to those with non-infected, neuro-ischaemic DFU, that have not healed after receiving a good standard of DFU care, with ischaemic defined as having moderate PAD (see accompanying Australian DFD Guideline for PAD for definitions)(13, 32). The panel suggests that before considering using sucrose-octasulfate impregnated dressings, health professionals should confirm the person has moderate PAD and that they have a non-healing DFU after receiving the aforementioned principles of a good standard of DFU care. Non-healing DFUs can be defined as those DFUs that have not reduced in size by >50% after receiving 4-6 weeks of the above good standard of care. Once these parameters are confirmed the use of sucrose-octasulfate impregnated dressings should be considered in addition to a good standard of DFU care. Please also refer to Recommendation 2 for similar implementation considerations, as well as the panel's definition of good standard of wound care for DFU in the below glossary of terms section.

Subgroup considerations

Other subgroup considerations

The panel also suggests that there are no contraindications to implementing Recommendation 4, however we do note that benefit of this sucrose-octasulfate impregnated dressing has only been demonstrated in those with neuro-ischaemic DFU and benefit in other DFU types is unknown.

Monitoring considerations

Please refer to Recommendation 2.

Future research considerations

The panel agreed with the IWGDF that further high quality RCTs, in accordance with IWGDF standards for conducting and reporting DFU trials, on the clinical utility and effectiveness of most non-antimicrobial and antimicrobial dressings compared with a good standard of DFU care are needed. In addition, that further high quality RCTs on the use of sucrose-octasulfate impregnated dressings are also still required to confirm or refute the existing high quality trial. However, it is noted post publication of the IWGDF Guideline (2019), a further study reported the cost effectiveness of the sucrose-octasulfate impregnated dressing compared with a simple dressing as €6,017.25 versus €9,928.49 respectively, for direct treatment costs incurred over 20 weeks with complete wound closure as a primary endpoint, indicating that sucrose-octasulfate impregnated dressings may also be cost-effective(36). It is reasserted future studies are required to confirm this finding.



Recommendation 5

Consider the use of systemic hyperbaric oxygen therapy as an adjunctive treatment in non-healing ischaemic diabetic foot ulcers despite best standard of care (weak; moderate)

DECISION: ADOPTED

Rationale

The panel decided to adopt this recommendation as our judgements agreed with all the IWGDF judgements for each recommendation, including the strength of recommendation, quality of evidence, patient values and that systemic hyperbaric oxygen therapy (HBOT) is generally applicable and acceptable in the Australian context.

Summary justification

The panel agreed with the IWGDF there is a moderate quality of supporting evidence for the use of HBOT on non-healing ischaemic ulcers. This was based on two older RCTs with low risk of bias that showed that in some ischaemic DFUs, HBOT significantly improved healing within 12 months(37, 38). Seven subsequent heterogenous RCTs with mostly high risk of bias, investigating different DFU types, populations, healing outcomes and follow-up times showed mostly no difference between HBOT and control treatments(19). Therefore, there is likely some small-to-moderate desirable effects for using HBOT in ischaemic DFU types. It was further agreed that although HBO therapies are available and approved for use in Australia, the cost-effectiveness, accessibility, and acceptability of use in Australia may be limited and because of this, small undesirable effects are likely for using HBOT over good standard of DFU care. Overall, the panel agreed that the balance of effects probably favours HBOT over a good standard of care in moderately ischaemic DFU types only.

Implementation considerations

Systemic HBOT aims to overcome wound hypoxia, promote epithelialisation, and subsequently accelerate healing. There is a dose-response relationship for HBOT which often requires patients to attend four to five treatments per week. The total number of treatment sessions varies depending on the response of the wound to HBOT, but often exceeds 6 weeks of treatment in total(39). Due to the need for frequent, and lengthy treatment sessions, the desirable effects (small-to-moderate benefit on wound healing) and undesirable effects (small risks from increased costs, treatment time and potential adverse effects) should be carefully discussed with the patient, in addition to the requirement to commit to regular attendance for required treatment periods, which may limit a patients' autonomy. Moreover, the cost-effectiveness of systemic HBOT is yet to be established, although HBOT is subsidized by the Australian Medicare Benefits Schedule for DFU.

The panel notes the study population for this recommendation is limited to those with non-healing, ischaemic DFU that have not healed after receiving a good standard of DFU care, with ischaemic defined as having moderate PAD (see accompanying Australian DFD Guideline for PAD for definitions)(13, 32). The panel suggests that before considering using systemic HBOT that health professionals should confirm the person does have PAD, has adequate vessel patency and that they have a non-healing DFU after receiving a good standard of DFU care. Please also refer to Recommendation 2 for similar implementation considerations, as well as the panel's definition of non-healing DFU and a good standard of wound care for DFU.

Where systemic HBOT is considered as an adjunctive mode of treatment in addition to a good standard of care, we recommend referral and comprehensive assessment by the receiving HBOT unit prior to commencement of therapy. The selection of patients for HBOT should include a comprehensive medical assessment and take into consideration patient preferences and overall goals of care. The panel also reiterate that this recommendation is specific to people with ischaemic DFU as there is, as yet, no clear evidence of benefit for HBOT in healing for other DFU types. Furthermore, when applied, systemic HBOT is to be an adjunctive mode of treatment in addition to good standard of care, not as a replacement for such care.

Q3 In individuals with active diabetic foot ulcers, does systemic hyperbaric oxygen or topical oxygen therapy in comparison to standard care help promote healing?



Recommendation 5

Consider the use of systemic hyperbaric oxygen therapy as an adjunctive treatment in non-healing ischaemic diabetic foot ulcers despite best standard of care (weak; moderate)

DECISION: ADOPTED

Subgroup considerations

Geographically remote people

At the time of writing, there were twelve hyperbaric oxygen units across Australia, all of which were in major metropolitan or major regional areas. Due to the requirement for numerous sessions of daily treatment over several weeks, people living in rural and remote Australia will likely have limited access to this treatment modality, as requirements of travel or the costs of temporary accommodation in close proximity to hyperbaric units may be prohibitive. The panel suggests that in these circumstances, healthcare providers in rural and remote Australia should carefully discuss with their patient the additional travel costs for geographically remote patients along with the small-to-moderate benefit that HBOT treatment is likely to provide for patients with ischaemic DFU. Health professionals who have patients who make an informed decision to undergo HBOT should establish contacts and referral pathways to facilitate access to this treatment modality.

Aboriginal and Torres Strait Islander Peoples

This recommendation is potentially applicable to Aboriginal and Torres Strait Islander people. However, the panel acknowledges that many Aboriginal and Torres Strait Islander people live in geographically remote areas with limited accessibility to HBOT as stated above. The panel also recommends that Aboriginal health workers should be involved where possible to carefully discuss the risks and benefits of HBOT for ischaemic DFU with Aboriginal and Torres Strait Islander people to ensure that patients are able to make a culturally appropriate informed decision.

Other subgroup considerations

Numerous systemic HBOT units in Australia also require patients to be within a confined space for a few hours at a time and a patient's disposition to claustrophobia should be considered when recommending HBOT.

Monitoring considerations

The panel also proposes that organisations include the use of systemic HBOT alongside other wound healing interventions (such as the above wound dressings) in their organisational database monitoring systems to monitor the impact of these wound healing interventions on clinical outcomes and DFU healing rates. Although this is not currently an item in existing national High Risk Foot Service database monitoring systems(24), the panel propose HBOT be considered for inclusion as an intervention worthy of future monitoring.

Future research considerations

Since publication of the IWGDF Guidelines in 2019, a systematic review and meta-analysis of HBOT in DFU has shown reduction in major amputation rates, but not wound healing rates, in patients with DFU and PAD(39). However, the panel agree with the IWGDF that further appropriately powered high quality RCTs are required to confirm the (cost)-effectiveness of HBOT(19). Further, the type of DFU that would benefit most from HBOT, and duration of therapy is still unknown with further high-quality research in this area still needed(19).



Recommendation 6

We suggest not using topical oxygen therapy as a primary or adjunctive intervention in diabetic foot ulcers including those that are difficult to heal (weak; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt the recommendation as our judgements agreed with all the IWGDF judgements for the recommendation, including the strength of recommendation, quality of evidence, patient values and that topical oxygen therapy is generally applicable and acceptable in the Australian context.

Summary justification

The panel agrees with the IWGDF regarding the lack of evidence supporting the balance of effects favouring topical oxygen therapy over a good standard of DFU care to achieve wound healing. Although a few published studies showed some beneficial effect of topical oxygen in wound healing, most were at high risk of bias due to methodological flaws(7), and although two high quality RCTs(40, 41) with low risk of bias have been published, they have conflicting results. Moreover, topical oxygen therapy is likely to require additional wound healing expertise to use and be more expensive than a good standard of DFU care. Thus, the balance of effects probably favours a good standard DFU care over topical oxygen therapy. The panel agreed with the IWGDF for not recommending topical oxygen therapy as a primary or adjunctive treatment in DFU healing until more high quality RCTs are available and the true effect of topical oxygen therapy on wound healing is ascertained(7).

Implementation, subgroup and monitoring considerations

Topical oxygen therapy supplies continuous or cyclical diffusion of oxygen over the surface of the wound. As this recommendation favours a good standard of care over the intervention in DFU healing, there are no additional considerations for implementation, monitoring and subgroups than those outlined for a good standard of care in earlier wound dressing recommendations (See Recommendations 2-4).

Future research considerations

The panel agree with the IWGDF that further high-quality, well conducted RCTs compared with a good standard of DFU care controls are required to substantiate any future desirable effects over undesirable effects before topical oxygen therapy can be recommended for use in people with DFU.



