Clinical and Experimental Optometry

ISSN: 0816-4622 (Print) 1444-0938 (Online) Journal homepage: www.tandfonline.com/journals/tceo20

Understandability and actionability of patient education materials for diabetic retinopathy among indigenous and general populations

Kam Chun Ho, Falicia Tay, Caitlin Quan & Faran Sabeti

To cite this article: Kam Chun Ho, Falicia Tay, Caitlin Quan & Faran Sabeti (2026) Understandability and actionability of patient education materials for diabetic retinopathy among indigenous and general populations, Clinical and Experimental Optometry, 109:1, 67-74, DOI: 10.1080/08164622.2025.2492765

To link to this article: https://doi.org/10.1080/08164622.2025.2492765

CLINICAL AND EXPERIMENTAL OPTOMETRY
2026, VOL. 109, NO. 1, 67–74
https://doi.org/10.1080/08164622.2025.2492765

Understandability and actionability of patient education materials for diabetic retinopathy among indigenous and general populations

Kam Chun Ho, Falicia Tay, Caitlin Quan and Faran Sabeti

Discipline of Optometry and Vision Science, University of Canberra, Canberra, Australia

ABSTRACT

Clinical relevance: Effective diabetic retinopathy (DR) patient education materials (PEMs) are vital for improving patient outcomes by fostering understanding and self-management.

Background: DR is a leading cause of vision impairment and blindness among Australians with diabetes, with Indigenous populations facing higher rates of severe complications. Despite the availability of online PEMs, their understandability and actionability, especially those designed for Indigenous Australians, remains underexplored, creating a gap in effective patient education.

Methods: This descriptive study assessed online PEMs using the Patient Education Materials Assessment Tool (PEMAT). Evaluations were conducted with online search platforms for printable and audiovisual PEMs on DR. Two independent reviewers scored the PEMs for understandability and actionability, with discrepancies resolved by a third adjudicator. A 70% threshold was used to indicate acceptable scores.

Results: From 540 identified PEMs, 54 met the inclusion criteria. Indigenous-targeted PEMs achieved higher in understandability (80%) than general population PEMs (75%). However, actionability scores were lower across all formats, with printable PEMs having a mean score of 42% for general population and 53% for Indigenous PEMs, and audiovisual PEMs at 29%.

Conclusion: While most DR-related PEMs are generally understandable, their low actionability, especially audiovisual formats, indicates a need for clearer, step-by-step guidance to support patient self-management. Improving the structure and content of both printable and audiovisual PEMs can improve engagement and adherence to preventive behaviours among people living with diabetes, potentially reducing the burden of DR.

ARTICLE HISTORY
Received 8 November 2024
Revised 29 January 2025
Accepted 8 April 2025

KEYWORDS
Actionability; diabetic retinopathy; indigenous health; patient education materials; understandability

Introduction

Diabetic retinopathy (DR) is a leading cause of vision impairment and blindness among Australians with diabetes.[1] It poses a significant public health challenge and can severely impact the quality of life of the patients, reducing independence and increasing the risk of depression.[2] Recent studies report that DR affects 30.2% of Indigenous Australians and 23.7% of non-Indigenous Australians, with Indigenous populations at greater risk of severe complications, such as vision-threatening DR.[3]

Although DR is largely preventable through regular eye examinations, early detection, and lifestyle changes, many people living with diabetes struggle to adhere to these measures.[4,5] Patient education materials (PEMs) are crucial in raising awareness and promoting self-management.[6,7] However, the quality of these resources, particularly their understandability (ease of comprehension) and actionability (clear guidance on next steps), remains underexplored.[8] This gap in evaluation is especially critical for Indigenous Australians, who require culturally appropriate materials to support equitable health outcomes.[9]

Online PEMs are a primary source of health information in Australia, accessed by 78% of the population due to their low cost and accessibility.[10,11] Audiovisual PEMs, in particular, are shown to be more effective than printable formats in motivating DR screenings by providing visual aids (e.g., illustrations or diagrams) to enhance understanding.[12–14] However, many ophthalmic PEMs lack clear, actionable guidance necessary to empower patients to manage their conditions effectively.[15,16]

Current evaluations of DR-related PEMs commonly employed tools like the Flesch-Kincaid Grade Level and JAMA benchmark criteria to measure readability, accuracy, and accountability but fail to assess patient comprehension or the clarity of instructions for actionable measures.[15] The Patient Education Materials Assessment Tool (PEMAT) addresses this gap by evaluating both the 'understandability' and 'actionability' of PEMs.[8] Recent research highlights how using structured method like PEMAT can improve the clarity and usability of educational materials, making them more helpful for patients.[17] However, the application of PEMAT in assessing both printable and audiovisual DR-related PEMs has not been undertaken to evaluate how well these PEMs promote patient engagement and self-management in DR.

