

BMJ Open Epidemiology and healthcare access inequities in diabetic foot disease: a retrospective study in Central Queensland, Australia

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ABSTRACT

Objectives Diabetic foot disease (DFD) requires proactive healthcare management to minimise the risk of complications. Healthcare delivery has been shown to present significant challenges in rural and regional settings with Central Queensland being a large geographic area with limited local healthcare resources. Our objectives are to describe the distribution of DFD in a regional setting and assess the impact of remoteness on healthcare accessibility for this cohort.

Design A retrospective analysis of hospital admissions for DFD data between January 2017 and December 2023.

Setting, Participants All recorded episodes of care for DFD patients provided by Central Queensland Hospital and Health Service (CQHHS) were included.

Primary and secondary outcome measures Primary outcome was the number of DFD episodes. Secondary outcomes included the number of hospital bed days used by DFD cases, the number of lower extremity amputations and the number of interhospital transfers (IHTs) for DFD cases.

Results 1597 DFD episodes, 15528 bed days, 340 lower extremity amputations and 452 IHTs were recorded. Population-adjusted outcomes showed 1054 DFD episodes per 100 000 males compared with 383 per 100 000 females (incidence rate ratio (IRR) 2.75, 95% CI: 2.46 to 3.07), and 1384 per 100 000 Indigenous Australians compared with 669 per 100 000 non-Indigenous Australians (IRR 2.07, 95% CI: 1.80 to 2.38). Remoteness was associated with lower DFD treatment completion rates at local hospitals, with only 9.3% of patients from the most remote regions completing treatment locally, compared with 76.3% from the least remote regions ($p < 0.001$). The number of IHTs and amputations referred to healthcare facilities external to CQHHS increased throughout the study period.

Conclusions Males and Indigenous Australians were disproportionately affected by DFD in Central Queensland. Remoteness poses a significant risk factor to completing treatment for DFD at a local facility. Further research into key drivers leading to the disproportionate outcomes demonstrated in this study between specific cohorts of people with DFD is suggested to help design future interventions to improve accessibility and outcomes.

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This study uses a comprehensive dataset of all hospital admissions for diabetic foot disease (DFD) across a large regional health service over a 7-year period.
- ⇒ Standardised diagnostic coding (International Classification of Diseases-Tenth Revision-Australian Modification) was used to ensure consistent case identification.
- ⇒ Remoteness was classified using the Modified Monash Model, allowing geographic comparisons in healthcare access.
- ⇒ The study did not include DFD cases treated in primary care, private hospitals or metropolitan hospitals not linked to the regional health service.
- ⇒ Local hospital assignment based on residential suburb may not fully capture individual patient care-seeking behaviours.

INTRODUCTION

Diabetes is a significant risk factor for a number of conditions and complications including diabetic foot disease (DFD). DFD is defined as infection, ulceration or destruction of tissues of the foot associated with neuropathy and/or peripheral artery disease in the lower extremity of a person with diabetes mellitus.¹ It serves as a potent predictor of future lower extremity amputation and mortality, with 5-year mortality rates associated with diabetic foot ulcers nearing 50%.^{2 3} This results in significant morbidity and mortality for people with DFD and significant burden on the Australian health system, costing an estimated \$875 million annually.⁴ Australian studies show that hospitalisations as a result of DFD are increasing, underscoring the importance of appropriately managing DFD to prevent hospitalisations.⁵

Effective DFD management is complex and requires a diverse multidisciplinary approach with collaboration from various healthcare professionals including endocrinologists,

orthopaedic surgeons, vascular surgeons, infectious disease physicians, podiatrists, diabetic educators and general practitioners. Coordinating multidisciplinary care for people with DFD is challenging, especially when healthcare services need to be delivered across large geographical areas and reach regional and remote communities. Disparities in access to local services for people residing in these communities often lead to people accessing healthcare outside their region, or not accessing appropriate care at all, leading to concerns about unequal access to healthcare.⁶ Inequitable access to healthcare can have devastating consequences for patients with DFD, reflected in the findings of the Australian Burden of Disease Study which showed patients residing in remote regions had a fourfold increase in amputations compared with those residing in major cities.⁷

Central Queensland Hospital and Health Service (CQHHS) delivers care to a diverse population of approximately 250 000 people across a broad geographical area.⁸ This area of 117 000 square kilometres incorporates 12 health facilities: Rockhampton Hospital, Gladstone Hospital, Biloela Hospital, Emerald Hospital, Capricorn Coast Hospital, Mount Morgan Multipurpose Health Service (MPHS), Baralaba MPHS, Moura MPHS, Theodore MPHS, Woorabinda MPHS, Springsure MPHS and Blackwater MPHS.^{8,9} Delivering effective healthcare for DFD in this setting poses a particularly challenging task. The large geographic expanse the health service needs to cover, combined with a lack of specialists' services at the local level, such as endocrinologists and vascular surgeons, complicates DFD management within Central Queensland.¹⁰ Patients requiring tertiary-level care not available within CQHHS typically need to be referred to metropolitan centres located approximately 600 km away in Brisbane.