Recommendation 7

Consider the use of negative pressure wound therapy (NPWT) to reduce wound size, in addition to best standard of care, in patients with diabetes and a post-operative (surgical) wound on the foot (weak; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt these recommendations as our judgements agreed with all the IWGDF judgements for these recommendations, including the strength of recommendation, quality of evidence, patient values, and that NPWT is widely available and acceptable in the Australian context.

Summary justification

The panel agreed with the IWGDF that whilst there were four studies showing shortened time to healing in those using NPWT when used as an adjunctive treatment for DFU that have undergone surgical intervention, these were all at high risk of bias and had numerous methodological flaws(7). Thus, the balance of effects slightly favours the use of NPWT in addition to best standard of care for patients with a surgically-treated DFU, although the quality of supporting evidence is low. Furthermore, NPWT is applicable and acceptable, and currently widely used within the Australian context, although the cost-benefit of its use has not been demonstrated(7).

Implementation considerations

Negative pressure wound therapy (NPWT) is the application of an intermittent or continuous subatmospheric pressure to the system foam or gauze filler, which more recently has been shown to actually provide a positive pressure to the surface of a wound and facilitates the draining of wound exudate, the promotion of angiogenesis, granulation tissue and assists with wound contraction(42). Apart from appropriate patient selection, there are no specific considerations for implementation.

Subgroup considerations

Geographically remote people

Surgical procedures on DFU and the use of NPWT thereafter are likely to be instituted in a large tertiary or regional hospital or community settings, which may not be in close proximity to people living in geographically remote areas. Continuation of NPWT upon discharge also relies upon the availability of competent staff as well as access to NPWT equipment, which again may be unavailable in geographically remote areas. When implementing NPWT in surgically treated DFUs in people from geographically remote areas, health professionals should consider the access to NPWT equipment and availability of competent staff to facilitate NPWT treatment. The panel also recommends discussion of the potential desirable (potentially faster wound healing) and undesirable effects (higher costs or a longer admission) with patients so an informed decision can be made. Staff in geographically remote areas may also consider undertaking training to overcome any skill gap, including in provision of post-hospital discharge NPWT with portable devices or NPWT single use dressings.

Aboriginal and Torres Strait Islander Peoples

In a similar manner to considerations for people in geographically remote locations, the panel also considers that Aboriginal and Torres Strait Islander people who reside in rural and remote Australia may have to travel away from their families to receive surgical care for DFU. Hence, considerations for initiating NPWT in surgically treated DFUs should take into consideration availability of staff and equipment in the patient's community upon discharge and the desirable and undesirable effects discussed as part of informed consent and patient-centered care.

Other subgroup considerations

The panel is unaware of any subgroups for which NPWT would be unacceptable.

Monitoring considerations

The panel propose organisations monitor the use and effect of NPWT on healing surgical wounds in organisational database monitoring systems for patients with DFU. Although this is not currently an item in existing national High Risk Foot Service database monitoring systems(24), it is proposed for inclusion in the future.

Future research considerations

The panel agrees with the IWGDF that robust RCTs are required to determine the (cost)-effectiveness of NPWT as an adjunctive treatment in addition to best standard of care for surgical and non-surgically treated DFUs(19). The panel is cognisant that NPWT is occasionally used in non-surgical DFUs in Australia and recommend that similar high quality RCTs evaluating its (cost) effectiveness be conducted to support its use in Australia.



Recommendation 8

We suggest not using negative pressure wound therapy in preference to best standard of care in nonsurgical diabetic foot ulcers (weak; low)

DECISION: ADOPTED

Rationale

The panel decided to adopt these recommendations as our judgements agreed with all the IWGDF judgements for these recommendations, including the strength of recommendation, quality of evidence, patient values, and that NPWT is widely available and acceptable in the Australian context.

Summary justification

The panel agree with the IWGDF that some studies reporting on the use of NPWT on non-surgically treated DFU showed some statistically significant benefit compared to standard care. However, those studies were at high risk of bias with incomplete reporting, statistical analysis and other significant methodological flaws(7). Thus, the desirable effects are likely to be small-to-moderate at most and the undesirable effects of additional time, cost and expertise are also small-to-moderate. Overall, the balance of effects does not favour NPWT over a good standard of care to enhance healing of non-surgically treated DFU. It was further agreed that the strength of recommendation suggesting not to use NPWT in people with non-surgical treated DFU in preference to best standard of care is weak, and the quality of evidence is low(7).

Implementation considerations

As this recommendation favours standard care over the intervention, there are no considerations for implementation.

Subgroup considerations

Refer to Recommendation 7.

Monitoring considerations

As this recommendation favours a good standard of DFU care over the intervention (NPWT in people with chronic, non-surgical DFU), there are no monitoring considerations needed for this recommendation.

Future research considerations

Refer to Recommendation 7.



Recommendation 9

Consider the use of placental derived products with informed consent as an adjunctive treatment, in addition to best standard of care, when the latter alone has failed to reduce the size of the wound (weak; low)

DECISION: ADAPTED

Rationale

The panel decided to adapt the original IWGDF recommendation, based on having a differing judgement to the IWGDF for the acceptability rating. Therefore, we re-worded the IWGDF recommendation to include the need to specifically obtain informed consent prior to using placental-derived products to enhance DFU healing.

Summary justification

The panel agreed with the IWGDF overall on the balance of effects and low quality of evidence. The key area of disagreement was around acceptability; noting that the product had only very recently been approved in Australia (December 2020) and thus, the panel felt that placental derived products may not be widely acceptable, and particularly for people identifying with certain religious faiths. The recommendation was adapted to overtly emphasise the need for fully informed consent being provided by the patient to use a placental derived product after careful explanation as to the nature of the product. Otherwise, the panel agreed with the IWGDF that feasibility of wider use of this intervention is also unknown.

Detailed justifications

After full assessment of all IWGDF evidence(7, 19) and any additional Australian evidence or expert opinion, the panel had similar judgements to the IWGDF for most EtD criteria that proved justification for the original IWGDF recommendation. Our judgements were:

Problem a priority

Yes. The panel agreed with the IWGDF that DFU are a significant health problem in Australia(3, 4) and internationally(1, 2).

Desirable effects

Moderate additional desirable effects. The panel agreed with the IWGDF that overall, desirable effects of the use of placental derived products are likely to be moderate as several studies showed benefit of its use on healing (improvement in time to healing(43-45) and incidence of healing(46)) when used in conjunction with standard care as compared to standard care alone.

Undesirable effects

Small additional undesirable effects. The IWGDF did not report on any undesirable effects in either the IWGDF Guideline (2019) or the systematic review. However, the panel rated this as small, based on our expert opinion that this is a non-invasive topical therapy with unknown adverse events, patient satisfaction, and cost, with the cost likely to be higher for these products than good standard of care.

Quality (or certainty) of evidence

Low. The panel agreed with the IWGDF that the quality of evidence was low due to the only eligible studies having moderate to high risk of bias.

Values of outcomes

Probably no important uncertainty. Although the IWGDF did not specifically report on the values of outcomes relating to the use of placental derived products, our expert opinion was there is probably no important uncertainty or variability on how patients value the main outcomes of healing.

Balance of effects

Probably favours the intervention. The panel considered the balance of effects probably favours placental derived products compared to best standard of care, based on the difference between moderate desirable effects (benefits) and small undesirable effects (risks).

Acceptability

Unknown. The IWGDF did not report on any issues relating to acceptability. However, at the time of writing, placental derived products were very new to the Australian context (approved for use in December 2020) and thus the skills, equipment and cost requirements, along with acceptability of its use were unknown. The panel acknowledges (see subgroup considerations) that this product may also be unacceptable to certain faith groups. Furthermore, there may be a potential or actual lack of clinical expertise to sustain use of these therapies nationally.



Recommendation 9

Consider the use of placental derived products with informed consent as an adjunctive treatment, in addition to best standard of care, when the latter alone has failed to reduce the size of the wound (weak; low)

DECISION: ADAPTED

Feasibility

Unknown. The panel agreed with the IWGDF that the feasibility of placental derived products in wound care is unknown.

Implementation considerations

Placental membranes are those that contain a host of growth factors, extracellular matrix, fibroblasts and epithelial cells that are conducive to wound healing. These products are available in cryopreserved preparations containing live cells and growth factors, as well as dehydrated products containing growth factors only(19). The IWGDF collectively analyzed the effectiveness of these interventions over standard care, but whilst there was evidence of limited benefit, the evidence is insufficient to support the superiority of one (type of) product over another. To our knowledge, only the dehydrated version of placental derived products is now available, but not yet widely used within Australia, having not long received approval with the Therapeutic Goods Administration (TGA); whilst cryopreserved and live preparation options are not yet available. Therefore, due to the lack of knowledge of this new product in Australia, we suggest that health professionals considering using placental derived products adhere to the manufacturer's recommendations for use. Availability of placental membrane derived products are also limited by availability of suitable donors, potentially contributing to the final product cost.

Subgroup considerations

Geographically remote people

The equipment and expertise likely to be required for using placental derived products may be significant and people living in rural and regional Australia may have difficulties in accessing it.

Aboriginal and Torres Strait Islander Peoples

In addition to all above considerations, the panel suggest this intervention may be unacceptable to some Aboriginal and Torres Strait Islander people due to traditional beliefs causing reticence in using placental derived products.

Other subgroup considerations

The use of placental derived products may be unacceptable to people who identify with certain religious backgrounds; for this reason, the panel have highlighted the importance of obtaining specific full informed consent for using this product before using it as an intervention.

Monitoring considerations

In addition to general monitoring considerations outlined for other dressings in earlier recommendations (see Recommendations 2-4), to the panel's knowledge there were no specific monitoring implications for this recommendation. However, the panel again strongly suggest that any health professionals using this product strictly adhere to manufacturer's recommendations for safe use and monitoring.