Accordingly, this study evaluates the understandability and actionability of online DR PEMs available to the Australian population, including both Indigenous and general population groups. Using PEMAT, this research identifies strengths and areas for improvement across both printable and audiovisual formats. The findings will provide evidence-based recommendations to enhance future DR PEMs,

CONTACT Kam Chun Ho hokamchun@hotmail.com Discipline of Optometry and Vision Science, University of Canberra, Canberra, Australia
Supplemental data for this article can be accessed online at https://doi.org/10.1080/08164622.2025.2492765

empowering patients to take proactive steps in managing their eye health and reducing the burden of DR in Australia.

Methods

Study design

This descriptive survey involved collecting online PEMs on DR using the three most used search engines, Google, Microsoft Bing, and Yahoo[18] and three relevant search terms: 'diabetic retinopathy', 'diabetic eye disease', and 'diabetic vision'. The search results were screened for duplicates, and the remaining unique PEMs were evaluated for understandability and actionability using the PEMAT. Figure 1 outlines the data collection and selection process for PEMs.

Data collection and eligibility

The search terms selected were 'diabetic retinopathy', 'diabetic eye disease', and 'diabetic vision' to ensure a focused yet comprehensive search. 'diabetic retinopathy' is widely used in academic and clinical settings, while 'diabetic eye disease' captures broader complications like diabetic macular oedema and glaucoma. 'diabetic vision' reflects layperson language commonly used by patients and caregivers, broadening the search to include patient-centred resources.

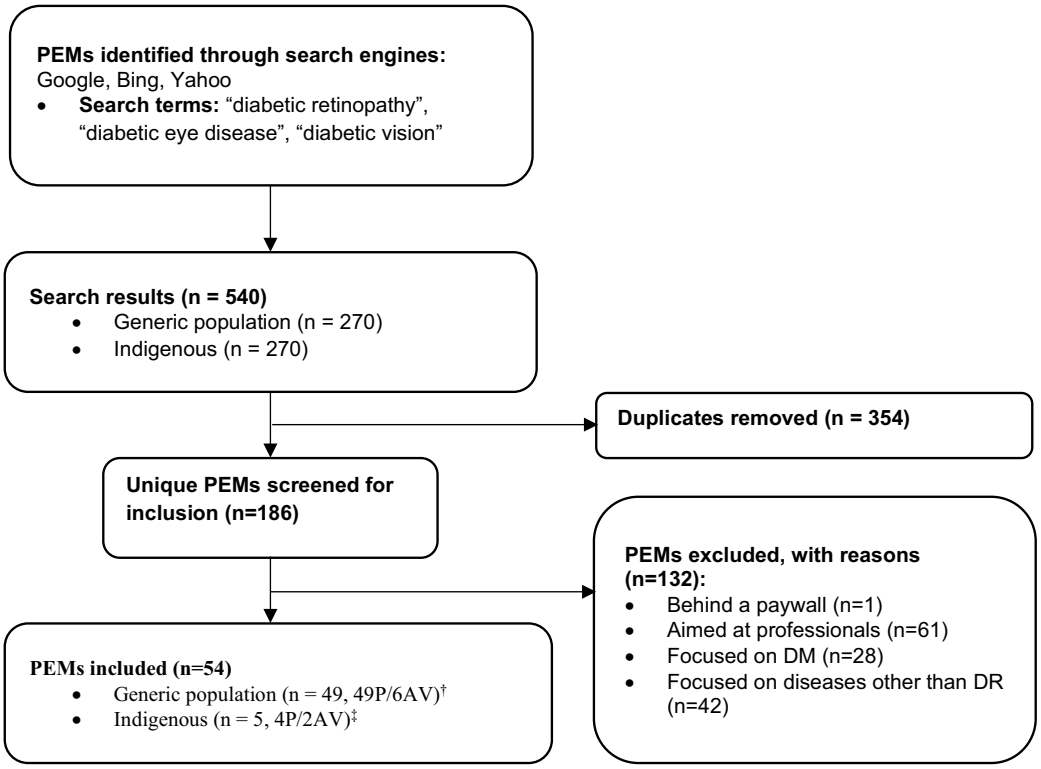
To identify Indigenous-specific PEMs, the same search terms were prefixed with 'Indigenous' (e.g., 'Indigenous diabetic retinopathy'), targeting Aboriginal and Torres Strait Islander communities, where 'Indigenous' is a commonly used term in Australian healthcare.[19]

The search was conducted using Google Chrome in 'Incognito' (private browsing) mode to prevent previous search history, cookies, or browser activity from influencing the search results. This ensures unbiased results and mimic the experience of an average user searching for information about DR for the first time.[14,20,21] The first thirty results for each search term were included, reflecting typical user behaviour of not exploring beyond the third page.[22] Due to the introduction of pageless scrolling, the first thirty results were selected as a practical cut-off. Both printable (e. g., written PEMs with or without images suitable for printing) and audiovisual (e.g., videos, podcasts, recorded lectures) PEMs were included.

