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Management Of Digital Technologies In The Care Of Patients With Diabetes Mellitus In Australia: A Scoping Review

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ABSTRACT
Objective: To map the evidence on managing Digital Technologies in caring for patients with Diabetes Mellitus in Australia: a Scoping Review. Method: Scope review, based on the method described in the JBI (Joanna Briggs Institute) and PRISMA-ScR (Preferred Reporting Items for Systematic Reviews and Meta-Analyses – Scoping Reviews) Manual, containing academic articles published between 2017 and 2022 of 3 databases. A guiding question for the study was determined using the mnemonic PCC (Population, Concept, and Context). The articles were independently evaluated by two reviewers who carried out the screening and selection steps of the studies according to the guiding question and the criteria determined by the team. The characterizations of the articles included in this study are presented in figures and tables. It ended with narrative syntheses, discussion, and conclusions. Results: The database search resulted in 145 articles. After the screening and selection steps, 24 articles were analyzed in this scoping review. The analysis of these articles revealed that using Digital Technologies in caring for patients with Diabetes Mellitus in Australia is still a challenge, an essential obstacle to optimal functioning from the health systems perspective. The use of different types of digital technology was verified, with their characteristics and results. It was observed that barriers prevent patient adherence and engagement, which can significantly hinder digital health actions for diabetic patients in Australia. The use of digital technologies by diabetic patients in Australia is primarily by women; applications have low engagement and maintenance with insignificant results. Some positive characteristics, however, were observed, such as greater adherence and maintenance of patients in programs where there is interaction between peers, applications, and systems that help with mental health and physical activity. The main barriers include the lack of engagement or maintenance in the most diverse systems for adaptation to individuals or groups, thus suggesting customization of systems or at least adaptability to specific groups of patients based on their characteristics. Conclusion: Digital health systems and technologies must be studied and implemented to overcome the barriers that inhibit use by patients and thus achieve the expected results, both in terms of resolution and quality of life for diabetic patients, as well as issues of economics of Australia's health systems.

Keywords: *Diabetes mellitus; Telemedicine; Digital health; Medical informatics; Health informatics; m-Health; e-Health; Australia.*

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I. INTRODUCTION

Digital technologies have increasingly become powerful allies in the management of health and health systems around the world, as can be seen from studies such as those by Dahiya et al. (2022), Arafa et al. (2023), Inkster et al. (2020), Pal et al. (2023) and Sauli et al. (2023), among countless others. One of these contemporary challenges is its direction to deal with chronic diseases (Shi et al., 2024; Li et al., 2023; Zhang et al., 2024), such as diabetes mellitus (Binhowemel et al., 2023; Liang et al., 2023; Chuang & Lee, 2023). Chronic non-communicable diseases have become the leading causes of death and disability throughout the world, mainly affecting low- and middle-income countries (Marrero et al., 2012).

Science suspects that chronic non-communicable diseases are associated with several factors, from the increase in the population's life expectancy and the growing and rapid urbanization to lifestyles, such as lack of physical activity, unhealthy diet, alcoholism, and smoking (Beaglehole et al., 2008). Tackling these diseases has a very high cost, estimated at around US$47 trillion from 2010 to 2030 (Beaglehole et al., 2008; Capizzi et al., 2015). The reason for this is that diabetic patients require constant monitoring since this disease is silent (Nagrini et al., 2023; Sony et al., 2023) and multiorgan (Al-Busaidi et al., 2023; Zahid & Shakil, 2023; Sookdee & Jianbunjongkit, 2023).

Digital health management, or digital technologies for health, has become a prominent field of practice for employing routine and innovative forms of information and communication technologies (ICT) to respond to health needs. The term digital health has its roots in eHealth, defined as the use of information and communication technologies to support health and health-related domains. Mobile health (mHealth) is a subset of eHealth and is understood as using wireless mobile technologies for health." More recently, digital health has been introduced as a comprehensive term, including phenomena from eHealth (including mHealth) to emerging areas of advanced computational sciences, such as big data, genomics, and artificial intelligence.

Type 2 diabetes is the result of ineffective use of insulin and the body's inability to produce insulin, and is responsible for approximately 90% of all diabetes diagnoses. Simple lifestyle changes such as maintaining an ideal body weight, exercising, and adopting a healthy diet are essential to managing Type 2 diabetes. However, each activity requires a substantial commitment from the diabetic patient. Self-management of an illness requires considerable knowledge, discipline, and self-regulation. For this reason, prescribed activities are not solely determined by medical factors. Characteristics of successful patients include responsibility, motivation for change, and active participation. Peer support and community resources also effectively engage patients (Deas, 2015). These appear to be the main challenges to be transposed to digital health for better outcomes with diabetic patients, especially Type II diabetics.

The Australian community has been clear about what it expects from health services today and in the future. Australians want a healthcare system that puts people first – giving more choice, control, and transparency, better access to mobile digital health services for the entire community - and not just for experienced users of new technologies; they want their health information to be confidential and secure, protected from cyber criminals and any unauthorized access, as healthcare providers have been equally clear; want secure digital services that provide immediate access to a patient's information - especially in an emergency, support early diagnosis and better disease management, as well as the development of new medicines and treatments; and they want technology to reduce their administrative burden so they can spend more time with patients (Australia, 2022). Therefore, reviewing the literature in this area provides a multifaceted approach to understanding digital health and its roles in improving healthcare quality. This understanding is essential because the literature has reported that innovative digital technology contributes to healthcare quality in several ways and at a significantly accelerated rate (Ibrahim et al., 2022).