Inequity in healthcare access for DFD patients has been documented in metropolitan regions in Queensland, with DFD patients within the same health service catchment area having comparatively poorer access to healthcare due to their residential address.⁶ However, no studies have yet examined the equity of healthcare access for DFD patients across a region as geographically extensive as Central Queensland. The aim of this study is to determine the burden of DFD and the equity of access to healthcare for patients with DFD in Central Queensland. The results will help inform future health system planning for pathways to support people with DFD.

METHODS

Data source

Study data were based on episodes of care for DFD, defined as presentations to the emergency department or an inpatient service that concluded with discharge, death or interhospital transfer. All DFD episodes occurring between 1 January 2017 and 31 December 2023 at a CQHHS facility for patients aged 18 years and above, with a residential address within the CQHHS catchment

area, were included. DFD episodes were identified using International Classification of Diseases-Tenth Revision-Australian Modification (ICD-10-AM) codes as defined by the Queensland Diabetic Foot Working Group^{5 6 11} (online supplemental Appendix Table 1,2). Amputation procedures were identified by reviewing the patient's electronic health record for documented evidence. Amputations were reported if they occurred during a DFD episode at a CQHHS facility or at an external facility to which the patient was transferred for DFD care from CQHHS. If a patient underwent multiple amputation procedures during a single DFD episode, only the final procedure was recorded, as it was considered the completion of their surgical treatment for DFD.

All suburbs within the CQHHS catchment area were identified using ArcGIS software mapping provided by Queensland Health.¹² Population data for each suburb were obtained from the 2021 Australian Bureau of Statistics Census.¹³ For this study, patients were assigned a Modified Monash Model (MMM) classification score based on their suburb of residence. The MMM classification system, which defines the remoteness and population size of regions in Australia, is used to determine healthcare services distribution, particularly in rural and remote regions.¹⁴ MMM classification data were obtained from the Department of Health and Aged Care.¹⁵

Data Analysis

The primary outcome measure was the number of DFD episodes. Secondary outcomes were the hospital bed days used by DFD cases and count of lower extremity amputations. For this study, major and minor amputations were combined, as both require surgery and serve as indicators of access to operative care for diabetic foot disease. Although amputations were not classified as major or minor for the purposes of data analysis, a descriptive breakdown by type is provided in online supplemental Appendix Table 3. These outcomes have been further defined in our previous publication.⁶ Crude and population-adjusted outcomes were compared by sex, Indigenous status and MMM classification score. The population count from the 2021 Census was used as the denominator for all population-adjusted outcomes. An incidence rate ratio and 95% CI for primary and secondary outcome measures were calculated. The number of interhospital transfers (IHTs) for DFD cases was also determined. IHT was defined as the relocation of a patient at the end of a DFD episode to another healthcare facility for ongoing treatment.

Crude outcomes were plotted by year to evaluate annual variations and trends. Bed days were stratified into three groups: (i) bed days for DFD episodes where an amputation was performed at a CQHHS facility, (ii) bed days for DFD episodes requiring an IHT and (iii) bed days not associated with either an amputation or an IHT. An annual average bed day per DFD episode was also calculated. IHTs were categorised by destination into two

groups: (i) IHT within CQHHS facilities and (ii) IHT to Brisbane facilities.

DFD episodes were assessed for whether they presented to and had treatment completed at the patient's local hospital and were compared by sex, Indigenous status and MMM classification score. Local hospital was defined as a health facility with the same MMM classification as the patient's residential suburb. All patients were considered to have completed their treatment for their DFD episode unless they required an IHT at the end of that episode. A χ^2 test was performed to assess any statistical association between presentation to and treatment completion at the local hospital and the variables of sex, Indigenous status and MMM classification score. Statistical significance was determined at a p value of <0.05 for all statistical analysis. All statistical analysis was performed using R studio.

RESULTS

1597 DFD episodes, 15 528 bed days, 340 lower extremity amputations and 452 IHTs were recorded over the study period.

DFD outcomes by sex, ethnicity, and remoteness

Males accounted for the majority of DFD with 1177 DFD episodes which led to 11 095 bed days and 270 amputations. In contrast, females had 420 DFD episodes, which led to 4433 bed days and 70 amputations. Males had a statistically significant higher incidence rate ratio (IRR) for all outcomes, with an IRR of 2.75 (95% CI: 2.46 to 3.07) for DFD episodes (table 1), 2.45 (95% CI: 2.37 to 2.54) for bed days and 3.78 (95% CI: 2.91 to 4.92) for amputations (table 2).

Non-Indigenous patients accounted for the majority of DFD, with 1373 DFD episodes, 13 842 bed days and 284 amputations. Indigenous Australian patients had 224 DFD episodes, which led to 1686 bed days and 56 amputations. When adjusted for population size, Indigenous Australians had 1384 DFD, 10 416 bed days and 346 amputations per 100 000 people compared with 669 DFD episodes, 6746 bed days and 138 amputations per 100 000 people for non-Indigenous Australians. Indigenous Australians had a statistically significant higher IRR for all outcomes compared with non-Indigenous Australians, with an IRR of 2.07 (95% CI: 1.80 to 2.38) for DFD episodes (table 1), 1.54 (95% CI: 1.47 to 1.62) for bed days and 2.50 (95% CI: 1.88 to 3.33) for amputations (table 2).