Inclusion and exclusion criteria

Inclusion criteria required that PEMs be patient-targeted, delivered in English, and freely accessible online (i.e., not behind a paywall). Patient-targeted PEMs were identified based on specific criteria: materials were deemed patient-targeted if the website explicitly stated that the resources were aimed at patients or if the content was accessible and comprehensible to a lay audience. Conversely, materials were categorised as provider-focused and excluded if they were published on academic websites explicitly targeting clinicians or health professionals, statistical websites (e.g., Australian Institute of Health and Welfare government reports), or were research papers.

PEMs focusing on diabetes mellitus or other retinal diseases, rather than specifically on DR, were excluded to maintain the focus of the study on DR-related PEMs. Content from



Key: DM = diabetes mellitus, DR = diabetic retinopathy, P = printable, AV = audiovisual
†Six PEMs contained both P and AV components
‡One PEMs contained both P and AV components

Figure 1. Process of patient education materials (PEMs) selection.

multiple pages on DR within the same website was combined and counted as a single PEM, while separate links or PDF documents were treated as distinct PEMs and evaluated individually. Duplicates were identified and removed using EndNote.

Data assessment of understandability and actionability

The understandability and actionability of PEMs were evaluated using the PEMAT, a validated tool designed for use by both healthcare professionals and lay-people.[23] The PEMAT has two versions: PEMAT-P for printable PEMs, which includes 17 criteria for understandability and 7 criteria for actionability, and PEMAT-AV for audiovisual PEMs, with 13 understandability and 4 actionability criteria (Table 1).[8,23] These criteria account for the different ways information is conveyed in print and audiovisual formats, ensuring a comprehensive assessment.[8] The PEMAT uses a forced-choice binary system, where each item is marked as 'Agree' (scored 1) or 'Disagree' (scored 0), with some items allowing a 'Not Applicable' option, which excludes that item from the final score calculation.[8]

The PEMAT evaluates the understandability and actionability of patient education materials but does not explicitly assess cultural relevance or adaptation. PEMs with a score of 70% or higher in understandability or actionability are

Table 1. Understandability items scores for Indigenous-focused and general population patient education materials (PEMs).

Item	General population printable PEMs ($n = 49$)†	Indigenous printable PEMs ($n = 4$)‡	General population audiovisual PEMs ($n = 6$)†	Indigenous audiovisual PEMs ($n = 2$)‡
Domain: Understandability				
U1: The material makes its purpose completely evident (P and AV)	31%	75%	50%	100%
U2: The material does not include information or content that distracts from its purpose (P)	67%	75%	-	-
Topic: Word Choice & Style				
U3: The material uses common, everyday language (P and AV)	94%	100%	83%	100%
U4: Medical terms are used only to familiarise audience with the terms. When used, medical terms are defined (P and AV)	92%	100%	67%	100%
U5: The material uses the active voice (P and AV)	75%	50%	17%	50%
Topic: Use of Numbers				
U6: Numbers appearing in the material are clear and easy to understand (P)	74%	25%	-	-
U7: The material does not expect the user to perform calculations (P)	98%	100%	-	-
Topic: Organization				
U8: The material breaks or 'chunks' information into short sections (P and AV)	96%	100%	60%	100%
U9: The material's sections have informative headers (P and AV)	96%	100%	40%	50%
U10: The material presents information in a logical sequence (P and AV)	98%	100%	100%	100%
U11: The material provides a summary (P and AV)	33%	25%	0%	100%
Topic: Layout & Design				
U12: The material uses visual cues (e.g., arrows, boxes, bullets, bold, larger font, highlighting) to draw attention to key points (P and AV)	98%	100%	NA	100%
U13: Text on the screen is easy to read (AV)	-	-	100%	100%
U14: The material allows the user to hear the words clearly (e.g., not too fast, not garbled) (AV)	-	-	100%	50%
Topic: Use of Visual Aids				
U15: The material uses visual aids whenever they could make content more easily understood (e.g., illustration of healthy portion size) (P)	22%	75%	-	-
U16: The material's visual aids reinforce rather than distract from the content (P)	70%	75%	-	-
U17: The material's visual aids have clear titles or captions (P)	63%	75%	-	-
U18: The material uses illustrations and photographs that are clear and uncluttered (P and AV)	89%	100%	100%	100%
U19: The material uses simple tables with short and clear row and column headings (P and AV)	NA	NA	NA	NA
Mean Understandability score	**75%**	**80%**	**66%**	**86%**
Domain: Actionability				
A20: The material clearly identifies at least one action the user can take (P and AV)	31%	75%	50%	100%
A21: The material addresses the user directly when describing actions (P and AV)	67%	75%	17%	50%
A22: The material breaks down any action into manageable, explicit steps (P and AV)	NA	NA	0%	0%
A23: The material provides a tangible tool (e.g., menu planners, checklists) whenever it could help the user take action (P)	94%	100%	-	-
A24: The material provides simple instructions or examples of how to perform calculations (P)	92%	100%	-	-
A25: The material explains how to use the charts, graphs, tables, or diagrams to take actions (P and AV)	75%	50%	NA	NA
A26: The material uses visual aids whenever they could make it easier to act on the instructions (P)	NA	NA	-	-
Mean Actionability score	**75%**	**80%**	**66%**	**86%**