Future research considerations

Current evidence supporting the use of placental derived products in wound care is limited. There is insufficient evidence to support superiority of one type of placental derived product over another. Data are also lacking on adverse events such as risk of infection, health economic outcomes and applicability in daily practice(19). The panel agree with the IWGDF that high quality RCTs for efficacy and cost-effectiveness of these interventions are essential to strengthen the rationale for their use(7).



Recommendation 10

We suggest not using growth factors, autologous platelet gels, bioengineered skin products, ozone, topical carbon dioxide, and nitric oxide in preference to best standard of care (weak; low).

DECISION: ADOPTED

Rationale

The panel decided to adopt these recommendations as our judgements agreed with all the IWGDF judgements for these recommendations, including the strength of recommendation, quality of evidence, patient values, and that these products were not widely available and acceptable in the Australian context.

Summary justification

The panel agreed with the IWGDF that although there is some evidence supporting the use of products that alter the biology (growth factors and platelet related products) in promoting wound healing, they are at high risk of bias and have severe methodological flaws(19). Moreover, the costs and expertise involved in using these interventions may be significant, and thus the balance of effects probably favours a good standard DFU care over their use and has not been recommended. The panel agreed with the IWGDF providing a weak strength of recommendation for not recommending the use of products that alter the biology of wounds in promoting wound healing until more high quality RCTs become available, the true effect of these interventions on wound healing is ascertained, and its acceptability and applicability to the Australian context are known.

Implementation, subgroup and monitoring considerations

As this recommendation favours a good standard care over the intervention in treating DFU, there are no additional considerations for implementation, monitoring and subgroups than those outlined for a good standard of care in earlier wound dressing recommendations (See Recommendations 2-4).

Future research considerations

These intervention(s) require further high-quality, well conducted RCTs compared with a good standard of care controls to substantiate any future desirable effects over undesirable effects before they can be recommended for use in people with DFU.



Recommendation 11

Consider the use of autologous combined leucocyte, platelet and fibrin as an adjunctive treatment, in addition to best standard of care, in non-infected diabetic foot ulcers that are difficult to heal only if this adjunctive treatment becomes approved for use in Australia (weak; moderate)

DECISION: ADAPTED

Rationale

The panel adapted the recommendation, based on a differing judgement to the IWGDF for the feasibility rating as to our knowledge this product has not been approved for use in Australia. Therefore, the panel re-worded the IWGDF recommendation to include the need for this product to be approved in Australia before it can be used.

Summary justification

Whilst the panel disagreed with the IWGDF on feasibility we agreed on all other GRADE EtD criteria (see detailed justifications below). The evidence behind the use of autologous combined leucocyte, platelet and fibrin as an adjunctive treatment is based on one high quality RCT reporting statistically significant improved primary (wound healing) and secondary (time to healing) outcomes compared to standard care, with no significant adverse events or effects associated with its use(14). Thus, the balance of effects probably favours the intervention with the quality of evidence rated as moderate and strength of recommendation weak. Whilst there are restrictions for its use in specific populations, the panel considered its use would be probably be acceptable for most patients in Australia. However, to our knowledge, this product is not currently approved for use in Australia hence precluding its use in Australia. In recognition of the moderate quality of favourable evidence supporting this product compared to a good standard of care alone in certain patients, the panel have adapted this recommendation to enable the product to potentially be used once it becomes approved and available for use in Australia.

Detailed justifications

After full assessment, the panel had mostly similar judgements to IWGDF on justifications for this recommendation (7, 19), with the exception being feasibility.

Problem a priority

Yes. The panel agreed with the IWGDF that the problem of DFU is significant in Australia(3, 4) and globally(1, 2).

Desirable effects

Moderate additional desirable effects. There was one high quality RCT(47) reporting on the use of autologous combined leucocytes, platelets and fibrin in patients with hard to heal ulcers. The panel considered the likely desirable effect size was moderate based on a 12% significant difference in ulcer healing favouring the intervention compared to a control of a best standard of care (19). Furthermore, time to healing as a secondary outcome was significantly shorter in the intervention group ($p=0.034$)(14). Overall, the panel rated the desirable effects as moderate, in agreement with the IWGDF.

Undesirable effects

Small additional undesirable effects. The IWGDF's systematic review failed to report the details of secondary outcomes or serious adverse events that were cited in the original RCT. However, the RCT reported that there were likely trivial effects for secondary outcomes as key findings reported for infection and anaemia rates were not significantly different between both arms in the reported RCT(14). However, there were no findings reported on costs and in our expert opinion the costs of this product are likely to be much higher than best standard of care, plus, it was unclear if the requirement for patients to attend weekly for preparation and application of the autologous combined leucocytes, platelet and fibrin may be undesirable and difficult to achieve. Thus, the panel rated the undesirable effects as small.

Quality (or certainty) of evidence

Moderate. The panel agreed with the IWGDF that the quality of evidence is moderate, based on the one RCT of high quality, but was currently lacking cost-effectiveness data and has not had findings supported by a further RCT as yet. Thus, the quality of evidence was rated as moderate (7).



Recommendation 11

Consider the use of autologous combined leucocyte, platelet and fibrin as an adjunctive treatment, in addition to best standard of care, in non-infected diabetic foot ulcers that are difficult to heal only if this adjunctive treatment becomes approved for use in Australia (weak; moderate)

DECISION: ADAPTED

Values of outcomes

Probably no important uncertainty. The panel agreed with the IWGDF valuing wound healing as the main critical outcome.

Balance of effects

Probably favours the intervention. The panel considered the balance of effects probably favours the use of autologous combined leucocytes, platelet and fibrin with best standard of care compared to best standard of care alone, based on the difference between moderate desirable (benefits) and small undesirable effects (risks) in patients with hard to heal ulcers(7).

Acceptability

Probably yes. The panel agreed with the IWGDF that the use of autologous combined leucocytes, platelet and fibrin would probably be acceptable to most patients and providers in healthcare settings that typically provide such treatment. However, the panel also acknowledged that it is currently not available for use in Australia (not approved by the TGA) and as such costs of implementing this product are unknown. There would, however, be subgroups for which this would be unacceptable, as described further below.

Feasibility

Not feasible. The panel agreed with the IWGDF that the autologous combined leucocytes, platelet and fibrin requires weekly visits for preparation and application which may have significant cost implications. However, at the time of publication the most significant barrier to feasibility is until TGA approved the product is not available for use in Australia.

Implementation considerations

At the time of publication, the autologous combined leucocyte, platelet and fibrin as an adjunctive treatment was not available in Australia. However, should the Australian TGA approve its use the panel suggests health professionals consider the following before using it:

1. Skills in phlebotomy are required. The autologous combined leucocyte, platelet and fibrin intervention is obtained by first drawing 18mL of a patient's venous blood, which is subsequently spun for 20 minutes accordingly in a pre-specified program in a centrifuge, producing a final three layered patch that can be applied to the foot ulcer using an aseptic technique(14). It is then covered by a low adherent, knitted viscose rayon primary dressing and a protective secondary dressing.
2. It is unclear whether specialist equipment such as the centrifuge will need to be purchased; even if existing pathology laboratory centrifuges can be used, these are not commonly co-located with multidisciplinary DFU units and may present a significant challenge for implementation.



Recommendation 11

Consider the use of autologous combined leucocyte, platelet and fibrin as an adjunctive treatment, in addition to best standard of care, in non-infected diabetic foot ulcers that are difficult to heal only if this adjunctive treatment becomes approved for use in Australia (weak; moderate)

DECISION: ADAPTED

Subgroup considerations

Geographically remote people

Sites in rural and remote Australia may sometimes lack health professionals with skills in phlebotomy, or equipment necessary to perform this intervention.

Aboriginal and Torres Strait Islander Peoples

This intervention may be unacceptable to Aboriginal and Torres Strait Islander people as traditional beliefs may cause reticence in using blood-related products.

Other subgroup considerations

Small subgroups of the population may refuse blood transfusion based on faith and cultural beliefs. One key example is those of Jehovah's Witness faith, who deem autologous predonation of blood products unacceptable(48); approximately 0.4% of the Australian population identify with this faith(49). These preferences should be taken into consideration in assessing suitability of a person for this intervention. The panel also highlights that the RCT excluded patients with interdigital ulcers due to difficulties in measuring and placing the patch on the wound(14) and thus this dressing may be impractical for these wound types.

Monitoring considerations

In addition to general monitoring considerations outlined for other dressings in earlier recommendations (see Recommendations 2-4), to the panel's knowledge there were no specific monitoring implications for this recommendation, however, it is strongly advised to strictly adhere to manufacturer's recommendations for safe use and monitoring.

Future research considerations

The panel agreed with the IWGDF that future high quality RCTs and cost-effectiveness analyses should be undertaken to help support or refute the findings of the one high-quality RCT on this intervention to date.



Recommendation 12

We suggest not using agents reported to have an effect on wound healing through alteration of the physical environment including through the use of electricity, magnetism, ultrasound and shockwaves in preference to best standard of care (weak; low)

DECISION: ADAPTED

Rationale

The panel have adapted the recommendation, based on having differing judgements to the IWGDF for undesirable effects, balance of effects and feasibility ratings. Therefore, the panel downgraded the strength of the recommendation from "strong" to "weak" and changed the wording accordingly to reflect this conditional/weak recommendation.