The majority of DFD occurred in MMM 2 regions, with 680 DFD episodes, 7086 bed days and 163 amputations. MMM 6 regions had the fewest cases, with 86 episodes, 678 bed days and 21 amputations. When adjusted for population, MMM 5 regions had the highest rate of DFD, with 1060 DFD episodes, 11 203 bed days and 239 amputations per 100 000 people. MMM 5 regions had a statistically significant higher IRR for DFD (1.29, 95% CI: 1.13 to 1.49) (table 1) and bed days (1.31, 95% CI: 1.26 to 1.37) compared with MMM 2 regions. However, there was no difference in the IRR of amputations between MMM 2

Table 1 Crude and population-adjusted DFD episodes by sex, ethnicity and Modified Monash Model (MMM) classification score

	DFD episodes		
	Total episodes; n	Per 100 000 people; n	IRR (95% CI)
Sex			
Female	420	383	Reference
Male	1177	1054	2.75 (2.46 to 3.07)
Ethnicity			
Non-Indigenous	1373	669	Reference
Indigenous	224	1384	2.07 (1.80 to 2.38)
MMM			
2	680	820	Reference
3	417	518	0.63 (0.56 to 0.71)
4	130	592	0.72 (0.60 to 0.87)
5	284	1060	1.29 (1.13 to 1.49)
6	86	769	0.94 (0.75 to 1.17)
Total	1597	710	
Data reported as count. DFD, diabetic foot disease; IRR, incidence rate ratio.			

regions and remote regions—MMM 5: IRR 1.22 (95% CI: 0.91 to 1.62); MMM 6: IRR 0.96 (95% CI: 0.61 to 1.50) (table 2).

Annual trends in DFD outcomes

The number of annual DFD episodes in CQHHS remained relatively stable throughout the study period, ranging from 211 episodes in 2021 to 258 episodes in 2019 (online supplemental Appendix Table 4). In contrast, bed days for DFD episodes exhibited a downward trend, beginning at 2803 bed days in 2017 and declining gradually to 1482 bed days by 2023. This declining trend was observed across all categories of DFD-related bed days, which includes DFD episodes associated with amputations, IHTs and those without amputations or transfers. Average bed days per DFD episode also followed a similar trend, beginning with 11 average bed days in 2017 and declining to 7 average bed days by 2023 (figure 1 and online supplemental Appendix Table 5).

Over the study period, 340 DFD episodes were associated with lower extremity amputations, representing 21.3% of all DFD episodes. Of those, 191 were performed at CQHHS facilities, while 149 were performed at an external facility, in Brisbane. The total number of amputations showed an initial upward trend from 46 in 2017 to a peak of 57 in 2020, before gradually falling to 40 by 2023. While the number of amputations performed at CQHHS facilities remained consistent between 2017 and

Table 2 Crude and population-adjusted bed days and amputations for DFD by sex, ethnicity and Modified Monash Model (MMM) classification score

	Bed days; n			Amputations; n		
	Total bed days; n	Per 100 000 people; n	IRR (95% CI)	Total amputations; n	Per 100 000 people; n	IRR (95% CI)
Sex						
Female	4433	4046	Reference	70	64	Reference
Male	11 095	9932	2.45 (2.37 to 2.54)	270	242	3.78 (2.91 to 4.92)
Ethnicity						
Non-Indigenous	13 842	6746	Reference	284	138	Reference
Indigenous	1686	10 416	1.54 (1.47 to 1.62)	56	346	2.50 (1.88 to 3.33)
MMM						
2	7086	8543	Reference	163	197	Reference
3	3346	4160	0.49 (0.47 to 0.51)	70	87	0.44 (0.33 to 0.59)
4	1417	6450	0.75 (0.71 to 0.80)	22	100	0.51 (0.33 to 0.80)
5	3001	11 203	1.31 (1.26 to 1.37)	64	239	1.22 (0.91 to 1.62)
6	678	6061	0.71 (0.66 to 0.77)	21	188	0.96 (0.61 to 1.50)
Total	15 528	6901		340	151	

Data reported as count.
DFD, diabetic foot disease; IRR, incidence rate ratio.