Although there are studies on the use of digital technologies in the care of diabetic patients, to date, no satisfactory model has definitively resolved this issue. Studies that use the most diverse forms of digital technology, such as eHealth, mHealth, monitors, and wearables, among others, have shown promise but are still far from the ideal result, requiring constant updating and continued mapping of new evidence that supports advances in this area. Because of this, this study aimed to map the evidence of the use of digital technologies in the health care of diabetic patients in Australia to understand and establish the level of evolution in that country.

II. METHODS

This is a scoping review conducted based on the methodological framework developed by the Joanna Briggs Institute (Aromataris & Munn, 2020) and the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews checklist (Tricco et al., 2018). According to the proposed methodological basis, this review was developed in five stages (Aromataris & Munn, 2020; Tricco et al., 2018): (1) identification of the research question; (2) bibliographical survey to search for relevant studies; (3) selection of studies, according to the criteria defined in this review; (4) data mapping; and (5) presentation of results.

Data collection

For the first stage, identifying the research question, the mnemonic PCC (Population, Concept, and Context) was used, according to the study by Aromataris and Munn (2020): the letter P (Population) was defined as patients with Diabetes Mellitus, the first letter C (Concept) was defined as the use of digital technologies in healthcare and the second C (Context) was established as Australia. Therefore, the guiding question of this article was the following: What is the evidence in recent literature on the use of Digital Technologies in the care of patients with Diabetes Mellitus in Australia?

The authors determined the creation of the query (step 2) based on an initial search in the Pubmed database. The search strategy was built with specific words related to the topic in natural language and Boolean operators AND and OR to obtain a broad spectrum of results in different databases. The searches took place on August 29, 2022, in the Pubmed, Web of Science, and Scopus databases. In the databases researched, the structuring presented in Table 1 was used.

Table 1 - Search strategy table used for document retrieval.

	Population	Concept	Context
Extraction	Chronic patients with Diabetes Mellitus	Use of digital technologies in health	Australia
Conversion	Diabetes Mellitus, except for Gestational Diabetes	Digital technologies in health	Australia
Construction	diabetes OR diabetic OR "diabetic patient" AND NOT (gestat* OR pregn*)	"telemedicine" OR "Digital health" OR "ehealth" OR "telehealth" OR "telemonitoring" OR "health informatics" OR "e-health" OR "m-health" OR "mhealth" OR "medical informatics" OR "informatics" OR "telehealth" OR "Teleconsulting"	"Australi*"
Pubmed Base Final Consultation	((("telemedicine"[Title/Abstract] OR "Digital health"[Title/Abstract] OR "ehealth"[Title/Abstract] OR "telehealth"[Title/Abstract] OR "telemonitoring"[Title/Abstract] OR "health informatics"[Title/Abstract] OR "e-health"[Title/Abstract] OR "m-health"[Title/Abstract] OR "mhealth"[Title/Abstract] OR "medical informatics"[Title/Abstract] OR "informatics"[Title/Abstract] OR "telehealth"[Title/Abstract] OR "Teleconsulting"[Title/Abstract]) AND (diabet*[Title/Abstract])) AND (austral*[Title/Abstract])) NOT (gestat* OR pregn*)		
Scopus Base Final Consultation	(TITLE-ABS-KEY ("telemedicine" OR "Digital health" OR "ehealth" OR "telehealth" OR "telemonitoring" OR "health informatics" OR "e-health" OR "m-health" OR "mhealth" OR "medical informatics" OR "informatics" OR "telehealth" OR "Teleconsulting")) AND (TITLE-ABS-KEY (diabetes OR diabetic OR "diabetic patient")) AND (TITLE-ABS-KEY (australi*)) AND NOT (TITLE-ABS-KEY (pregn* OR gestat*)) AND (LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017)) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (PUBSTAGE , "final"))		
Final Consultation Web of Science Base	(((AB=("telemedicine" OR "primary health care informatics" OR "telehealth" OR "Digital health" OR "ehealth" OR "telehealth" OR "telemonitoring" OR "health informatics" OR "e-health" OR "m-health" OR "mhealth" OR "medical informatics" OR "informatics" OR "mobile" OR "Teleconsulting")) AND AB=(diabetes)) AND AB=(australia)) NOT ALL=(gestat* OR pregn*)		

Source: Prepared by the authors.

Eligibility Criteria

As eligibility criteria for this scoping review, the following were established: publications of patients with Diabetes Mellitus (excluding studies related to Gestational Diabetes) carried out using digital technologies in the last five years, written in English, related to Australia and in which they were the use of Digital Technologies in Health care was addressed. Regarding the type of study, primary and secondary, empirical, quantitative, and qualitative research of any design or methodology was chosen, excluding reviews. Book articles, letters to the editor, summaries in event annals, incomplete articles, pilot studies, non-systematized articles, and studies without definitive results were excluded. After the search, the retrieved articles were exported to the Zotero reference manager, and from this manager, they were exported to the Rayyan reference manager (Elmagarmid et al., 2014; Ouzzani et al., 2016) for the selection of studies to be included in this review as described in step 3.

Duplicates were removed. The two authors screened the remaining articles; based on the titles and abstracts, articles that answered three questions were selected: (1) this article has patients with Diabetes Mellitus as one of its main subjects. (2) does the article discuss health care in Australia? (3) does it meet the inclusion criteria? Moreover, (4) does the article mention using Digital Technologies in Health care? If the reference in question met these criteria, it was considered chosen for the next study phase. The two authors analyzed the data as independent reviewers, blinding each reviewer's interventions, and disagreements and doubts were resolved by consensus after discussion. The texts of the chosen studies were retrieved in total, and a first mapping was carried out in an Excel spreadsheet. The retrieved studies were then analyzed by reading the texts by both researchers.