Summary justification

The panel disagreed with the IWGDF that the magnitude of undesirable effects (such as adverse events, patient dissatisfaction) from these interventions that alter wound biology through mechanical and physical means (lasers, shockwaves, ultrasound, magnetism, and electric current) outweighed the desirable effects (see detailed judgements below) to such an extent that the panel could be certain that the balance of effects favours the best standard of care control over the intervention(s). Instead, the panel found the balance of effects likely does not favour either these intervention(s) or best standard of care as they both produce similar desirable and undesirable effects, resulting in the recommendation being downgraded. The panel, however, agreed it was not known if the intervention(s) would be acceptable for most patients and providers of DFU care in Australia and that the intervention(s) was probably not feasible to implement widely across Australia due to differences in TGA approval for these therapies, costs and expertise needed for use. Overall, the panel's ratings suggested a weak/conditional recommendation against using the intervention compared to best standard of care.

Detailed justifications

After full assessment, the panel had similar judgements to IWGDF on justifications for this recommendation, except for undesirable effects and feasibility:

Problem a priority

Yes. The panel agreed that the problem of DFU is significant in Australia(3, 4) and globally(1, 2).

Desirable effects

Trivial additional desirable effects. The panel agreed with the IWGDF that there did not seem to be an additional desirable effect for the intervention(s) compared with the control on healing(7). This was based on numerous studies in this topic being of low quality/high risk of bias investigating a range of heterogenous interventions compared with a range of heterogenous standard of care controls showing little or no significant benefit on healing(19). The panel rated desirable effects as trivial.

Undesirable effects

Trivial additional undesirable effects. The IWGDF Guideline (2019) or systematic review did not address any undesirable effects of the intervention(s), but did indicate at least a small-to-moderate undesirable effect as they concluded a balance of effects strongly favouring the control. However, the panel rated undesirable effects as being trivial, based on our expert opinion, that these are generally non-invasive topical therapies, although acknowledging that there is a lack of evidence on adverse events, cost effectiveness or patient dissatisfaction.

Quality (or certainty) of evidence

Low. The panel agreed with the IWGDF that the quality of evidence is low, based on the numerous aforementioned low-quality, heterogenous studies reporting inconsistent findings.

Values of outcomes

Possibly important uncertainty. The IWGDF reported on the value of wound healing as the most critical outcome. Whilst the panel did not necessarily disagree, it was our expert opinion that other outcomes such as pain and frequency of treatment may be critical and valued outcomes to patients and therefore rated the possibility of important uncertainty or variability on the value of outcomes.



Recommendation 12

We suggest not using agents reported to have an effect on wound healing through alteration of the physical environment including through the use of electricity, magnetism, ultrasound and shockwaves in preference to best standard of care (weak; low)

DECISION: ADAPTED

Balance of effects

Does not favour either the interventions or control, based on the difference between our ratings of trivial desirable and trivial undesirable effects.

Acceptability

Unknown. The panel were uncertain if most patients and providers would find these treatments acceptable based on the uncertain evidence for benefits and risks and that the interventions included in this recommendation are very heterogenous in terms of likely patient satisfaction, costs, treatment and frequency. Thus, the panel did not know if these collective interventions would be acceptable to most patients or not.

Feasibility

Probably no. The panel rated the collective intervention as probably not feasible to use due to differences in their TGA approval status for use in Australia, costs, and necessary expertise to be able to use widely in Australia.

Implementation, Subgroup and Monitoring considerations

As this recommendation favours a good standard of care over the intervention(s) in treating DFU, there are no additional considerations for implementation, subgroup or monitoring than those outlined for a good standard of care in earlier wound dressing recommendations (See Recommendations 2-4).

Future research considerations

These intervention(s) require further high-quality, well conducted RCTs compared with a good standard of care controls to substantiate any future desirable effects over undesirable effects before they can be recommended for use in people with DFU.



Recommendation 13

We suggest not using interventions aimed at correcting the nutritional status (including supplementation of protein, vitamins and trace elements, pharmacotherapy with agents promoting angiogenesis) of patients with a diabetic foot ulcer, with the aim of improving healing, but note that nutritional status should be reviewed, and adequate daily nutritional requirements should be met as part of best standard of care (weak; low).

DECISION: ADAPTED

Rationale

The panel adapted this recommendation, based on having differing judgements to the IWGDF for undesirable effects and balance of effects ratings, and the need to ensure there was no confusion on ensuring that appropriate nutritional intake for general health and wellbeing is maintained and not compromised by confusion around the wording of this recommendation. Therefore, the strength of the recommendation was downgraded from "strong" to "weak" and added the qualifying phrase "nutritional status should be reviewed, and adequate daily nutritional requirements should be met as part of best standard of care" to ensure that such a recommendation was not misinterpreted.

Summary justification

The panel disagreed with the IWGDF that the balance of effects favoured best standard of care alone over nutritional supplementation in combination with best standard of care to heal people with DFU. The panel considered the balance of effects to favour neither the intervention nor control. However, the panel also considered that adequate daily nutritional intake is essential for wound healing, collagen synthesis and angiogenesis in other wound types such as pressure injuries(50). The panel acknowledge that although DFU and pressure injuries have different aetiologies, there are similarities in principles of wound closure for both types of chronic wounds. The panel have clarified in the recommendation that patients with DFU should have their nutritional status reviewed to ensure daily nutritional requirements are met as part of best standard of general health care and wound care.

Detailed justifications

After full assessment, the panel had similar judgements to IWGDF on justifications for this recommendation, except for undesirable effects and feasibility:

Problem a priority

Yes. The panel agreed with the IWGDF that the problem is significant in Australia and globally.

Desirable effects

Small additional desirable effects. The panel agreed with the IWGDF that desirable effects of nutritional supplementation are small. Although numerous studies(51, 52) reported statistically significant benefit from nutritional supplementation on secondary outcomes of reducing ulcer size, there were major methodological flaws and inconsistencies ranging from poor definition of best standard of care, uncertainty around compliance and high risk of bias. Conversely, two high quality RCTs reported no differences between a nutritional supplementation intervention and best standard of care control on the primary outcome of healing at a certain time point, whilst another reported apparent improvement. All studies were on different nutritional supplementation interventions(19). Overall, the panel concluded that there was likely a small desirable effect.

Undesirable effects

Small additional undesirable effects. Unfortunately, the IWGDF Guideline (2019) or systematic review did not report the undesirable effects of adverse events, patient dissatisfaction or costs from nutritional supplementation in the aforementioned numerous trials. However, the panel's expert opinion deemed undesirable effects to be small and mostly relating to a potentially large additional ongoing cost of nutritional supplements which may be a burden.

Quality (or certainty) of evidence

Low. The panel agreed with the IWGDF that the quality of evidence is low, based on the numerous aforementioned trials with heterogenous quality, interventions, controls, and outcome definitions reporting inconsistent findings.

Values of outcomes

Probably no important uncertainty. The IWGDF did not report on any values apart from wound healing.

Balance of effects

Does not favour the intervention or control, based on the difference between our ratings of small desirable and small undesirable effects



Recommendation 13

We suggest not using interventions aimed at correcting the nutritional status (including supplementation of protein, vitamins and trace elements, pharmacotherapy with agents promoting angiogenesis) of patients with a diabetic foot ulcer, with the aim of improving healing, but note that nutritional status should be reviewed, and adequate daily nutritional requirements should be met as part of best standard of care (weak; low).

DECISION: ADAPTED

Acceptability

Probably yes. The IWGDF Guideline (2019) or systematic review did not address acceptability of nutritional supplements to patients and providers. However, in our expert opinion the panel considered nutritional supplements are probably acceptable in most patients considering the wide-spread use of nutritional supplements in the general Australian population.

Feasibility

Probably yes. The IWGDF Guideline (2019) or systematic review did not address feasibility or applicability of nutritional supplements to enhance wound healing. However, the panel rated the intervention as being probably feasible to implement for most patients, although it was recognized that the cost of such nutritional supplements without strong evidence of added benefit can pose a significant financial burden on patients and that the fresh food required to meet basic nutritional (dietary) needs may be limited in rural and remote communities as described below.

Implementation considerations

The panel felt there were no specific implementation implications for this recommendation however, advised consideration be again given to the general implementation implications outlined for a good standard of DFU care in earlier wound dressing recommendations (See Recommendations 2-4), plus, the need for nutritional screening to determine if daily nutritional intake for general health and wellbeing is adequate or not when implementing this recommendation. The panel refers readers to the Australian Dietary Guideline on recommendations on the types and amounts of foods Australians should consume to meet nutritional requirements(53), as well as nutritional support recommendations for specific subgroups of people with diabetes and diabetes-related complications(54). The panel additionally suggests, where indicated, referral to a dietician experienced in diabetes management for additional nutritional support should be considered.

Subgroup considerations

Geographically remote people

People living in rural and remote regions of Australia may have reduced access to fresh food such as fruit and vegetables required for adequate daily nutritional intake. The panel acknowledges inequitable access to fresh food may have implications for wound healing. Attempts should be made to rectify poor access to fresh food where possible.

Aboriginal and Torres Strait Islander Peoples

The recommendation is acceptable to Aboriginal and Torres Strait Islander people. However the panel acknowledges that like people living in rural and remote regions of Australia, there are multiple access challenges to affordable fresh produce within many Australian and Torres Strait Island communities.

Other subgroup considerations

The panel were not aware of any other subgroups where this recommendation would be unacceptable, however, refers readers to the Australian Dietary Guideline on recommendations on the types and amounts of foods Australians should consume to meet nutritional requirements or any potential contraindications(53).

Monitoring considerations

The panel propose there were no specific monitoring implications for this recommendation, however, advise consideration of the general monitoring implications in this guideline when implementing this recommendation.

Future research considerations

These nutritional supplement intervention(s) require further high-quality, well conducted RCTs compared with a good standard of care controls to substantiate any future desirable effects over undesirable effects before they can be specifically recommended for use in wound healing in people with DFU.