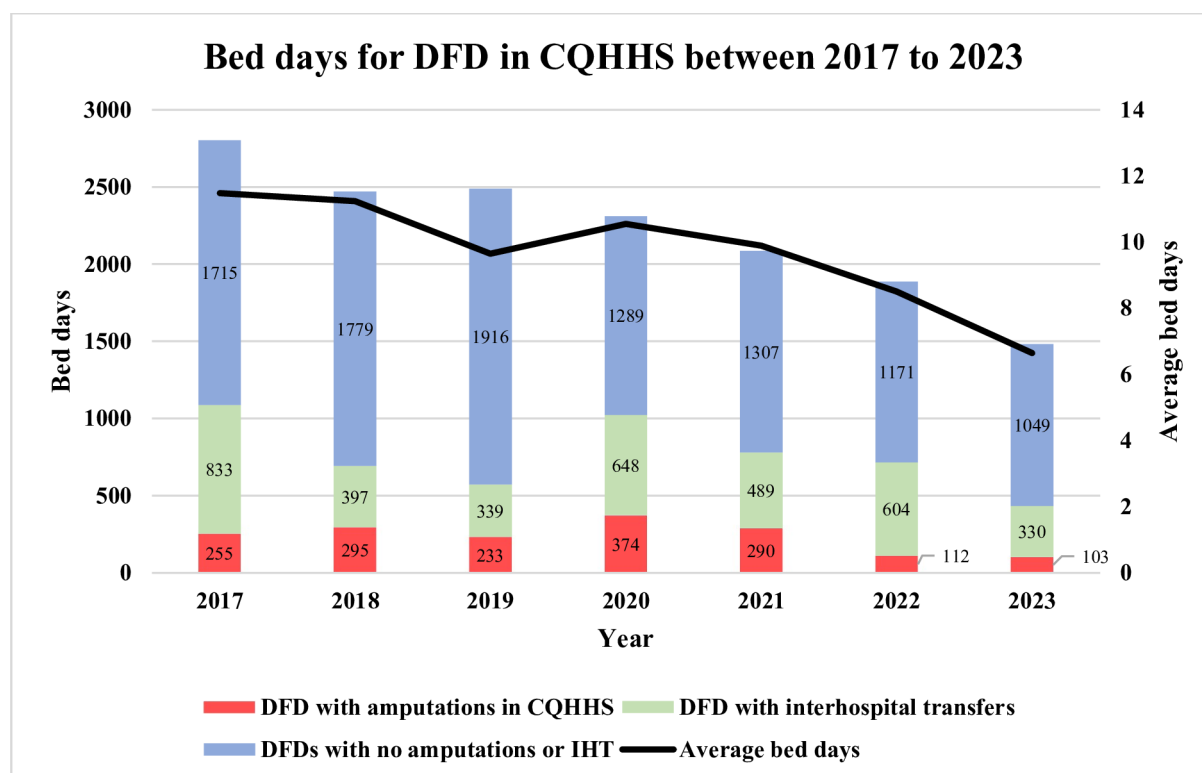


Figure 1 Line graph of total annual and average bed days for DFD in CQHHS between January 2017 and December 2023. CQHHS, Central Queensland Hospital and Health Service; DFD, diabetic foot disease; IHT, interhospital transfer.