A rigorous relevance analysis was then applied regarding the criteria chosen during this analysis of the completeness of the chosen studies. The reasons for selection or discard were noted in an Excel spreadsheet exclusively by each researcher. Differences were then resolved by consensus after a case-by-case discussion. The final selection of articles included for the definitive writing of this review then took place. Those selected were then mapped (step 4) in a table by Article number, Journal, Authors, Title, Database, Year of Publication, Study Design, Sampling, and Types of Digital Health Technologies used by the authors Table 2.

Table 2. Description of articles included in the review.

No.	Journal	Authors, Year	Title	Design	Sampling	Telemedicine Item
01	Health Promotion Journal of Australia	Freeman et al. (2022)	Barriers to digital health services among people living in areas of socioeconomic disadvantage: Research from hospital diabetes and antenatal clinics	Mixed method, with quantitative descriptive analysis and qualitative analysis	37 patients from a diabetes clinic and 99 from an antenatal clinic, adult men and women	e-Health, mHealth, telemedicine, EHR, and other resources that require digital access
02	Plos One	Ryan et al. (2021)	Identifying critical features of type two diabetes prevention interventions: A Delphi study with key stakeholders	Delphi	38 end users and 38 experts	Telemedicine and digital health (e-health) related to physical activity, diet, mental health, functional health literacy, access to health services, behavioral change, and environmental strategies 52 characteristics of these items were mentioned
03	BMJ Open	Li et al. (2021)	Effect of a smartphone application (Perx) on medication adherence and clinical outcomes: A 12-month randomized controlled trial	Randomized clinical trial	124 adult diabetic patients of both sexes (62 control and 62 intervention)	mHealth
04	Journal of Medical Internet Research	Yin et al. (2021)	How patient work changes over time for people with multimorbid type 2 diabetes: Qualitative study	Qualitative study	26 adult patients of both sexes with type II DM	Telemedicine, eHealth, mHealth, and wearables Miscellaneous: Step counter; applications for DM; medication reminder apps; digital glucose monitoring; digital prescription; alarms about symptoms; education; psychological support via telephone; scheduling and tele consultations
05	Internal Medicine Journal	Pang et al. (2021)	Management of diabetes-related foot disease in the outpatient setting during the COVID-19 pandemic	Longitudinal survey	419 adult diabetic patients of both sexes participating in Diabetes Feet Australia (DFA)	Tele consultation by video or telephone
06	Diabetes Research and Clinical Practice	Anderson et al. (2021)	International feasibility study for the women's wellness with type 2 diabetes program (WWDP): An eHealth-enabled 12-week intervention program for midlife women with type 2 diabetes	Randomized clinical trial	70 middle-aged women	eHealth and telenursing consultations
07	Journal of Medical Internet Research	Gong et al. (2020)	My diabetes coach, a mobile app-based interactive conversational agent to support type 2 diabetes self-management: randomized effectiveness-implementation trial	Randomized clinical trial	187 adults of both sexes with type II DM (93 intervention and 94 control)	App-Based Interactive Conversational Agent
08	JMIR mHealth and uHealth	Baptista et al. (2020)	Acceptability of an embodied conversational agent for type 2 diabetes self-management education and support via	Mixed method, with quantitative descriptive analysis and	93 adults of both sexes with type II DM (participants in another study, a randomized clinical trial)	App-Based Interactive Conversational Agent