Abbreviations: p = printable, AV = audiovisual, NA = not applicable.
'NA' is used for items that were universally excluded across all types of PEMs.
'-' is used for items that are simply not applicable to certain PEM formats (e.g., items relevant to printable materials only are marked '-' for audiovisual materials).
†Six general population PEMs contained both P and AV components.
‡One Indigenous PEMs contained both P and AV components.

considered to meet acceptable standards.[23] Item U19 ('the material uses simple tables with short and clear row and column headings') was marked as 'Not Applicable' for all PEMs, as none of the evaluated materials included tables. This approach ensures that only applicable criteria are included in the final scoring, consistent with the PEMAT methodology.

Two investigators (FT and CQ) independently assessed each PEM after reviewing the PEMAT User Guide to ensure consistent interpretation.[23] Discrepancies were resolved through a discussion with an adjudicator (FS) to reach a final consensus on each item.

PEMAT grading and data analysis

Each PEM received separate understandability and actionability scores. These scores were calculated by dividing the total score by the total applicable items and then multiplying by 100 to yield a percentage.[23] The percentages represent the proportion of criteria met by the PEM. Mean scores were calculated by averaging these percentages across all PEMs in a given category. Higher percentages indicate better understandability or actionability.[23] Additionally, the proportion of PEMs meeting this 70% threshold was recorded to provide a comprehensive overview of their performance.

Additionally, the study applied a modified scoring method from Kang, et al.,[24] and Wang, et al.,[14] which sets a 50% threshold for each criterion. This modification help identify specific areas within understandability and actionability that may require improvement, facilitating targeted recommendations for enhancing future PEMs.[14,24]

Ethical considerations

This study did not involve direct patient contact and focused solely on publicly accessible educational materials; therefore, ethics approval was not required.

Results

Initial search

The initial search yielded a total of 540 PEMs, comprising 270 general population PEMs and 270 Indigenous-focused PEMs. After duplicates were removed using EndNote, 186 unique PEMs remained for screening. Of these, 132 PEMs were excluded for not meeting the inclusion criteria, with the most common reason being that the PEMs were aimed at professionals (Figure 1). Ultimately, 54 PEMs were included in the analysis, with 46 classified as printable PEMs, 1 classified as audiovisual PEM, and 7 contained both printable and audiovisual components (Supplementary Material 1).

The included PEMs originated from a diverse range of creators across several categories. Non-governmental organisations contributed the largest share, with 18 PEMs, followed by government agencies ($n = 13$), healthcare providers ($n = 10$), academic or research institutions ($n = 6$), online health information portals ($n = 4$) and professional organisations ($n = 3$).

PEMAT-P 'understandability' scores

The mean understandability score for all printable PEMs was 71% ($n = 53$, range 44% – 94%). This percentage reflects the average proportion of PEMAT criteria met by the evaluated materials. Printable PEMs targeting the general population achieved a mean score of 75% ($n = 49$, range 44% – 94%), which was slightly lower than the mean score for Indigenous-focused PEMs, at 80% ($n = 4$, range 63% – 88%) (Table 2). Of the 53 printable PEMs, 33 met or exceed the 70% cut-off for understandability. A detailed breakdown of individual item scores for both understandability and actionability across general population and Indigenous-focused PEMs is provided in Table 1.

Using the modified scoring method,[14,24] the items with the lowest proportion of PEMs meeting the criteria for understandability were U1 ('the material makes its purpose completely evident'), U11 ('the material provides a summary'), and U15 ('the material uses visual aids whenever they could to make content more easily understood'), as summarised in Table 3a. For both Indigenous and general population PEMs, item U19 ('the material uses simple tables with short and clear row and column headings') was marked as 'Not Applicable' for all PEMs, thus was not included in any calculations. The criteria met by the highest proportion of both Indigenous and general population PEMs were U7 ('the material does not expect the user to perform calculations') and U10 ('The material presents information in a logical sequence').

PEMAT-AV 'understandability' scores

The mean understandability score for all audiovisual PEMs was 71% ($n = 8$, range 56% – 92%), calculated as the average proportion of criteria met across all evaluated materials. Indigenous audiovisual PEMs had a higher mean score of 86% ($n = 2$, range 80% – 92%) compared to general population PEMs, which had a mean score of 66% ($n = 6$, range 56% – 75%) (Table 2). Of the 8 audiovisual PEMs, 5 met the 70% cut-off for understandability.