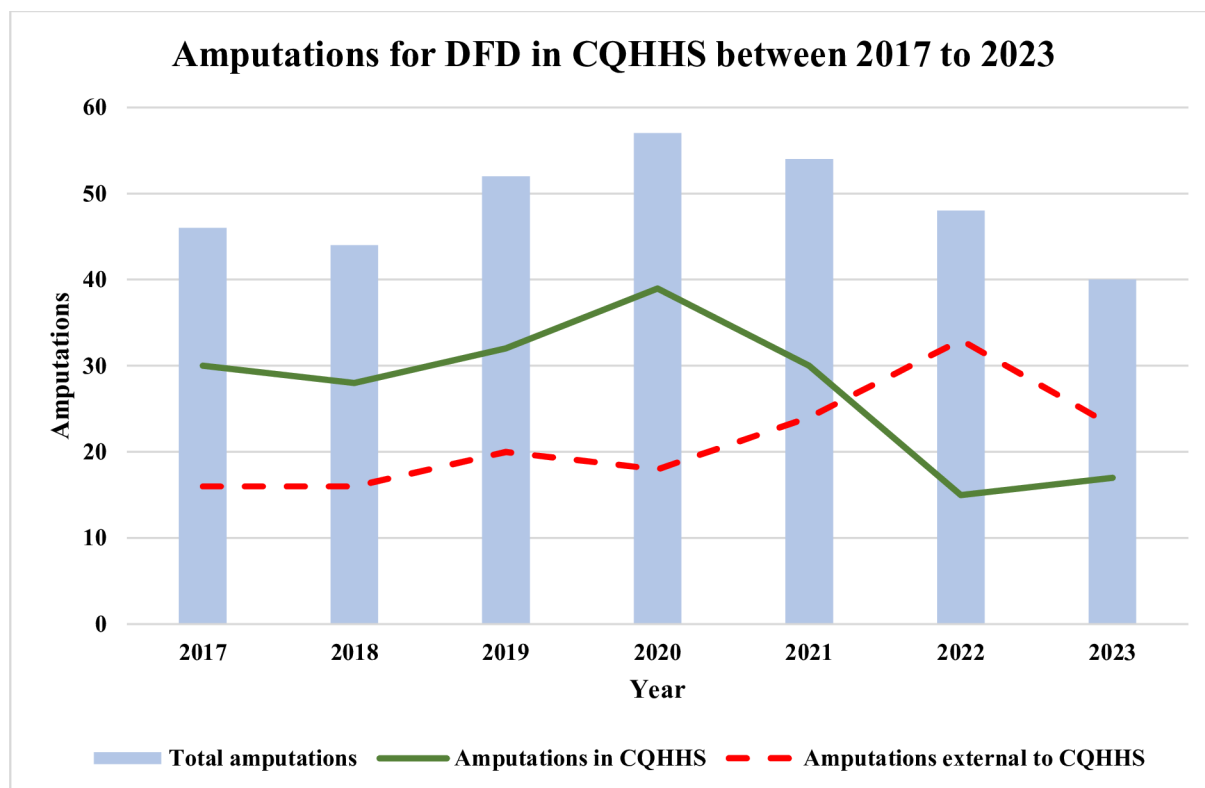


Figure 2 Line graph of amputations for DFD for CQHHS patients between January 2017 and December 2023. CQHHS, Central Queensland Hospital and Health Service; DFD, diabetic foot disease.

2021, ranging from 28 to 39 procedures annually, there was a significant reduction from 2022 onward, with only 15 amputations performed in 2022—less than half the average of the previous years. In contrast, there was a steady increase in amputations performed externally to CQHHS increasing from 16 in 2017 to a peak of 32 in 2022 (online supplemental Appendix Table 3). Notably, 2022 marked the first time a majority of amputations occurred at facilities in Brisbane rather than in CQHHS facilities (figure 2).

During the study period, CQHHS recorded a total of 452 IHTs for DFD episodes. Of these, 264 IHTs (16.5% of all DFD episodes) were to hospitals in Brisbane, while 188 IHTs (11.8% of all DFD episodes) occurred between facilities within the CQHHS network (online supplemental Appendix Table 6). The total number of IHTs increased steadily from 55 in 2017 to 76 in 2023, driven primarily by an increase in transfers to Brisbane facilities, which rose from 25 in 2017 to 44 in 2023. In contrast, IHTs within CQHHS facilities remained relatively stable throughout the study period, with an annual average of 27 transfers (figure 3).

Local healthcare access

Across all groups, a total of 28.3% of patients were transferred while the majority, 71.7%, remained at their initial hospital. Remoteness was strongly correlated with the need for IHTs. While 21.9% of DFD episodes in MMM 2 regions required transfers, this percentage increased to 39.5% in MMM 6 regions. Male and Indigenous

Australian patients were also transferred at a higher rate than their counterparts. 30.3% of male patients were transferred compared with 22.6% of female patients. 33.0% of Indigenous Australian patients were transferred compared with 27.5% of non-Indigenous patients (online supplemental Appendix Table 7).

Overall, 1132 of all DFD episodes (70.9%) presented to a local hospital and 834 (52.2%) completed treatment at the local hospital. There was a statistically significant relationship between MMM classification score and both DFD presentation ($p<0.001$) and treatment completion ($p<0.001$) at a local hospital. Lower rates of DFD presentation and treatment completion at a local hospital were observed with increasing remoteness. Only 19.4%–19.8% of DFD episodes presented to a local hospital from MMM 5 and 6 regions compared with 96.8% of DFD episodes from MMM 2 regions. Similarly, only 8.8%–9.3% of DFD from MMM 5 and 6 regions completed treatment locally compared with 76.3% for MMM 2 regions. There were no statistically significant differences by sex ($p=0.69$ for presentation; $p=0.08$ for treatment completion) or ethnicity ($p=0.55$ for presentation; $p=0.94$ for treatment completion) (table 3).

DISCUSSION

Reducing the burden of diabetes and its complications is a key objective of the Australian Government, as outlined in the Australian National Diabetes Strategy.¹⁶ However,