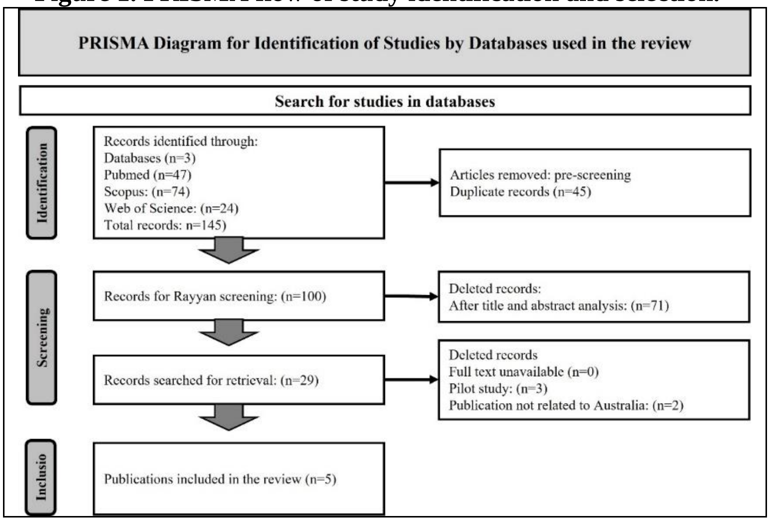
			a smartphone app: Mixed methods study	qualitative analysis		
09	Journal of Medical Internet Research	Flitcroft et al. (2020)	The demographic representativeness and health outcomes of digital health station users: Longitudinal study	Longitudinal study	180,442 adults of both sexes using Sisu digital health stations (5.18% type I or type II diabetics)	Digital Health Station
10	JMIR mHealth and uHealth	Adu et al. (2020)	User retention and engagement with a mobile app intervention to support self-management in Australians with type 1 or type 2 diabetes (my care hub): Mixed methods study	Mixed method, with quantitative descriptive analysis and qualitative analysis	42 diabetic adults of both sexes from Australia	mHealth
11	International Journal of Environmental Research and Public Health	Adu et al. (2020)	Efficacy and acceptability of My Care Hub mobile app to support self-management in Australians with type 1 or type 2 diabetes	Mixed method, with quantitative descriptive analysis and qualitative analysis	41 diabetic adults of both sexes from Australia	mHealth
12	Journal of Medical Internet Research	Fletcher et al. (2019)	Recruiting to a randomized controlled trial of a web-based program for people with type 2 diabetes and depression: Lessons learned at the intersection of e-mental health and primary care	Quantitative analysis	740 adult diabetics of both sexes in Australia	e-Health (Facebook, Internet searches, others)
13	Diabetes Technology and Therapeutics	Trawley et al. (2017)	The Use of Mobile Applications among Adults with Type 1 and Type 2 Diabetes: Results from the Second MILES - Australia (MILES-2) Study	Cross-sectional study	1589 type I and II people with diabetes of both sexes from Australia	mHealth
14	Journal of Telemedicine and Telecare	Menon et al. (2017)	A comparison of characteristics of patients seen in a tertiary hospital diabetes telehealth service versus specialist face-to-face outpatients	Cross-sectional study	188 adult patients with type I and type II diabetes of both sexes in Australia	Telemedicine (teleconsultation)
15	Preventive Medicine	Plotnikoff et al. (2017)	Integrating smartphone technology, social support, and the outdoor physical environment to improve fitness among adults at risk of, or diagnosed with, Type 2 Diabetes: Findings from the 'eCoFit' randomized controlled trial	Randomized clinical trial	84 adult patients of both sexes with type II diabetes (42 interventions and 42 control)	mHealth
16	Journal of Medical Internet Research	Middleton et al. (2021)	An enhanced SMS text message-based support and reminder program for young adults with type 2 diabetes (TEXT2U): randomized controlled trial	Randomized clinical trial	40 adults of both sexes with type II diabetes in Australia	SMS
17	JMIR Diabetes	Baptista et al. (2020c)	User experiences with a type 2 diabetes coaching app: qualitative study	Qualitative study	19 adults of both sexes with type II diabetes in Australia	App-Based Interactive Conversational Agent
18	JMIR formative research	Maharaj et al. (2021)	Comparing two commercially available diabetes apps to explore challenges in user engagement: Randomized controlled feasibility study	Controlled Feasibility Study	58 adults of both sexes with type 2 diabetes in Australia	mHealth
19	JMIR diabetes	Ng et al.	Transitional needs of	Randomized	13 young adult	eHealth and mHealth

		(2017)	Australian young adults with type 1 diabetes: Mixed methods study		individuals with type I diabetes in Australia	
20	BMJ open	Tahhan et al. (2020)	Evaluating the cost and wait times of a task-sharing model of care for diabetic eye care: A case study from Australia	Mixed method, with quantitative descriptive analysis and qualitative analysis	133 diabetic patients referred for DM-related ophthalmological care	virtual review of exams via telemedicine
21	Digital Health	Ng et al. (2019)	A mHealth support program for Australian young adults with type 1 diabetes: A mixed methods study	Retrospective audit of medical and financial records	34 young adult subjects with type I diabetes in Australia	mHealth and eHealth (Facebook)
22	BJGP open	Imai et al. (2022)	Telehealth use in patients with type 2 diabetes in Australian general practice during the COVID-19 pandemic: a retrospective cohort study	Mixed method, with quantitative descriptive analysis and qualitative analysis	57916 type II diabetes patients of both sexes from Australia	Telemedicine (telephone or video conferencing)
23	JMIR mHealth and uHealth	Buss et al. (2022)	Mobile health use by older individuals at risk of cardiovascular disease and type 2 diabetes mellitus in an Australian cohort: Cross-sectional survey study	Retrospective cohort	267,153 participants aged 45 years or over from Australia of both sexes with type I and type II diabetes	mHealth, eHealth, and wearables
24	Frontiers in Digital Health	Galliford et al. (2022)	Patient work personas of type 2 diabetes: A data-driven approach to persona development and validation	Cross-sectional analysis	23 elderly type II diabetics of both sexes from Australia	Wearable Cameras

Source: data collected by the authors.

Figure 1 demonstrates the identification, screening, and inclusion process of studies by the recommendations of PRISMA-ScR (PRISMA) and was developed by the authors according to the Template proposed by PRISMA-ScR.

Figure 1. PRISMA flow of study identification and selection.



Source: prepared by the authors.

After reading the articles in full and selecting them, a manual search was carried out for the data items that comprised this article's objective and were by the selection criteria. After this selection, the results were tabulated for mapping and analysis of the characterization of the selected studies according to their Article Number, Journal, Authors, Title, Database, Year of Publication, Study Design, Sampling, and Types of Digital Health Technologies used by the authors in Diabetes Mellitus care in Australia, as shown in Table 2. These results were then synthesized with the following information: Number, Authors, Year of Publication, Objectives, and

Results relating to the subjects chosen by the team for this scoping review, presented in Table 3. Distribution analyses by year, type of study design that were carried out, and technologies used are contained in graphs 1, 2, and 3.

Table 3 - Summary of articles mapped according to the objectives and main results identified in Diabetes Mellitus care in Australia from 2017 to 2022.