The criteria met by the lowest proportion of audiovisual PEMs were U5 ('the material uses the active voice'), U9 ('the material's sections have informative headers'), and U11 ('the material provides a summary'), as presented in Table 3b. Items U19 ('the material uses simple tables with short and clear row and column headings') and U12 ('the material uses visual cues to draw attention to key points') were marked 'Not Applicable' for audiovisual PEMs and printable PEMs, respectively.

PEMAT-P 'actionability' scores

The mean actionability score for printable PEMs was 42% ($n = 53$, range 0%–100%), reflecting the average proportion of

Table 2. Understandability and actionability scores for Indigenous-focused and general population patient education materials (PEMs).

Category	'U' mean (%)	'U' range (%)	PEMs ≥70% (U)	'A' mean (%)	'A' range (%)	PEMs ≥70% (A)
Printable, general population ($n = 49$)	75	44–94	33 (67%)	42	0–80	2 (4%)
Printable, Indigenous ($n = 4$)	80	63–88	3 (75%)	53	20–100	1 (25%)
Audiovisual, general population ($n = 6$)	66	56–75	3 (50%)	22	0–67	0 (0%)
Audiovisual, Indigenous ($n = 2$)	86	80–92	2 (100%)	50	33–67	0 (0%)

Abbreviations: U = understandability, A = actionability.

Table 3. Lowest performing items for (a) printable patient education materials (PEMs; $n = 53$) and (b) audiovisual patient education materials (PEMs; $n = 8$).

	Item type	Item code and description	PEMs meeting 50% threshold (%)
(a)	**printable patient education materials (PEMs; $n = 53$)**		
	Understandability	**U1** - The material makes its purpose completely n=evident.	18 (34%)
		U11 - The material provides a summary.	17 (32%)
		U15 - The material uses visual aids whenever they could make content more easily understood.	14 (26%)
	Actionability	**A22** - The material breaks down any action into manageable, explicit steps.	13 (25%)
		A23 - The material provides a tangible tool (e.g., menu planners, checklists) whenever it could help the user take action.	3 (6%)
		A26 - The material uses visual aids whenever they could make it easier to act on the instructions.	2 (4%)
(b)	**audiovisual patient education materials (PEMs; $n = 8$)**		
	Understandability	**U5** - The material uses the active voice.	2 (25%)
		U9 - The material's sections have informative headers.	3 (43%)
		U11 - The material provides a summary.	2 (25%)
	Actionability	**A21** - The material addresses the user directly when describing actions.	2 (25%)
		A22 - The material breaks down any action into manageable, explicit steps.	0 (0%)

actionability criteria met. General population printable PEMs had a mean score of 42% ($n = 49$, range 0% – 80%), while Indigenous PEMs scored slightly higher at 53% ($n = 4$, range 20%–100%) (Table 2). Only three of the 53 PEMs reached the 70% cut-off for actionability.

As shown in Table 3a, the actionability criteria met by the lowest proportion of printable PEMs were A22 ('the material breaks down any action into manageable, explicit steps'), A23 ('The material provides a tangible tool whenever it could help the user take action'), and A26 ('The material uses visual aids whenever they could make it easier to act on the instructions'). Item A24 ('The material provides simple instructions or examples of how to perform calculations') was marked 'Not Applicable' and excluded from final calculations. The actionability criterion met by the highest proportion of printable PEMs was A20 ('The material clearly identifies at least one action the user can take'), with 52 out of 53 PEMs (98%) graded 'Agree' on this item.

PEMAT-AV 'actionability' scores

Audiovisual PEMs had a mean actionability score of 29% ($n = 8$, range 0% – 67%). General population audiovisual PEMs had a mean score of 22% ($n = 6$, range 0%–67%), while Indigenous audiovisual PEMs scored higher with a mean actionability of 50% ($n = 2$, range 33%–67%) (Table 2). None of the audiovisual PEMs reached the 70% actionability cut-off.

As summarised in Table 3b, the actionability criteria met by the lowest proportion of audiovisual PEMs were A21 ('The material addresses the user directly when describing actions') and A22 ('The material breaks down any action into manageable, explicit steps'). Item A25 ('The material explains how to use the charts, graphs, tables, or diagrams to take actions') was marked 'Not Applicable' and excluded from final calculations. The actionability criterion met by the highest proportion of audiovisual PEMs was A20 ('The material clearly identifies at least one action the user can take'), with five out of eight audiovisual PEMs (63%) graded 'Agree' for this item.

Characteristics of creator and PEM performance

Table 4 summarises the mean understandability and actionability scores for printable and audiovisual PEMs by characteristics of creator. Printable PEMs from non-governmental organisations, government agencies, and professional organisations achieved the highest mean understandability scores (80%), while online health information portals had the lowest (58%). Actionability scores were highest for professional organisations (60%) and academic/research institutions (57%), but lower for healthcare providers (38%) and online health portals (30%). For audiovisual PEMs, government agencies achieved the highest mean understandability score (78%), followed by non-governmental organisations (70%). Actionability scores were consistently low across all creators, with non-governmental organisations scoring highest (45%) and healthcare providers scoring lowest (0%).