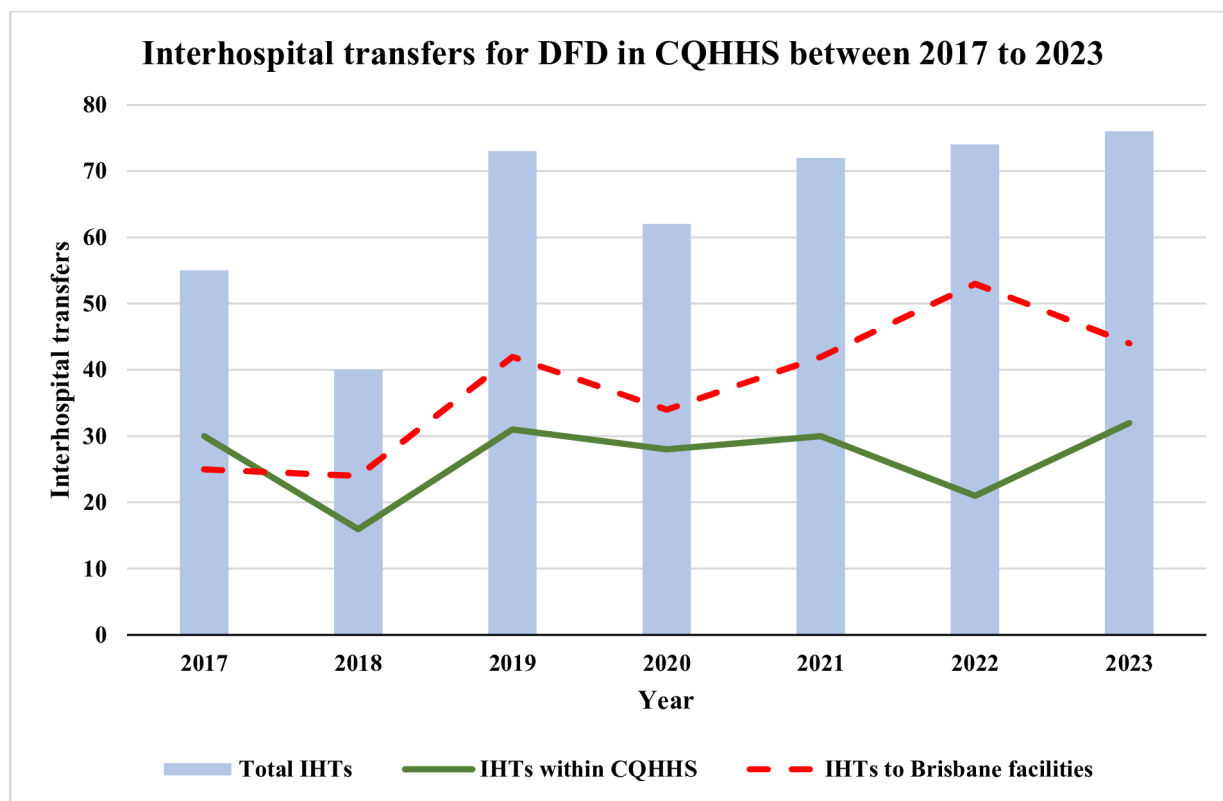


Figure 3 Line graph of interhospital transfers for DFD in CQHHS between January 2017 and December 2023. CQHHS, Central Queensland Hospital and Health Service; DFD, diabetic foot disease; IHTs, interhospital transfers.

our study reveals that in Central Queensland, the number of DFD episodes has remained stable over the past 7 years, indicating that the burden of DFD in the region has not decreased. This may reflect a combination of factors, including a rising prevalence of diabetes in the population, an ageing population and limited reach or effectiveness of preventative foot care programmes in the region.⁷ To address this persistent challenge, health policy in Central Queensland must focus on implementing more effective preventative measures to reduce the incidence and complications of DFD. Our study identified two demographic groups, males and Indigenous Australian patients, who should be prioritised in any future health-care strategy for the region. Males experience higher rates of DFD, which may be linked to delayed health-seeking, poorer foot self-care and reduced symptom reporting, leading to more advanced disease. While one meta-analysis showed that males are 30% more likely to undergo amputations,¹⁷ males in Central Queensland were more than three times as likely, indicating they are a particularly vulnerable group in the region. Conversely, although Indigenous Australians in Central Queensland were twice as likely to develop DFD compared with their non-Indigenous counterparts, this appears to be better than the national average, where Indigenous Australians typically face a threefold to sixfold increase in DFD complications. This elevated risk is likely driven by social determinants, including limited access to culturally safe care, systemic inequities and insufficient access to timely,

appropriate early intervention—though the disparity in Central Queensland appears less pronounced than national estimates.¹⁸ Internationally, similar disparities in DFD outcomes have been observed. For example, a US study found that rurality, along with race and ethnicity, was associated with higher rates of major amputations or death among patients hospitalised with diabetic foot ulcers, largely due to disparities in access to specialist and preventative care.¹⁹

The average bed days for DFD episodes gradually decreased over the study period, driven by a significant reduction in bed days for DFD episodes that did not require amputation or IHT. This improvement is partly attributable to a change implemented by CQHHS in 2021, where earlier consultations with orthopaedic surgery were introduced during patient episodes. Our findings support this shift in clinical care as it appears to have contributed to more efficient management of DFD cases. However, the decline in bed days may also reflect other factors beyond improved care coordination. Changes in discharge policies, hospital resource constraints or an increase in interhospital transfers—particularly to metropolitan centres such as Brisbane—may have contributed. Indeed, over the same period, there was an increase in the number of amputations and IHTs being referred to healthcare facilities in Brisbane. Although this study did not examine the specific factors leading to an IHT to Brisbane, the absence of a vascular surgery service in CQHHS is likely a significant contributor to this trend. Peripheral