DISCUSSION

Recommendations summary

For the first time in 10 years, new Australian wound healing intervention guidelines to heal DFUs have been developed. The panel systematically evaluated the 13 recent IWGDF Guideline (2019) evidence-based wound healing intervention recommendations to potentially adopt or adapt to the Australian context. Following this process, nine recommendations were adopted and four were adapted for the Australian context. The main reasons for adapting recommendations were: specifying the need for informed consent (recommendation 9), unavailability of the intervention in Australia (recommendation 11), re-wording to clarify best standard of care (recommendation 13), and downgrading the strength of two recommendations (recommendations 12 and 13). Overall, five wound healing interventions have been identified as having the potential to improve wound healing in specific DFU types when implemented in conjunction with other best standard of DFU care recommended in accompanying Australian DFD guidelines. These were the sucrose-octasulfate impregnated dressing, systemic hyperbaric oxygen therapy (HBOT), negative pressure wound therapy (NPWT), placental-derived products, and the autologous combined leucocyte, platelet and fibrin dressing. Of these five interventions, three (sucrose-octasulfate impregnated dressing, systemic HBOT and NPWT) are approved and available in Australia, one (placental-derived products) is newly registered with the ARTG and the other (autologous combined leucocyte, platelet and fibrin dressing) is not yet approved for use in Australia.

Differences to previous guidelines

There are thirteen recommendations in this new Australian 2021 Wound Healing Guidelines compared with seven recommendations made in the previous 2011 Australian DFD Guidelines relating to wound healing interventions. The similar recommendations that remain in this new guideline are that: local sharp debridement of DFU be performed if not contraindicated (Recommendation 1); wound dressings should be selected based primarily on exudate control, comfort or cost as there is a lack of evidence for one wound dressing product being more effective than others to heal all different DFU types (Recommendation 2); and that there is some evidence for the use of systemic HBOT for ischaemic DFU (Recommendation 5) and NPWT for post-surgical DFU (Recommendation 7) (8).

However, there were multiple new recommendations made in this new guideline potentially reflecting the new high-quality evidence gained in this field over the last decade(7). These new recommendations included a number of new wound product interventions that are appropriate to use and other wound products that are not appropriate to use for certain DFU types. Those new wound products to consider using included: sucrose-octasulfate impregnated dressings for hard-to-heal neuro-ischaemic DFU (Recommendation 4), placental derived products (Recommendation 9) and an autologous combined leucocyte, platelet and fibrin dressing for hard-to-heal DFU (Recommendation 11); although the latter products have only very recently been approved for use in Australia or not yet approved, respectively. Those wound products not recommended over a best standard of DFU wound healing care intervention (i.e. Recommendation 1 and 2) included: antimicrobial dressings (Recommendation 3); topical oxygen therapy (Recommendation 6); NPWT for non-surgically treated DFU (Recommendation 8); growth factors, autologous platelet gels, bioengineered skin products, ozone, topical carbon dioxide, and nitric oxide (Recommendation 9); electricity, magnetism, ultrasound and shockwaves therapy (Recommendation 12); and nutritional supplements (Recommendation 13).

Interestingly, two recommendations made in the previous 2011 Guideline were not addressed in this new 2021 Guideline: Larval therapy and Skin replacement therapies (cultured skin equivalents and skin grafting) were recommended to be considered in specialist centres in the previous guideline. This difference may be attributed to the difference in methodology and research questions used by the IWGDF in 2019 and the NHMRC in 2011. Thus, due to the methodology used in this guideline to adapt existing guidelines, we are unable to judge the appropriateness of these previous guideline recommendations and can only encourage health professionals to independently review and evaluate current evidence on the use of these therapies. Otherwise we suggest questions on larval therapy and skin replacement therapies should be included in future Australian DFD guidelines if possible.



Implementation considerations summary

All recommendations in this new 2021 Australian guideline should be implemented in conjunction with a good standard of DFU care. The panel defines this as including recommendations made on comprehensive DFU assessment (see wound classification guideline), appropriate debridement (Recommendation 1), wound dressings (Recommendation 2), antimicrobial management if infected (see infection guideline), revascularisation considerations if ischaemic (see PAD guideline) and the best available offloading device (see offloading guideline) (12, 30) in the accompanying Australian DFD Guidelines(31-34).

The panel acknowledge that the interventions recommended in this guideline in addition to good standard of care are likely to be more expensive (to both the individual and healthcare system), and cost-effectiveness data is generally lacking. In selecting or considering a recommended intervention to promote DFU healing, the health professional should carefully discuss with the patient their overall goals of care, short-term outcomes desired for any wound dressing of exudate control, comfort and cost, and the desirable (improved wound healing), and undesirable effects (any adverse events, increased consultations needed and costs) of any suggested wound product recommended in the process of obtaining informed consent.

Subgroup considerations summary

Overall, all thirteen recommendations are widely applicable to Aboriginal and Torres Strait Islander people. The panel acknowledge that Aboriginal and Torres Strait Islander populations residing in non-metropolitan areas may encounter difficulties in accessing good standard care, as well as certain wound healing interventions recommended in this Australian DFU Guideline. In such instances, the panel strongly recommend health professionals working in these communities develop required skillsets or referral pathways to ensure Aboriginal and Torres Strait Islander people with DFU can access equitable care. The panel have also highlighted that recommendations 9 and 11, consisting of placental and blood-related products, may not be acceptable to Aboriginal and Torres Strait Islander people and specific consent should be obtained prior to using these interventions. The main considerations for geographical remote populations relate to accessibility of specific wound healing strategies as identified within stated recommendations. Where local accessibility, or lack of skilled staff may present key limitations, as in the case of systemic HBOT or NPWT therapies respectively, the panel recommends developing referral pathways or clinical training to acquire competency. Other key subgroup considerations generally relate to contraindications of certain wound healing interventions, for example pain and severe ischaemia for sharp debridement, or patient preferences based on religious beliefs (blood and placental derived products). Thus, the panel has highlighted the need to obtain informed consent when these interventions are implemented.

Monitoring considerations summary

The panel recommend the use of existing High Risk Foot Service database monitoring systems(24) for monitoring the use and effectiveness of wound healing interventions on healing their patients with DFU. Further, it is acknowledged that important therapy regimen option details of several wound healing interventions such as frequency of debridement, NPWT or systemic HBOT treatments that are not currently collected in this database should be considered for inclusion in the future, as part of real-world data.



Future research considerations summary

The panel agree with the IWGDF that it is imperative that all 2016 IWGDF key reporting standards for DFU studies are adhered to (12). This should further enhance the body of evidence, strength of recommendation and quality of evidence behind all wound healing interventions to enhance the fields' understanding of what works best to promote DFU healing. The lack of (cost-)effectiveness investigated for numerous therapies were also a consistent theme across all 13 wound healing recommendations, and future research should implement cost-effectiveness analyses in their trials to shed important new light on these interventions for patients and providers (12).

Strengths and limitations

There are a number of strengths in the development of this Guideline. Firstly, the Guideline Working Development Group followed NHMRC-recommended ADAPTE and GRADE procedures to identify suitable international source guidelines(18, 20) and to systematically adapt the IWGDF Guideline (2019) to the Australian context. An independent panel of multi-disciplinary experts in the care of people with DFU were involved in this process. Moreover, the panel included a consumer representative and an Aboriginal and Torres Strait Islander expert who aided decision making, which the original IWGDF Guideline lacked.

A limitation of this guideline, however, was the reliance on the IWGDF's research questions and accompanying systematic reviews in identifying all relevant evidence for the panel to review, meaning evidence published after the 2019 review may have been missed. However, the panel were able to include and review any additional Australian literature of which they were aware. Finally, the panel acknowledge some opinions and views may have been missed, although a widely representative international expert panel were consulted in all decision-making processes, and the guidelines were widely available during a public call for consultation from all Australian health professionals, researchers and peak bodies.

CONCLUSION

The original IWGDF Guideline on use of interventions to enhance healing of chronic foot ulcers in diabetes (2019) recommended five wound healing interventions that have the potential to enhance wound healing in DFU when used in conjunction with good standard of care (7, 19). In these new Australian guidelines on wound healing interventions to enhance healing of foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease, the IWGDF Guidelines (2019) have been systematically adapted for the Australian context, in particular geographically remote and Aboriginal and Torres Strait Islander people. The guideline also highlights important considerations for implementation and monitoring, as well as future research priorities for Australia. In implementing and monitoring these recommendations, as well as the other recommendations in accompanying chapters of the new Australian DFD guidelines, it is anticipated patients with DFU should experience better care, and subsequently improved healing outcomes, reducing the national burden and inequalities amongst all Australians with or at risk of DFU.



DECLARATIONS

Ethical approvals

Not applicable

Consent for publication

Not applicable

Availability of data and materials

Data sharing is not applicable to this article as no datasets were generated or analysed during the current study.

Competing interests

The funding/supporting bodies below provided oversight and final approval for this guideline, however, did not have any input into the decisions on recommendations and rationale contained in these guidelines or in the writing of these guidelines. PC is the president of the Advanced Practicing Podiatrists – High Risk Foot Group and a member of the National Association of Diabetes Centres Foot Network Committee. TS participates on several industry related and specialty boards as well as providing education on behalf of industry partners; however, notes no relevant competing interests for this project. PAL has been a speaker consultant with Sanofi Australia, is chair of Diabetes Feet Australia, and is a member of the Journal of Foot & Ankle Editorial Board, National Association of Diabetes Centres Foot Network Committee, and Aboriginal and Torres Strait Islander Diabetic Foot Complications Program Expert Advisory Committee. JChe is employed by Diabetes Victoria and is fully funded by the National Diabetes Services Scheme. All other authors declare that they have no relevant competing interests.