Discussion

The evaluation of DR PEMs revealed generally adequate understandability scores, with most materials meeting the 70% threshold. Indigenous-focused PEMs achieved higher understandability scores than general population PEMs, suggesting greater clarity and relevance. However, actionability scores were lower across all formats and populations, with few PEMs reaching the 70% cut-off, highlighting a lack of clear, actionable steps to support patient self-management. These gaps emphasise the need for PEMs with step-by-step instructions and visual aids to enhance engagement and

Table 4. Mean understandability and actionability scores by characteristics of creator for printable and audiovisual patient educational materials (PEMs).

	Printable PEMs			Audiovisual PEMs		
Characteristics of Creator	n	'U' mean (%)	'A' mean (%)	n	'U' mean (%)	'A' mean (%)
Professional organisations	3	80	60	2	65	17
Government agencies	12	80	46	2	78	33
Non-governmental organisations	18	80	38	3	70	45
Academic or research institutions	6	71	57	-	-	-
Healthcare providers	10	71	38	1	75	0
Online health information portals	4	58	30	-	-	-

Abbreviations: U = understandability, A = actionability, PEM = patient educational material.

empower people living with diabetes to manage their condition effectively.[25,26]

In terms of understandability, the findings are consistent with prior research on PEMs for chronic conditions and ophthalmology.[14] Studies on age-related macular degeneration PEMs, for example, reported similar understandability scores, with printable materials achieving around 74% understandability.[14] This aligns with the results, where general population DR printable PEMs averaged 75%, while Indigenous PEMs scored slightly higher, at 80%. This trend may reflect the efforts to simplify language and enhance clarity, particularly in materials aimed at Indigenous populations, which have been tailored to improve comprehension by incorporating culturally relevant language.

While the PEMAT does not explicitly assess cultural relevance, the higher understandability scores observed for Indigenous PEMs may reflect the incorporation of culturally tailored language and design elements. This highlights the potential benefits of cultural adaptation in enhancing the clarity and accessibility of PEMs. Audiovisual PEMs, however, generally scored lower on understandability, which is consistent with the findings from diabetes-related PEMs assessed by Kang et al.,[24] where audiovisual materials often lacked clarity due to less organised content and insufficient use of visual aids.

Results showed that general population audiovisual DR PEMs had a mean understandability score of 66%, while Indigenous audiovisual PEMs scored higher at 86%. This difference underscores the potential benefit of cultural adaptation in improving comprehension and suggests that audiovisual materials may require more attention to structure and content presentation to reach an adequate level of understandability.

Regarding actionability, the findings reveal a significant gap, with scores markedly lower than understandability across all PEM types. This mirrors previous studies on age-related macular degeneration and general diabetes PEMs, where materials were understandable but lacked clear, practical steps for patient action.[14,27] For example, a study on age-related macular degeneration found that while these PEMs were comprehensible, they frequently failed to offer specific, actionable guidance for managing the condition effectively.[14]

Similarly, Kloosterboer et al.,[15] reported that many DR-related materials lacked explicit instructions, echoing the finding that both Indigenous and general population DR PEMs did not provide manageable, step-by-step guidance.[27] These consistent shortcomings underscore the importance of prioritising actionability, particularly for patients managing chronic conditions who depend on actionable guidance for preventive behaviours, such as regular eye exams or managing blood glucose levels, both essential in delaying DR progression.[4]

Additionally, findings indicate that audiovisual PEMs score lower than printable PEMs in actionability when assessed by clinical investigators, likely due to the absence of structured, step-by-step instructions. Since audiovisual PEMs are often more engaging and accessible, enhancing them with visual demonstrations, verbal prompts, and interactive features could significantly improve their effectiveness in supporting patient adherence to preventive practices, complementing traditional printable PEMs.[28,29]

The characteristics of PEM creators also appear to influence their effectiveness. Materials developed by non-governmental organisations and government agencies demonstrated higher understandability scores, while professional organisations performed better in actionability. These findings suggest that the characteristics of the creators, such as being consumer-led or involving co-design processes, may influence the effectiveness of PEMs. Future efforts could explore how leveraging these strengths across creator types can improve the overall quality of PEMs.

To further assess the alignment between clinical investigator and patient perspectives, we conducted a small pilot consultation with three patients living with diabetes. These patients evaluated a randomly selected subset of 11 printable and 4 audiovisual PEMs targeting the general population. For printable PEMs, the mean understandability scores were 76% for investigators and 66% for patients, while the mean actionability scores were nearly identical at 40% and 42%, respectively. However, for audiovisual PEMs, patients rated both understandability (90% vs. 76%) and actionability (87% vs. 25%) significantly higher than investigators.