No.	Authors (Year)	Goals	Results
01	Freeman et al. (2022)	A study carried out among patients treated at two hospitals in socioeconomically disadvantaged suburban areas in South Australia seeks to understand: 1. To what extent could patients in diabetes and prenatal clinics access, use, and benefit from digital health services? and 2. What were the most common factors influencing your access, use, or benefits of digital health services?	There are socioeconomic barriers to access, use, and ability to benefit from digital health strategies, which means not everyone can benefit from digital health services. And? As COVID-19 accelerates the shift to digital health services, people at a socioeconomic disadvantage may be excluded. If barriers to access and use are not addressed, they exacerbate growing health inequalities.
02	Ryan et al. (2021)	This study aims to identify critically essential characteristics of digital type 2 diabetes mellitus (T2DM) prevention interventions.	Key findings include, firstly, that digital tools are needed to help the target population improve their levels of physical activity, diet, mental health, and functional health literacy, which includes their ability to manage their health and knowledge of health systems. Fifty-two critical intervention characteristics were identified. Future interventions should address diet, physical activity, mental health, and functional health literacy while moving toward supporting behavior change.
03	Li et al. (2021)	To determine whether the Perx app improves medication adherence and clinical outcomes over 12 months compared to standard care in patients requiring polypharmacy.	This study provides preliminary evidence that app-based behavior change interventions can increase medication adherence and produce long-term improvements in some clinical outcomes in adults managing chronic illnesses with polypharmacy. These interventions may be particularly effective for people with obesity, taking medications for type 2 diabetes, and for people taking relatively fewer medications.
04	Yin et al. (2021)	Investigate how patient work evolves for those living with type 2 diabetes mellitus and chronic multimorbidity and explore implications for digital support system design.	Profile changes over time. There are still gaps in our understanding of how patient health goals change at different stages of their health, how different patients have different disease trajectories, and how digital health applications can adjust to these changes over time. The findings revealed four different trajectories, resulting in different patient work goals. Patients who have never experienced an exacerbation of the disease, those who lived through cycles of crisis and recovery, participants currently experiencing a decline in health, and those diagnosed during severe crises. This study highlights opportunities for the health informatics and design communities to explore the unexplored space of designing for time and trajectory, where future research should incorporate an individual's evolving healthcare experiences when designing digital technologies.
05	Pang et al. (2021)	To describe the adherence of patients with diabetic foot to remote podiatry consultations	Adherence of more than 80% of patients with good acceptability. Patients felt that telephone consultations were effective; however, they preferred to participate in face-to-face consultations due to the severity of the cases and the need for physical intervention in most situations.
06	Anderson et al. (2021)	To examine the feasibility of participant recruitment and retention rates for the Women's Wellness with Type 2 Diabetes (WWDP) program and evaluate the program's initial effectiveness in improving wellness outcomes.	Good retention rates and initial efficacy results indicated the viability of WWDP as a promising 12-week health and wellness program for women with T2DM. They suggest that incorporating a focus on self-efficacy and gender information may be necessary for improving well-being and health outcomes related to grief and menopause.
07	Gong et al. (2020)	To evaluate the adoption, use, and effectiveness of the My Diabetes Coach (MDC) program, an app-based interactive conversational agent, Laura, designed to support diabetes self-management in the home environment over 12 months.	Compared to the baseline, the estimated mean HbA1c (Glycosylated Hemoglobin) decreased in both arms at 12 months (intervention: 0.33% and control: 0.20%), but the net differences between the two arms in a change of HbA1c (-0.04%, 95% CI -0.45 to 0.36; P = 0.83) was not statistically significant. At 12 months, HRQOL (Health-Related Quality of Life) utility scores improved in the intervention arm compared with the control arm (difference between arms: 0.04, 95% CI 0.00 to 0. 07; P = 0.04).
08	Baptista et al. (2020)	To evaluate the acceptability of the Conversational Agent (Laura) used to provide diabetes self-management education and support on the My	The findings suggest that a Conversational Agent is an acceptable means of providing T2D self-management education and support. A human character who provides ongoing, friendly, non-judgmental, emotional, and motivational support is well-received.