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Authors' contributions

PC screened, assessed and drafted all recommendations and rationale for recommendations, and drafted and critically reviewed the manuscript. KC screened, assessed and drafted all recommendations and rationale for the recommendations, drafted the abstract and critically reviewed the manuscript. TS and PAL screened, assessed and drafted all recommendations and rationale for the recommendations, and critically reviewed the manuscript. JCha provided Aboriginal and Torres Strait Islander and end-user intellectual input and content into the screening, assessment and drafting of all recommendations and rationale, and critically reviewed the manuscript. JChe provided lived experience and consumer intellectual input and content into the screening, assessment, drafting of all recommendations and rationale, and critically reviewed the manuscript. JP screened, assessed and drafted all recommendations and rationale for recommendations and critically reviewed the manuscript. PC acted as the secretary and JP as the chair of the chapter group. PC and JP take full responsibility for the content of the manuscript and all authors approved the manuscript for submission.



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GLOSSARY OF TERMS

Good standard of diabetes-related foot ulcer (DFU) care

A comprehensive DFU assessment, appropriate debridement, wound dressings, antimicrobial management if infected, revascularisation considerations if ischaemic and the best available offloading device. In regard to wound healing, consider the short-term outcomes desired of the dressing to principally address exudate levels, comfort and cost, and overall goals of care and preferences of the patient. Dressings should be changed when soiled or when strikethrough is observed, and not placed on wounds for periods exceeding manufacturer's recommendations for use. The ability of the dressing to conform comfortably to the anatomical location is also a high priority.

Non-healing DFU

A DFU that has not reduced in size by >50% after receiving 4-6 weeks of good standard of care (above).

Non-sharp debridement

The removal of callus or non-viable tissue using other techniques including autolytic, mechanical, larval (biosurgical), ultrasonic, hydrosurgical abrasion or chemical methods.

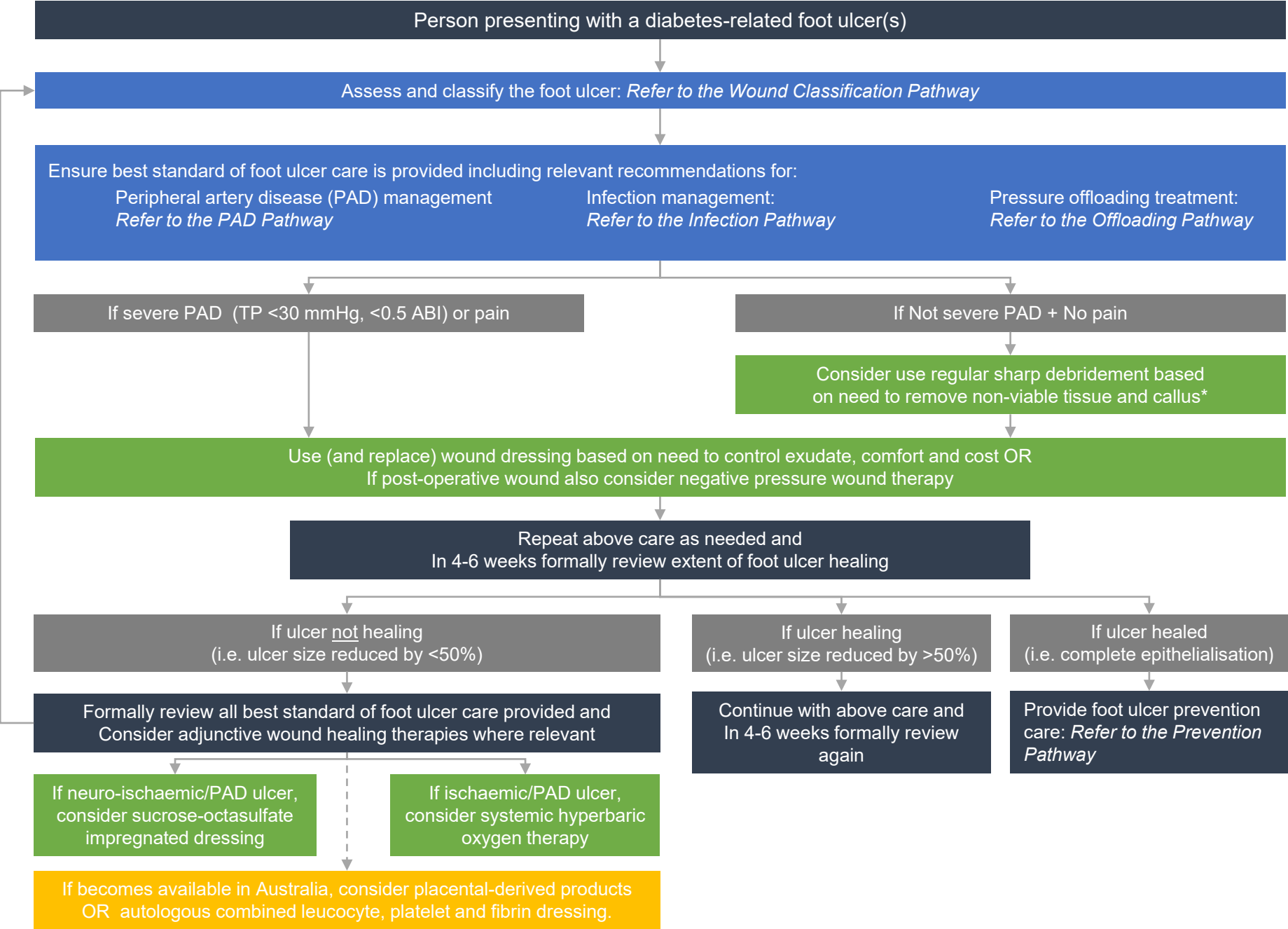
Sharp debridement

The removal of callus or non-viable tissue that can be surgical (performed in a theatre), or conservative (performed in a clinic), using an aseptic technique with sterilised scalpel or scissors.

LIST OF ABBREVIATIONS

DFU	Diabetes-related foot disease
EBR	Evidence-Based Recommendations
EtD	Evidence to Decision
GRADE	Grading of Recommendations, Assessment, Development and Evaluations
HBOT	Hyperbaric Oxygen Therapy
IWGDF	International Working Group of the Diabetic Foot
NHMRC	National Health and Medical Research Council
NPWT	Negative Pressure Wound Therapy
PAD	Peripheral Artery Disease
RCT	Randomised Controlled Trial
TGA	Therapeutic Goods Administration

Figure 1. Australian evidence-based clinical pathway on wound healing interventions for people with diabetes-related foot ulcers (DFU)



RECOMMENDED NOT TO USE

- Sharp debridement in the presence of severe PAD or pain
- Dressings containing antimicrobial agents with the sole aim of accelerating healing
- Negative pressure wound therapy for non-surgical ulcers
- Topical oxygen therapy
- Growth factors, autologous platelet gels, bioengineered skin products, ozone, topical carbon dioxide, and nitric oxide
- Electricity, magnetism, ultrasound and shockwaves agents
- Supplementation of protein, vitamins and trace elements, and pharmacotherapy with agents promoting angiogenesis

LEGEND

DARK BLUE BOX: Review foot ulcer care
BLUE BOX: Best standard of foot ulcer care recommendations
GREY BOX: Patient's ulcer characteristics
GREEN BOX: Wound healing therapy recommendations (in addition to best standard of foot ulcer care)
RED BOX: Wound healing therapies not recommended
ORANGE BOX: Adjunct wound healing therapy recommendations not yet available in Australia

*Sharp debridement should only be provided by those that can demonstrate competency

ABBREVIATIONS

ABI: Ankle brachial index;
PAD: Peripheral artery disease;
TP: Toe Pressures



Table 1

Summary of screening ratings for acceptability and applicability in the Australian context for all IWGDF wound healing interventions recommendations.

RECOMMENDATION	ACCEPTABILITY			APPLICABILITY				FULL	COMMENTS
	1	2	3	4	5	6	7	ASSESSMENT	
1	+	+	+	+	+	+	+	No	
2	+	+	+	+	+	+	+	No	
3	+	+	+	+	+	+	+	No	
4	+	+	+	+	+	+	+	No	
5	+	+	+	+	+	+	+	No	
6	+	+	+	+	+	+	+	No	
7	+	+	+	+	+	+	+	No	
8	+	+	+	+	+	+	+	No	
9	+	+	+	+	?	?	?	Yes	Assess intervention availability, expertise availability and legislative/policy constraints
10	+	+	+	+	+	+	+	No	
11	+	+	?	+	?	?	?	Yes	Assess patient preference, intervention availability, expertise availability and legislative/policy constraints
12	?	?	?	+	?	?	?	Yes	Assess quality of evidence, strength of recommendation, patient preference, intervention availability, expertise availability and legislative/policy constraints
13	+	?	+	+	+	+	+	Yes	Assess strength of recommendation
TOTAL	12	11	11	13	10	10	10	4	
%	92	85	85	100	77	77	77	31	

Note: +, yes item is met; -, no item is not met; ? unsure if item is met



WOUND HEALING INTERVENTIONS

Table 2: Summary of final panel judgements compared with IWGDF judgements for all IWGDF wound healing recommendations.