These findings suggest that audiovisual materials may resonate more strongly with patients, potentially due to their engaging and practical presentation, even though they may lack structured, step-by-step instructions as identified by investigators. This highlights the complementary value of patient perspectives alongside clinician-led evaluations, offering insights into how PEMs are utilised by their intended audience. Future research should further explore these differences through larger-scale patient evaluations and investigate how audiovisual PEMs can balance patient engagement with improved structured guidance to support preventive behaviours. Such efforts could inform the development of PEMs that better meet the needs, preferences, and experiences of people living with diabetes.

This study has several strengths, including the use of the validated Patient Education Materials Assessment Tool (PEMAT) to systematically evaluate the understandability and actionability of diabetic retinopathy (DR) PEMs. The inclusion of both Indigenous and general population PEMs provides novel insights into the accessibility and cultural relevance of materials available to diverse populations. While cultural adaptation may contribute to higher understandability scores for Indigenous PEMs, further research is needed to evaluate the impact of culturally specific elements systematically.

However, there are some limitations to be acknowledged. While the study focused on English-language materials, reflecting the prevalence of English health resources in Australia, this may limit generalisability to non-English-speaking populations. The decision to analyse only the first 30 search results aligns with typical user behaviour, ensuring relevance to commonly accessed resources. However, focusing on publicly available online PEMs means the study may not reflect materials provided in clinical settings; however, online resources are increasingly a primary source of health information for many individuals, underscoring the importance of evaluating these accessible materials.

While this study evaluated publicly available PEMs, emerging features of search engines, such as AI-generated summaries, warrant consideration. Although AI summaries were not available in Australia at the time of this study (June 2024), they now provide quick answers to keyword searches and cite a mix of patient-targeted and provider-focused resources. However, these summaries remain experimental and lack the depth of comprehensive PEMs tailored to the general

public. Future research should explore how AI-generated summaries impact patients' ability to find and engage with high-quality, patient-centred PEMs.

Future efforts should focus on addressing the identified gaps in actionability by incorporating step-by-step instructions, visual aids, and culturally relevant content. Larger-scale evaluations involving patients could provide valuable insights into how PEMs are perceived and utilised. Expanding research to include non-English PEMs and exploring the role of emerging technologies, such as AI-generated summaries, could further enhance the accessibility and effectiveness of patient education materials. Additionally, co-designing PEMs with input from patients and healthcare providers will ensure that materials are aligned with user needs and preferences, ultimately improving patient outcomes.

Conclusion

This study highlights the need for DR-related PEMs to enhance both understandability and actionability, supporting self-management among diverse populations. While many PEMs met the 70% threshold for understandability, Indigenous-targeted materials generally scored higher, indicating that culturally tailored content may improve comprehension. However, actionability scores were consistently low across all PEM types, especially in audiovisual formats, revealing a critical gap in providing clear, actionable steps for effective self-management. Future PEMs should include step-by-step instructions, visual aids, and simplified language to better engage patients and support self-management behaviours. Improving these aspects can empower both Indigenous and general population patients to manage DR, reducing disease burden and promoting equitable health outcomes.

Acknowledgement

The authors would like to thank the individuals living with diabetes who generously shared their time and perspectives to evaluate a subset of the patient education materials as part of a supplementary consultation. Their insights added valuable context to this study.

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Kam Chun Ho http://orcid.org/0000-0001-9029-4329
Faran Sabeti http://orcid.org/0000-0001-9187-7569