Table 3 Patients attending and completing treatment at a local hospital

	DFD episodes presenting at local hospital; n (%)			DFD episodes completed treatment locally; n (%)		
	Yes	No	P value	Yes	No	P value
Sex						
Male	838 (71.2%)	339 (28.8%)	p=0.69	599 (50.9%)	578 (49.1%)	p=0.08
Female	294 (70.0%)	126 (30.0%)		235 (56.0%)	185 (44.0%)	
Ethnicity						
Indigenous	163 (72.8%)	61 (27.2%)	p=0.55	116 (51.8%)	108 (48.2%)	p=0.94
Non-Indigenous	969 (70.6%)	404 (29.4%)		718 (52.3%)	655 (47.7%)	
MMM						
2	658 (96.8%)	22 (3.2%)	p<0.001	519 (76.3%)	161 (23.7%)	p<0.001
3	305 (73.1%)	112 (26.9%)		217 (52.0%)	200 (48.0%)	
4	97 (74.6%)	33 (25.4%)		65 (50.0%)	65 (50.0%)	
5	55 (19.4%)	229 (80.6%)		25 (8.8%)	259 (91.2%)	
6	17 (19.8%)	69 (80.2%)		8 (9.3%)	78 (90.7%)	
Total	1132 (70.9%)	465 (29.1%)		834 (52.2%)	763 (47.8%)	

Data reported as count (row percentages).

DFD, diabetic foot disease; MMM, Modified Monash Model.

artery disease is estimated to affect half of the patients with DFD,²⁰ and those requiring revascularisation procedures must be transferred to metropolitan centres. Additionally, although less common, in-hospital deaths may also have influenced episode duration; however, our dataset did not include sufficient detail on discharge outcomes to explore this further.

One of CQHHS's core strategies to ensure equitable health outcomes and improve access to quality, safe healthcare is to deliver care 'closer to home'.²¹ We found that nearly half of DFD cases within CQHHS were not treated locally, with 16.5% requiring transfers to healthcare facilities in Brisbane. This issue was particularly pronounced in remote regions, where fewer than 1 in 10 DFD episodes completed treatment locally. The likelihood of IHTs also sharply increased with remoteness, with patients in the most remote areas being almost twice as likely to require transfers compared with those in the least remote areas. The lack of access to local healthcare, contributing to poorer outcomes for remote patients, remains a persistent challenge in the Australian healthcare system.²² To address this, DFD management in Central Queensland should prioritise innovative care models like telemedicine, which could enhance access to specialised care locally and reduce the reliance on transfers from remote to regional and metropolitan

centres.^{23 24} Service level agreements that allow specialists to provide consultations at local hospitals, either in person or remotely, are necessary to facilitate the implementation of these care models.

Limitations and future work

The observational design limits causal inference: while associations between remoteness and outcomes like interhospital transfers and treatment completion are described, underlying causal mechanisms cannot be determined. Additional methodological limitations also apply. Assigning patients to an MMM classification based solely on their residential suburb, and defining their 'local hospital' accordingly, may not fully account for actual patient behaviours. Patients might choose to seek care at non-local hospitals due to perceived lower quality of care at their local facilities or to access specialised services that are unavailable locally.

The study relied on routinely collected administrative data, which is subject to incompleteness, misclassification and potential referral bias. The dataset lacked clinical details, including the reasons for interhospital transfers—such as comorbidities, diabetes duration and revascularisation—limiting insight into the clinical drivers of transfer. Identifying these would require a review of individual patient records, which was beyond the study's

scope. Our study did not account for the different age structure, ethnic composition and socioeconomic factors between MMM regions,²² and these might confound the relationship between the MMM classification score and DFD outcomes. Although multivariate analysis could help adjust for such confounders, the absence of individual-level data precluded meaningful modelling. Given the descriptive focus of this study, we instead used population-adjusted outcomes to support regional health service planning. Finally, data from primary healthcare facilities, private hospitals and patients directly admitted to metropolitan facilities were not available, introducing potential selection bias and likely leading to an underestimation of the true burden of DFD in Central Queensland.

This study has demonstrated the significant inequities that still exist in DFD outcomes in Central Queensland. Future research needs to focus on the patient and system factors that contribute to patients not accessing care at the local level and undergoing IHTs to metropolitan facilities for DFD care. It is also important for the health service to implement new models of care that can bring specialised DFD healthcare to key demographic groups across a wide geographic area with limited local healthcare resources and infrastructure.

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Contributors YS was responsible for conceptualisation, data acquisition, analysis, interpretation, writing original draft, review and editing. MK was responsible for conceptualisation, writing critical review and editing. GK and RV were responsible for conceptualisation, supervision, constant coordination, writing critical review and editing. RV is responsible for the overall content as the guarantor. All the authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by Central Queensland Hospital and Health Service Human Research Ethics Committee (HREC/2024/QCQ/107352). Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. Data are available upon reasonable request. Deidentified patient data can be requested from the Business Analysis & Decision Support at rock-bads.rock-bads@health.qld.gov.au.