		Diabetes Coach (MDC) app.	However, ECA can be improved by increasing the congruence between its verbal and nonverbal communication and accommodating user preferences.
09	Flitcrof et al. (2020)	To evaluate the demographic representation of users of health centers, identify factors associated with repeated use of health centers, and determine whether the health status of repeat users changed between the initial and final consultation.	Important demographic survey of users of digital health stations in Australia. These findings provide valuable insights into the benefits of digital health stations for self-monitoring and partially support previous research on the effect of demographics and health status on health self-management.
10	Adu et al. (2020)	Assess Participant Retention and Engagement with My Care Hub, a Diabetes Self-Management Mobile App	Results from this short-term intervention study suggested acceptable levels of participant retention and engagement with My Care Hub, indicating that it may be a promising tool for extending DSM support and education beyond the confines of a physical clinic.
11	Adu et al. (2020)	To evaluate the preliminary effectiveness and user acceptance of the My Care Hub (MCH) mobile application - developed to provide evidence-based support and education about the	Interview results revealed that the app reinforced knowledge and provided motivation to participate in diabetes self-management activities. The study suggested a positive impact of the My Care Hub app on diabetes self-management and acceptability by patients. More large-scale, long-term studies are needed to confirm these promising results.
12	Fletcher et al. (2019)	diabetes self-management (DSM)	Key barriers to general practice recruitment included perceived mismatch between the study design and the diabetes population, prioritization of acute health problems, and disruptions caused by events at the practice and community level. Participants recruited through the three different approaches differed in age, gender, employment status, depressive symptoms, and diabetes distress, with online participants being distinguished from those recruited through general practice or other sources. However, most differences reached only a small effect size and are unlikely to be clinically significant. Conclusions: Time, labor, and cost-intensive efforts did not translate into successful recruitment through general practice in this case, with barriers identified at several different levels. Online recruitment yielded more participants, broadly similar to those recruited through general practice.
13	Trawley et al. (2017)	To investigate the frequency of use of diabetes-specific apps in a sample of adults in Australia with T1D or T2D, including the app's name and reasons for use and non-use. A secondary aim was to investigate associations between diabetes-specific apps and markers of physical health, self-management, and emotional well-being.	Among adults with DM1, 24% (n = 188) reported using apps, with carbohydrate counting (74%; n = 139) being the most cited objective. App use was significantly associated with shorter diabetes duration, more frequent glucose monitoring, and lower self-reported HbA1c. Among adults with DM2, 8% (n = 64) reported using apps, with glucose monitoring (62%; n = 39) being the most common objective. For all respondents, the most commonly reported reason for not using apps was the belief that they could not help with diabetes self-management. A minority of adults with T1D and T2D use apps to support their self-management. App use among adults with T1D is associated with a more recent T1D diagnosis, more frequent glucose monitoring, and lower self-reported HbA1c.
14	Menon et al. (2017)	To describe the characteristics of patients who attend the diabetes telehealth service at a tertiary hospital and compare them with those who attend face-to-face consultations at the outpatient diabetes service at the same hospital.	Patients with type 2 diabetes mellitus in the diabetes telehealth service group had a higher mean glycated hemoglobin of 9.1% (76 mmol/mol) vs 8.1% (65 mmol/mol) in the diabetes outpatient service group. The diabetes telehealth service had more people with initial consultations, had higher rates of self-reported smoking in patients with type 2 diabetes mellitus, and had adequate access to allied health supports as recommended for diabetes management. Diabetes telehealth service patients had more complex diabetes, as evidenced by a higher proportion of Indigenous clients, higher glycated hemoglobin, and longer average duration of diabetes.
15	Plotnikoff et al. (2017)	Develop, implement, and evaluate a physical activity intervention through the eCoFit App to improve aerobic and muscular fitness among adults at risk for or diagnosed with T2D.	After ten weeks, significant group-by-time effects were observed for aerobic and muscular fitness (lower body). Intervention effects for secondary outcomes included significantly increased physical activity (1330 steps/week), improved upper body muscular fitness, improved functionality, reduced waist circumference (2.8 cm), and systolic blood pressure (- 10.4 mm Hg). After 20 weeks, significant effects were observed on lower-body muscular fitness and health outcomes. eCoFit is an innovative lifestyle intervention that integrates smartphone technology, social support, and the outdoor environment to improve aerobic and muscular fitness.
16	Middleton et al. (2021)	To examine the effectiveness of an enhanced SMS text messaging-based support and reminder program to improve clinic attendance, metabolic control, engagement in self-management, and psychological health	There were no differences between groups in Glycated Hemoglobin, BMI, lipids, or availability of pathology data and Digital Glucose. The odds of recording an improvement in the Diabetes Empowerment Scale–Short Form score was more significant in the intervention group at six months (odds ratio 4.3, 95% CI 1.1-17), with this effect attenuating at the end of the study

		in young-onset type 2 diabetes.	(OR 3.1, 95% CI 0.9-11). Acceptability of the program was high; >90% of participants would recommend the program to new patients. An enhanced SMS text message-based support and reminder program doubled scheduled clinical care rates for patients with early-onset type 2 diabetes. The program was highly acceptable and provided early support for patient empowerment but had no significant effect on metabolic control or self-management measures.
17	Baptista et al. (2020c)	Explore users' real-world experiences with the My Diabetes Coach (MDC) self-management app.	Two themes were constructed from the interview data: (1) the moderating effect of diabetes self-management styles on needs, preferences, and expectations and (2) factors influencing users' engagement with the app: one size does not fit all. User characteristics, use context, and application features interact and influence engagement. Promoting engagement is vital for diabetes self-management apps to complement clinical care in supporting optimal self-management.
18	Maharaj et al. (2021)	To investigate differences in user engagement between 2 commercially available apps (free versions of Glucose Buddy and mySugr) over two weeks in adults with type 2 diabetes.	No changes in self-care or illness beliefs were observed in either group. Of the self-care behaviors, only the blood glucose test was significantly associated with minutes of app use (P=0.02). Interviews suggested that although both applications were considered acceptable, they were generally seen as time-consuming and too complicated to use. The low engagement with Glucose Buddy and mySugr reflects the challenges associated with engaging users with diabetes apps. Due to low engagement and loss of follow-up, changes in outcome measures should be interpreted with caution. The results highlight the need for more clinical support and involvement of end users and behavior change experts to incorporate evidence-based behavior change techniques.
19	Ng et al. (2017)	Identify the health and wellbeing needs of young Australian adults aged 18-35 with T1D to develop appropriate solutions to engage them in diabetes self-management.	Diabetes education and service needs for young adults with T1D are related to improving access to existing diabetes education programs and services with credible informational resources and personalized advice on diabetes management. Participants especially valued relevant, real-time information and opportunities for peer support, particularly from web-based platforms. These findings also support the use of diabetes education programs or services offered online through mHealth systems in this population.
20	Tahhan et al. (2020)	To determine whether a collaborative model of care that uses task sharing for managing low-risk diabetic retinopathy, Community Eye Care (C-EYE-C), can improve access to care and better use of resources compared to hospital care.	This study showed that collaborative eye care reduced patient waiting time (15 weeks less) and considerable cost savings (43%) while maintaining a high standard of patient care compared to traditional hospital care in managing low-risk hospital referrals with diabetic eye disease. Improved access and reduced costs were primarily the result of better allocation of tasks through greater use of primary care professionals to provide services to low-risk patients.
21	Ng et al. (2019)	This article presents findings, by STROBE guidelines, on the usability and acceptability of a patient-informed mHealth support program (Diabetes YES) developed for young adults with T1D.	Participants rated the site favorably for its ease of navigation and easy understanding of the information. Web page visits decreased markedly, while peer support group engagement via Facebook remained consistent throughout the intervention. Participants used weekly discussion threads to generate conversations within the peer support group. Emotional support from peers was the benefit most considered by participants. Diabetes YES is an example of a mHealth support program that has been readily embraced by young adults living with T1D. Feasibility studies are an essential formative step in implementing mHealth programs in conventional healthcare.
22	Imai et al. (2022)	Per guideline recommendations, evaluate the uptake of telehealth consultations and associated patient characteristics in Australian general practice, including frequency of hemoglobin A1c (HbA1c) testing and change in HbA1c levels by use of telehealth.	Of the 57,916 patients, 80.8% had telehealth consultations during the pandemic. Telehealth consultations were positively associated with T2DM patients who were older, female, had chronic kidney disease (CKD), prescribed antidiabetic medications, and lived in remote areas. No significant difference was found in 6-month HbA1c tests and HbA1c levels between telehealth users and patients who had in-person appointments only.
23	Buss et al. (2022)	To evaluate the use of mHealth apps among older Australians and those at risk of cardiovascular disease or type 2 diabetes mellitus.	Key findings: The overall aim of this analysis was to understand how older Australians generally, particularly those at risk of CVD or T2D, use mHealth. To our knowledge, this is the first study of its kind in Australia. Among the at-risk population, the proportion of mHealth users was slightly higher than the overall proportion. Multivariate logistic regression analysis showed that women, younger people, individuals without disabilities, and those with higher incomes were more likely to use mHealth. Among mHealth users, there were fewer smokers and fewer people with high blood pressure or physical disabilities. Conversely, among those who did not use mHealth, fewer people were overweight, and fewer reported