References

1. Keel S, Xie J, Foreman J et al. The prevalence of diabetic retinopathy in Australian adults with self-reported diabetes: the national eye health survey. Ophthalmology 2017; 124: 977–984. doi: 10.1016/j.ophtha.2017.02.004
2. Gupta P, Liang Gan AT, Kidd Man RE et al. Impact of incidence and progression of diabetic retinopathy on vision-specific functioning. Ophthalmology 2018; 125: 1401–1409. doi: 10.1016/j.ophtha.2018.02.011
3. Chia MA, Taylor JR, Stuart KV et al. Prevalence of diabetic retinopathy in indigenous and non-indigenous australians: a systematic review and meta-analysis. Ophthalmology 2023; 130: 56–67. doi: 10.1016/j.ophtha.2022.07.024
4. Beaser RS, Turell WA, Howson A. Strategies to improve prevention and management in diabetic retinopathy: qualitative insights from a mixed-methods study. Diabetes Spectr 2018; 31: 65–74. doi: 10.2337/ds16-0043
5. Schreur V, van Asten F, Ng H et al. Risk factors for development and progression of diabetic retinopathy in Dutch patients with type 1 diabetes mellitus. Acta Ophthalmologica 2018; 96: 459–464. doi: 10.1111/aos.13815
6. Bryl A, Mrugacz M, Falkowski M et al. The effect of diet and lifestyle on the course of diabetic retinopathy—A review of the literature. Nutrients 2022; 14: 14. doi: 10.3390/nu14061252
7. Lopez-Olivo MA, Lin H, Rizvi T et al. Randomized controlled trial of patient education tools for patients with rheumatoid arthritis. Arthritis Care & Res 2021; 73: 1470–1478. doi: 10.1002/acr.24362
8. Shoemaker SJ, Wolf MS, Brach C. Development of the patient education materials assessment tool (PEMAT): a new measure of understandability and actionability for print and audiovisual patient information. Patient Educ Couns 2014; 96: 395–403. doi: 10.1016/j.pec.2014.05.027
9. Nash S, Arora A. Interventions to improve health literacy among aboriginal and torres strait islander peoples: a systematic review. BMC Public Health 2021; 21: 248. doi: 10.1186/s12889-021-10278-x
10. Hall Dykgraaf S, Desborough J, de Toca L et al. "A decade's worth of work in a matter of days": the journey to telehealth for the whole population in Australia. Int J Med Inf 2021; 151: 104483. doi: 10.1016/j.ijmedinf.2021.104483
11. Boroumand MA, Sedghi S, Adibi P et al. Patients' perspectives on the quality of online patient education materials: a qualitative study. J Educ Health Promot 2022; 11: 402. doi: 10.4103/jehp.jehp_1127_21
12. Ramagiri R, Kannuri NK, Lewis MG et al. Evaluation of whether health education using video technology increases the uptake of screening for diabetic retinopathy among individuals with diabetes in a slum population in Hyderabad. Indian J Ophthalmol 2020; 68: S37–S41. doi: 10.4103/ijo.IJO_2028_19
13. Scanlon PH, Aldington SJ, Stratton IM. Epidemiological issues in diabetic retinopathy. Middle East Afr J Ophthalmol 2013; 20: 293–300. doi: 10.4103/0974-9233.120007
14. Wang E, Kalloniatis M, Ly A. Assessment of patient education materials for age-related macular degeneration. Ophthalmic Physiol Opt 2022; 42: 839–848. doi: 10.1111/opo.12991
15. Kloosterboer A, Yannuzzi NA, Patel NA et al. Assessment of the quality, content, and readability of freely available online information for patients regarding diabetic retinopathy. JAMA Ophthalmol 2019; 137: 1240–1245. doi: 10.1001/jamaophthalmol.2019.3116
16. Novin S, Konda SM, Xing B et al. Diabetic retinopathy online: a powerful opportunity for revision. J Consum Health Internet 2020; 24: 251–268. doi: 10.1080/15398285.2020.1791668
17. Mastroianni F, Chen YC, Vellar L et al. Implementation of an organisation-wide health literacy approach to improve the understandability and actionability of patient information and education materials: a pre-post effectiveness study. Patient Educ Couns 2019; 102: 1656–1661. doi: 10.1016/j.pec.2019.03.022
18. Statista. Worldwide market share of search engines from January 2010 to August 2024. 2024.
19. Australian Public Service Commission. First nations vocabulary: using culturally appropriate language and terminology. 2024.
20. Matthijs N, Radlinski F. Personalizing web search using long term browsing history. In. Proceedings of the fourth ACM international conference on Web search and data mining. Hong Kong, China: Association for Computing Machinery, 2011. p 25–34.
21. Horsman G. A process-level analysis of private browsing behaviour: a focus on Google chromes incognito mode. *In 2017 5th International Symposium on Digital Forensic and Security (ISDFS)*; 26–28 April 2017; Tirgu Mures, Romania.
22. Iqbal M, Khalid MN, Manzoor DA et al. Search engine optimization (SEO): a study of important key factors in achieving a better search engine result page (SERP) position. Sukkur IBA J Comput Math Sci 2022; 6: 1–15. doi: 10.30537/sjcms.v6i1.924
23. Agency for healthcare res and qual. The patient educ mater assess tool (PEMAT). 2024
24. Kang SJ, Lee MS. Assessing of the audiovisual patient educational materials on diabetes care with PEMAT. Public Health Nurs 2019; 36: 379–387. doi: 10.1111/phn.12577

25. Simmons L, Baker NJ, Schaefer J et al. Activation of patients for successful self-management. J Ambul Care Manage 2009; 32: 16–23. doi: 10.1097/01.JAC.0000343120.07844.a9
26. Kim S, Song Y, Park J et al. Patients' experiences of diabetes self-management education according to health-literacy levels. Clin Nurs Res 2020; 29: 285–292. doi: 10.1177/1054773819865879
27. Lipari M, Berlie H, Saleh Y et al. Understandability, actionability, and readability of online patient education materials about diabetes mellitus. Am J Health Syst Pharm 2019; 76: 182–186. doi: 10.1093/ajhp/zxy021
28. Cohen SM, Baimas-George M, Ponce C et al. Is a picture worth a thousand words? A scoping review of the impact of visual aids on patients undergoing surgery. J Surg Educ 2024; 81: 1276–1292. doi: 10.1016/j.jsurg.2024.06.002
29. Deshpande N, Wu M, Kelly C et al. Video-based educational interventions for patients with chronic illnesses: systematic review. J Med Internet Res 2023; 25: e41092. doi: 10.2196/41092