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REFERENCES

- van Netten JJ, Bus SA, Apelqvist J, *et al.* Definitions and criteria for diabetic foot disease. *Diabetes Metab Res Rev* 2020;36 Suppl 1:e3268.
- Martins-Mendes D, Monteiro-Soares M, Boyko EJ, *et al.* The independent contribution of diabetic foot ulcer on lower extremity amputation and mortality risk. *J Diabetes Complications* 2014;28:632–8.
- Chen L, Sun S, Gao Y, *et al.* Global mortality of diabetic foot ulcer: A systematic review and meta-analysis of observational studies. *Diabetes Obes Metab* 2023;25:36–45.
- Diabetes Australia. Facts and figures. Available: <https://www.diabetesaustralia.com.au/facts-and-figures/> [Accessed 17 Dec 2024].
- Quigley M, Morton JL, Lazzarini PA, *et al.* Trends in diabetes-related foot disease hospitalizations and amputations in Australia, 2010 to 2019. *Diabetes Res Clin Pract* 2022;194:110189.
- Soonarane YK, Pollard G, Knack B, *et al.* Inequity of healthcare access for patients with diabetic foot disease: a retrospective study in south-east Queensland. *BMJ Open* 2024;14:e074155.
- Australian Institute of Health and Welfare. Lower limb amputations due to diabetes: summary. Available: <https://www.aihw.gov.au/reports/burden-of-disease/lower-limb-amputations-due-to-diabetes/summary> [Accessed 17 Dec 2024].
- Central Queensland Hospital and Health Service. Annual report 2017–2018. Available: <https://documents.parliament.qld.gov.au/tableOffice/TabledPapers/2018/5618T1694.pdf>
- Central Queensland Hospital and Health Service. Hospitals and health centres. Available: <https://www.cq.health.qld.gov.au/hospitals-and-health-centres> [Accessed 17 Dec 2024].
- Central Queensland Hospital and Health Service. Our regional health. Available: <https://www.choreport.health.qld.gov.au/our-regions/our-regional-health> [Accessed 17 Dec 2024].
- Lazzarini PA, O'Rourke SR, Russell AW, *et al.* Reduced Incidence of Foot-Related Hospitalisation and Amputation amongst Persons with Diabetes in Queensland, Australia. *PLoS One* 2015;10:e0130609.
- Queensland Health. QLD health maps: interactive map. Available: <https://qldhealth.maps.arcgis.com/apps/webappviewer/index.html?id=33c2da78f641454690dd0093013281a8> [Accessed 17 Dec 2024].
- Australian Bureau of Statistics. Fwind census data by area. Available: <https://www.abs.gov.au/census/find-census-data/search-by-area> [Accessed 17 Dec 2024].
- Australian Government Department of Health and Aged Care. Rural health workforce classifications: modified monash model (MMM). Available: <https://www.health.gov.au/topics/rural-health-workforce/classifications/mmm> [Accessed 17 Dec 2024].
- Australian Government Department of Health and Aged Care. Modified monash model (MMM) suburb and locality classification home care subsidy. Available: <https://www.health.gov.au/resources/publications/modified-monash-model-mmm-suburb-and-locality-classification-home-care-subsidy> [Accessed 17 Dec 2024].
- Australian Department of Health. Australian national diabetes strategy. 2021. Available: https://www.health.gov.au/sites/default/files/documents/2021/11/australian-national-diabetes-strategy-2021-2030_0.pdf
- Lin C, Liu J, Sun H. Risk factors for lower extremity amputation in patients with diabetic foot ulcers: A meta-analysis. *PLoS One* 2020;15:e0239236.
- West M, Sadler S, Hawke F, *et al.* Foot health of Aboriginal and Torres Strait Islander Peoples in regional and rural NSW, Australia. *J Foot Ankle Res* 2020;13:27.
- Tan T-W, Mustapha J, Chandra V, *et al.* Association of Race, Ethnicity, and Rurality With Major Leg Amputation or Death Among Medicare Beneficiaries Hospitalized With Diabetic Foot Ulcers. *JAMA Netw Open* 2022;5:e224392.
- National Diabetes Services Scheme (NDSS). Diabetes and feet toolkit. Available: <https://www.ndss.com.au/wp-content/uploads/diabetes-and-feet-toolkit.pdf> [Accessed 17 Dec 2024].

- 21 Central Queensland Hospital and Health Service. Clinical services plan. Available: https://www.cq.health.qld.gov.au/__data/assets/pdf_file/0008/213011/clinical-services-plan.pdf [Accessed 17 Dec 2024].
- 22 Australian Institute of Health and Welfare. Rural and remote health. Available: <https://www.aihw.gov.au/reports/rural-remote-australians/rural-and-remote-health> [Accessed 17 Dec 2024].
- 23 Timpel P, Oswald S, Schwarz PEH, *et al.* Mapping the Evidence on the Effectiveness of Telemedicine Interventions in Diabetes, Dyslipidemia, and Hypertension: An Umbrella Review of Systematic Reviews and Meta-Analyses. *J Med Internet Res* 2020;22:e16791.
- 24 Beard M, Orlando JF, Kumar S. Overcoming the tyranny of distance: An audit of process and outcomes from a pilot telehealth spinal assessment clinic. *J Telemed Telecare* 2017;23:733–9.