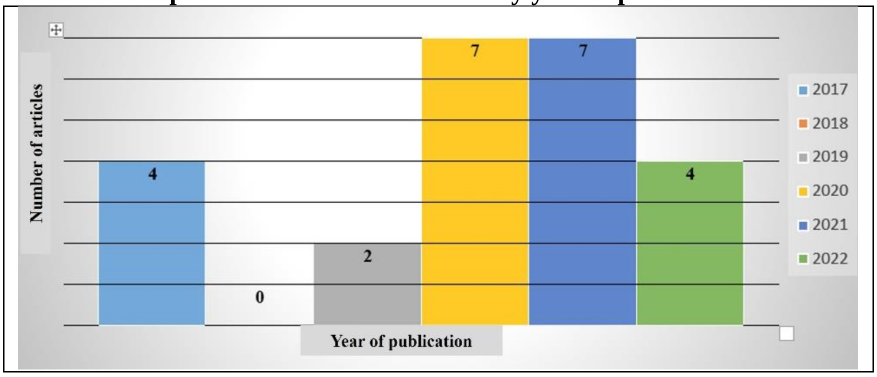
			a family history of CVD or T2D. According to the results, people at risk of CVD or DM2 are no more likely to use mHealth than those without risk.
24	Galliford et al. (2022)	Make the persona development process more transparent and generate accurate, relevant personas based on patient data. Validate personas by obtaining feedback from patients who contributed the data and by using a cohort in a different country and setting, thus understanding the representativeness of these personas and specific components for both cohorts.	The original participants and the independent online cohort reported that the personas accurately represented their patient work routines. For the independent online cohort, 74% (97/131) indicated that people stratified according to their exercise levels and diet control were like their patients' work routines. Personas for a specific purpose can be accurate if developed from real-life data—the personas maintained accuracy even when tested against an independent cohort, demonstrating their generalizability. Our data-driven approach has clarified the often-non-transparent process of persona development and validation, suggesting that it is possible to systematically identify whether persona components are accurate. Moreover, which aspects require more personalization and customization?

Source: data collected by the authors.

III. RESULTS

The search identified 145 potentially relevant studies in the two databases consulted, Pubmed, Web of Science, and Scopus; 45 were removed because they were duplicates. One hundred records were then analyzed by title and summary with pre-established criteria, eliminating 71 articles in this stage. The next step was the recovery of the complete manuscripts of the remaining 29 articles. The two researchers read the articles in full independently and were classified as eligible or not. Five articles were discarded at this stage, leaving 24 articles selected for this analysis to compose the sample (Figure 1). All articles were written in Australia. All were in English and distributed over time: 4 articles in 2017, no articles in 2018, 2 articles in 2019, seven articles in 2020, 7 articles in 2021, and 4 articles in 2022 (Graph 1).

Graph 1. Distribution of articles by year of publication.