NO	PROBLEM	DESIRABLE EFFECTS	UNDESIRABLE EFFECTS	QUALITY OF EVIDENCE	VALUES	BALANCE OF EFFECTS	ACCEPTABILITY	APPLICABILITY/ FEASIBILITY	DECISION	COMMENT
1	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
2	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
3	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
4	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
5	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
6	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
7	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
8	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
9	Yes	Moderate	Small	Low	Probably no important uncertainty or variability	Probably favours the intervention	Don't know	Don't know	Adapt	Adapted to include need for informed consent
10	=	=	=	=	=	=	=	=	Adopt	Adopted in ADAPTE screening
11	Yes	Moderate	Small	Moderate	Probably no important uncertainty or variability	Probably favours the intervention	Probably yes	No	Adapt	Adapted to reflect unavailability of intervention in Australia
12	Yes	Trivial	Trivial	Low	Possibly important uncertainty or variability	Does not favour either intervention or comparison	Don't know	Probably no	Adapt	Adapted strength of recommendation
13	Yes	Small	Small	Low	Probably no important uncertainty or variability	Does not favour either intervention or comparison	Probably yes	Probably yes	Adapt	Adapted strength of recommendation and to include nutrition as part of standard care

Note: +, panel agreed with original IWGDF judgement; -, panel disagreed with original IWGDF judgement; ?, panel unsure if agreed with original IWGDF judgement due to lack of IWGDF information on judgement; =, panel agreed with original IWGDF judgements during screening (see Table 1); QoE: Quality of evidence.

Table 3: Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for Wound Healing Interventions.

NO	ORIGINAL IWGDF RECOMMENDATION	DECISION	NEW AUSTRALIAN RECOMMENDATION
1	Remove slough, necrotic tissue, and surrounding callus of a diabetic foot ulcer with sharp debridement in preference to other methods, taking relative contraindications such as pain or severe ischemia into account (GRADE strength of recommendation: strong; quality of evidence: low)	Adopted	As stated in original the IWGDF Recommendation
2	Dressings should be selected principally on the basis of exudate control, comfort and cost (strong; low)	Adopted	As stated in original the IWGDF Recommendation
3	Do not use dressings/applications containing surface antimicrobial agents with the sole aim of accelerating the healing of an ulcer (strong; low)	Adopted	As stated in original the IWGDF Recommendation
4	Consider the use of the sucrose-octasulfate impregnated dressing as an adjunctive treatment, in addition to best standard of care, in noninfected, neuro-ischaemic diabetic foot ulcers that are difficult to heal (weak; moderate)	Adopted	As stated in original the IWGDF Recommendation
5	Consider the use of systemic hyperbaric oxygen therapy as an adjunctive treatment in non-healing ischaemic diabetic foot ulcers despite best standard of care (weak; moderate)	Adopted	As stated in original the IWGDF Recommendation
6	We suggest not using topical oxygen therapy as a primary or adjunctive intervention in diabetic foot ulcers including those that are difficult to heal (weak; low)	Adopted	As stated in original the IWGDF Recommendation
7	Consider the use of negative pressure wound therapy to reduce wound size, in addition to best standard of care, in patients with diabetes and a post-operative (surgical) wound on the foot (weak; low)	Adopted	As stated in original the IWGDF Recommendation
8	We suggest not using negative pressure wound therapy in preference to best standard of care in nonsurgical diabetic foot ulcers (weak; low)	Adopted	As stated in original the IWGDF Recommendation
9	Consider the use of placental-derived products as an adjunctive treatment, in addition to best standard of care, when the latter alone has failed to reduce the size of the wound (weak; low)	Adapted	Consider the use of placental derived products <u>with informed consent</u> as an adjunctive treatment, in addition to best standard of care, when the latter alone has failed to reduce the size of the wound (weak; low)
10	We suggest not using growth factors, autologous platelet gels, bioengineered skin products, ozone, topical carbon dioxide, and nitric oxide in preference to best standard of care (weak; low)	Adopted	As stated in original the IWGDF Recommendation

Note: underlined wording indicates the specific adapted changes to the original IWGDF recommendation



WOUND HEALING INTERVENTIONS

Table 3 (cont): Summary of the original IWGDF recommendation compared with the new Australian guideline recommendations for Wound Healing Interventions.

NO	ORIGINAL IWGDF RECOMMENDATION	DECISION	NEW AUSTRALIAN RECOMMENDATION
11	Consider the use of autologous combined leucocyte, platelet and fibrin as an adjunctive treatment, in addition to best standard of care, in noninfected diabetic foot ulcers that are difficult to heal (weak; moderate)	Adapted	Consider the use of autologous combined leucocyte, platelet and fibrin as an adjunctive treatment, in addition to best standard of care, in non-infected diabetic foot ulcers that are difficult to heal <u>only if this adjunctive treatment becomes approved for use in Australia</u> (weak; moderate)
12	Do not use agents reported to have an effect on wound healing through alteration of the physical environment including through the use of electricity, magnetism, ultrasound, and shockwaves in preference to best standard of care (strong; low)	Adapted	<u>We suggest not using</u> agents reported to have an effect on wound healing through alteration of the physical environment including through the use of electricity, magnetism, ultrasound and shockwaves in preference to best standard of care (<u>weak</u> ; low)
13	Do not use interventions aimed at correcting the nutritional status (including supplementation of protein, vitamins and trace elements, pharmacotherapy with agents promoting angiogenesis) of patients with a diabetic foot ulcer, with the aim of improving healing, in preference to best standard of care (strong; low)	Adapted	<u>We suggest not using</u> interventions aimed at correcting the nutritional status (including supplementation of protein, vitamins and trace elements, pharmacotherapy with agents promoting angiogenesis) of patients with a <u>diabetes-related</u> foot ulcer, with the aim of improving healing, <u>but nutritional status should be reviewed and adequate daily nutritional requirements should be met as part of best standard of care.</u> (<u>weak</u> ; low).

Note: underlined wording indicates the specific adapted changes to the original IWGDF recommendation



REFERENCES

1. Zhang Y, Lazzarini PA, McPhail SM, van Netten JJ, Armstrong DG, Pacella RE. Global Disability Burdens of Diabetes-Related Lower-Extremity Complications in 1990 and 2016. *Diabetes care*. 2020;43(5):964-74.
2. Boulton AJ, Vileikyte L, Ragnarson-Tennvall G, Apelqvist J. The global burden of diabetic foot disease. *Lancet* (London, England). 2005;366(9498):1719-24.
3. van Netten JJ, Lazzarini PA, Fitridge R, Kinnear E, Griffiths I, Malone M, et al. Australian diabetes-related foot disease strategy 2018-22: The first step towards ending avoidable amputations within a generation. Brisbane: Diabetic Foot Australia, Wound Management CRC; 2017.
4. Lazzarini PA, van Netten JJ, Fitridge RA, Griffiths I, Kinnear EM, Malone M, et al. Pathway to ending avoidable diabetes-related amputations in Australia. *The Medical journal of Australia*. 2018;209(7):288-90.
5. West M, Chuter V, Munteanu S, Hawke F. Defining the gap: a systematic review of the difference in rates of diabetes-related foot complications in Aboriginal and Torres Strait Islander Australians and non-Indigenous Australians. *Journal of foot and ankle research*. 2017;10:48.
6. NIAA. NATIONAL AGREEMENT ON CLOSING THE GAP Canberra: National Indigenous Australians Agency; 2020.
7. Rayman G, Vas P, Dhatariya K, Driver V, Hartemann A, Londahl M, et al. Guidelines on use of interventions to enhance healing of chronic foot ulcers in diabetes (IWGDF 2019 update). *Diabetes/metabolism research and reviews*. 2020;36 Suppl 1:e3283.
8. NHMRC. National Evidence-Based Guideline on Prevention, Identification and Management of Foot Complications in Diabetes (Part of the Guidelines on Management of Type 2 Diabetes). Melbourne, Australia: National Health and Medical Research Council; 2011.
9. Parker CN, Van Netten JJ, Parker TJ, Jia L, Corcoran H, Garrett M, et al. Differences between national and international guidelines for the management of diabetic foot disease. *Diabetes/metabolism research and reviews*. 2019;35(2):e3101.
10. Game FL, Attinger C, Hartemann A, Hinchliffe RJ, Löndahl M, Price PE, et al. IWGDF guidance on use of interventions to enhance the healing of chronic ulcers of the foot in diabetes. *Diabetes/metabolism research and reviews*. 2016;32 Suppl 1:75-83.
11. Game FL, Hinchliffe RJ, Apelqvist J, Armstrong DG, Bakker K, Hartemann A, et al. A systematic review of interventions to enhance the healing of chronic ulcers of the foot in diabetes. *Diabetes/metabolism research and reviews*. 2012;28 Suppl 1:119-41.
12. Jeffcoate WJ, Bus SA, Game FL, Hinchliffe RJ, Price PE, Schaper NC. Reporting standards of studies and papers on the prevention and management of foot ulcers in diabetes: required details and markers of good quality. *The Lancet Diabetes & Endocrinology*. 2016;4(9):781-8.
13. Edmonds M, Lázaro-Martínez JL, Alfayate-García JM, Martini J, Petit JM, Rayman G, et al. Sucrose octasulfate dressing versus control dressing in patients with neuroischaemic diabetic foot ulcers (Explorer): an international, multicentre, double-blind, randomised, controlled trial. *The Lancet Diabetes & Endocrinology*. 2018;6(3):186-96.
14. Game F, Jeffcoate W, Tarnow L, Jacobsen JL, Whitham DJ, Harrison EF, et al. LeucoPatch system for the management of hard-to-heal diabetic foot ulcers in the UK, Denmark, and Sweden: an observer-masked, randomised controlled trial. *The Lancet Diabetes & Endocrinology*. 2018;6(11):870-8.
15. Edmonds M. A renaissance in diabetic foot care: new evidence-based treatments. *The Lancet Diabetes & Endocrinology*. 2018;6(11):837-8.
16. Lazzarini PA, Raspovic A, Prentice J, Commons RJ, Fitridge R, Charles J, et al. Guidelines development protocol and findings: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
17. Schünemann HJ, Wiercioch W, Brozek J, Etxeandia-Ikobaltzeta I, Mustafa RA, Manja V, et al. GRADE Evidence to Decision (EtD) frameworks for adoption, adaptation, and de novo development of trustworthy recommendations: GRADE-ADOLOPMENT. *Journal of clinical epidemiology*. 2017;81:101-10.
18. NHMRC. Guidelines for Guidelines: Adopt, adapt or start from scratch - Version 5.2. Canberra, Australia 2019.
19. Vas P, Rayman G, Dhatariya K, Driver V, Hartemann A, Londahl M, et al. Effectiveness of interventions to enhance healing of chronic foot ulcers in diabetes: a systematic review. *Diabetes/metabolism research and reviews*. 2020;36 Suppl 1:e3284.
20. The ADAPTE Collaboration. The ADAPTE Process: Resource Toolkit for Guideline Adaptation - Version 2.0. Perthshire, Scotland: Guideline International Network; 2009 <https://g-i-n.net/library/tools>.
21. Alonso-Coello P, Oxman AD, Moberg J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 2: Clinical practice guidelines. *Bmj*. 2016;353:i2089.



REFERENCES

22. Alonso-Coello P, Schünemann HJ, Moberg J, Brignardello-Petersen R, Akl EA, Davoli M, et al. GRADE Evidence to Decision (EtD) frameworks: a systematic and transparent approach to making well informed healthcare choices. 1: Introduction. *Bmj*. 2016;353:i2016.
23. Vowden K. TIME to identify and manage tissue types present in the wound bed. *Wound Care Today* 2017;4(1).
24. National Association of Diabetes Centres (NADC) and Australian Diabetes Society (ADS). NADC Collaborative Interdisciplinary Diabetes High Risk Foot Services Standards. Version 1.1. Sydney, Australia: National Association of Diabetes Centres; 2018.
25. Delgado-Enciso I, Madrigal-Perez VM, Lara-Esqueda A, Diaz-Sanchez MG, Guzman-Esquivel J, Rosas-Vizcaino LE, et al. Topical 5% potassium permanganate solution accelerates the healing process in chronic diabetic foot ulcers. *Biomedical reports*. 2018;8(2):156-9.
26. Piaggese A, Goretti C, Mazzurco S, Tascini C, Leonildi A, Rizzo L, et al. A randomized controlled trial to examine the efficacy and safety of a new super-oxidized solution for the management of wide postsurgical lesions of the diabetic foot. *The international journal of lower extremity wounds*. 2010;9(1):10-5.
27. Muthukumarasamy MG, Sivakumar G, Manoharan G. Topical phenytoin in diabetic foot ulcers. *Diabetes care*. 1991;14(10):909-11.
28. Pai MR, Sitaraman N, Kotian MS. Topical phenytoin in diabetic ulcers: a double blind controlled trial. *Indian journal of medical sciences*. 2001;55(11):593-9.
29. Shaw J, Hughes CM, Lagan KM, Stevenson MR, Irwin CR, Bell PM. The effect of topical phenytoin on healing in diabetic foot ulcers: a randomized controlled trial. *Diabetic medicine : a journal of the British Diabetic Association*. 2011;28(10):1154-7.
30. Schaper NC, van Netten JJ, Apelqvist J, Bus SA, Hinchliffe RJ, Lipsky BA. Practical Guidelines on the prevention and management of diabetic foot disease (IWGDF 2019 update). *Diabetes/metabolism research and reviews*. 2020;36 Suppl 1:e3266.
31. Hamilton EJ, Scheepers J, Ryan H, Perrin B, Charles J, Cheney J, Twigg SM. Australian guideline on wound classification of diabetes-related foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease; version 1.0. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
32. Chuter V, Quigley F, Tosenovsky P, Ritter JC, Charles J, Cheney J, Fitridge R. Australian guideline on diagnosis and management of peripheral artery disease: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease; version 1.0. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
33. Commons RJ, Charles J, Cheney J, Lynar SA, Malone M, Raby E. Australian guideline on management of diabetes-related foot infection: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease; version 1.0. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
34. Fernando ME, Horsley M, Jones S, Martin B, Nube VL, Charles J, Cheney J, Lazzarini PA. Australian guideline on offloading treatment for foot ulcers: Part of the 2021 Australian evidence-based guidelines for diabetes-related foot disease; version 1.0. Brisbane, Australia: Diabetes Feet Australia, Australian Diabetes Society; 2021.
35. Dowsett C, Ayello E. TIME principles of chronic wound bed preparation and treatment. *British journal of nursing*. 2004;13(15):S16-23.
36. Lobmann R, Augustin M, Lawall H, Tigges W, Potempa C, Thiem H, et al. Cost-effectiveness of TLC-sucrose octasulfate versus control dressings in the treatment of diabetic foot ulcers. *Journal of wound care*. 2019;28(12):808-16.
37. Löndahl M, Katzman P, Nilsson A, Hammarlund C. Hyperbaric oxygen therapy facilitates healing of chronic foot ulcers in patients with diabetes. *Diabetes care*. 2010;33(5):998-1003.
38. Abidia A, Laden G, Kuhan G, Johnson BF, Wilkinson AR, Renwick PM, et al. The role of hyperbaric oxygen therapy in ischaemic diabetic lower extremity ulcers: a double-blind randomised-controlled trial. *European journal of vascular and endovascular surgery: the official journal of the European Society for Vascular Surgery*. 2003;25(6):513-8.
39. Brouwer RJ, Laliou RC, Hoencamp R, van Hulst RA, Ubbink DT. A systematic review and meta-analysis of hyperbaric oxygen therapy for diabetic foot ulcers with arterial insufficiency. *Journal of vascular surgery*. 2020;71(2):682-92.e1.
40. Niederauer MQ, Michalek JE, Liu Q, Papas KK, Lavery LA, Armstrong DG. Continuous diffusion of oxygen improves diabetic foot ulcer healing when compared with a placebo control: a randomised, double-blind, multicentre study. *Journal of wound care*. 2018;27(Sup9):S30-s45.



REFERENCES

41. Driver VR, Reyzelman A, Kawalec J, French M. A prospective, randomized, blinded, controlled trial comparing transdermal continuous oxygen delivery to moist wound therapy for the treatment of diabetic foot ulcers. *Ostomy/wound management*. 2017;63(4):12-28.
42. Liu Z, Dumville JC, Hinchliffe RJ, Cullum N, Game F, Stubbs N, et al. Negative pressure wound therapy for treating foot wounds in people with diabetes mellitus. *Cochrane Database Syst Rev*. 2018;10(10):Cd010318.
43. Lavery LA, Fulmer J, Shebetka KA, Regulski M, Vayser D, Fried D, et al. The efficacy and safety of Grafix(®) for the treatment of chronic diabetic foot ulcers: results of a multi-centre, controlled, randomised, blinded, clinical trial. *International wound journal*. 2014;11(5):554-60.
44. Tettelbach W, Cazzell S, Sigal F, Caporusso JM, Agnew PS, Hanft J, et al. A multicentre prospective randomised controlled comparative parallel study of dehydrated human umbilical cord (EpiCord) allograft for the treatment of diabetic foot ulcers. *International wound journal*. 2019;16(1):122-30.
45. Kirsner RS, Sabolinski ML, Parsons NB, Skornicki M, Marston WA. Comparative effectiveness of a bioengineered living cellular construct vs. a dehydrated human amniotic membrane allograft for the treatment of diabetic foot ulcers in a real world setting. *Wound Repair Regen*. 2015;23(5):737-44. doi: 10.1111/wrr.12332. Epub 2015 Sep 3. PMID: 26100572.
46. Zelen CM, Serena TE, Gould L, Le L, Carter MJ, Keller J, et al. Treatment of chronic diabetic lower extremity ulcers with advanced therapies: a prospective, randomised, controlled, multi-centre comparative study examining clinical efficacy and cost. *International wound journal*. 2016;13(2):272-82.
47. Game FL, Apelqvist J, Attinger C, Hartemann A, Hinchliffe RJ, Londaal M, et al. Effectiveness of interventions to enhance healing of chronic ulcers of the foot in diabetes: a systematic review. *Diabetes/metabolism research and reviews*. 2016;32 Suppl 1:154-68.
48. Chand NK, Subramanya HB, Rao GV. Management of patients who refuse blood transfusion. *Indian journal of anaesthesia*. 2014;58(5):658-64.
49. Australian Bureau of Statistics (2016) '2016 Census Data Summary', Religion in Australia [[https://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/E3E51096DAC0AD7CCA25814D00240616/\\$File/religion_2016_census_data_summary_updated.pdf](https://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/E3E51096DAC0AD7CCA25814D00240616/$File/religion_2016_census_data_summary_updated.pdf)], accessed 28 January 2021.
50. European Pressure Ulcer Advisory Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance.. Prevention and treatment of pressure ulcers/injuries: Clinical Practice Guideline. E. Haesler (Ed.) EPUAP/NPIAP/PPPIA: 2019.
51. Marfella R, Sasso FC, Rizzo MR, Paolisso P, Barbieri M, Padovano V, et al. Dipeptidyl peptidase 4 inhibition may facilitate healing of chronic foot ulcers in patients with type 2 diabetes. *Experimental diabetes research*. 2012;2012:892706.
52. Rewale V, Prabhakar KR, Chitale AM. Pentoxifylline: a new armamentarium in diabetic foot ulcers. *Journal of clinical and diagnostic research: JCDR*. 2014;8(1):84-6.
53. National Health and Medical Research Council (2013) Australian Dietary Guidelines. Canberra: National Health and Medical Research Council.
54. Dyson PA, Twenefour D, Breen C, Duncan A, Elvin E, Goff L et al. Diabetes UK evidence-based nutrition guidelines for the prevention and management of diabetes. *Diabet Med*. 2018 May;35(5):541-547. doi: 10.1111/dme.13603. PMID: 29443421.

ENDORISING BODIES

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