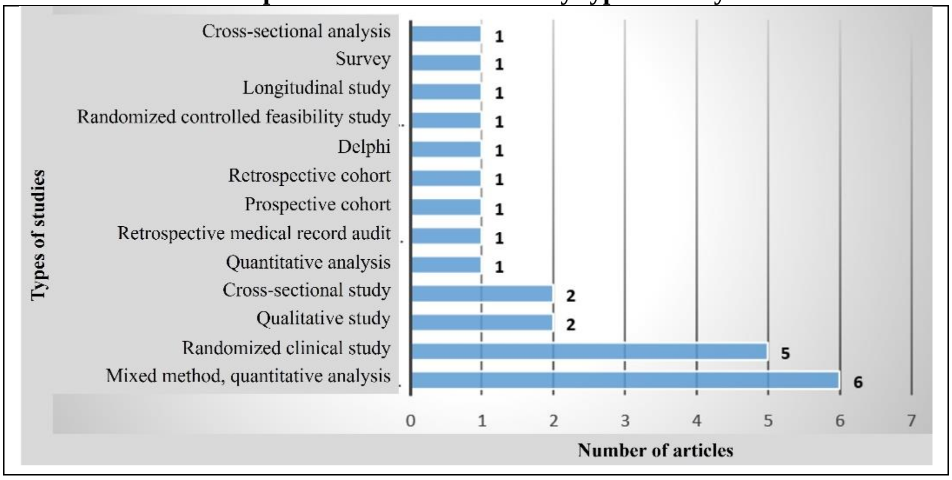


Source: Data collected by the authors.

As for the journals, they were not limited to those specific to the areas of endocrinology and diabetes or health information technology. The journals cited were the following: BJGP open (Imai et al., 2022), BMJ open (Imai et al., 2022; Li et al., 2021; Tahhan et al., 2020), Diabetes Research and Clinical Practice (Anderson et al., 2021), Diabetes Technology and Therapeutics (Trawley et al., 2017), Digital Health (Ng et al., 2019), Frontiers in Digital Health (Galliford et al., 2022), Health Promotion Journal of Australia (Freeman et al., 2022), Internal Medicine Journal (Pang et al., 2021), International Journal of Environmental Research and Public Health (Adu et al., 2020), JMIR diabetes (Baptista et al., 2020c; Ng et al ., 2017), JMIR formative research (Maharaj et al., 2021), JMIR mHealth and uHealth (Adu et al., 2020; Baptista et al., 2020; Buss et al., 2022), Journal of Medical Internet Research (Fletcher et al., 2019; Flitcroft et al. 2020; Gong et al., 2020; Middleton et al., 2021; Yin et al., 2021), Journal of Telemedicine and Telecare (Menon et al., 2017), Plos One (Ryan et al., 2021) and Preventive Medicine (Plotnikoff et al., 2017).

This diversity of journals demonstrates the multifaceted characteristics of Diabetes Mellitus and the challenges arising from this characteristic. The studies analyzed were mixed method, quantitative and qualitative analysis (Adu et al., 2020, 2020; Baptista et al., 2020; Freeman et al., 2022; Ng et al., 2017, 2019), randomized clinical trial (Anderson et al., 2021; Gong et al., 2020; Li et al., 2021; Middleton et al., 2021; Plotnikoff et al., 2017), qualitative study (Baptista et al., 2020c; Yin et al ., 2021), cross-sectional study (Menon et al., 2017), quantitative analysis (Fletcher et al., 2019), retrospective audit of medical and financial records (Tahhan et al., 2020), prospective cohort (Galliford et al., 2022), retrospective cohort (Imai et al., 2022), delphi (Ryan et al., 2021), randomized controlled feasibility study (Maharaj et al., 2021), longitudinal study (Flitcroft et al., 2020), survey (Pang et al., 2021) and cross-sectional analysis (Buss et al., 2022), as shown in Graph 2.

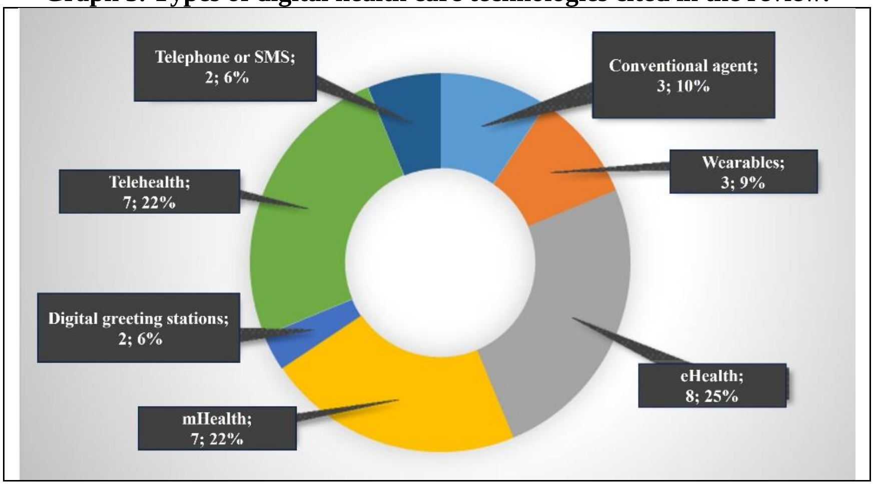
Graph 2. Number of articles by type of study.



Source: Data collected by the authors.

In all these studies, we could objectively infer the participation of 510,006 people in the sum of the samples from the selected studies, some with Diabetes Mellitus and others not (Table 2). In Table 3, the summary of evidence was mapped for an overview of the results with an emphasis on the use of digital health technologies. Several digital technologies were mentioned in the selected articles, namely conversational agents, wearables, eHealth, mHealth, digital health stations, telehealth/telemedicine, and telephone or SMS. These findings are described quantitatively in Graph 3.

Graph 3. Types of digital health care technologies cited in the review.



Source: Data collected by the authors.

IV. SUMMARY OF THE EVIDENCE

In this scoping review, we identified 24 studies addressing evidence from recent literature (2017-2022) on using digital health technologies in caring for patients with Diabetes Mellitus in Australia. The findings were found on different digital technologies and focused on different situations. In general, the use of digital health technologies in diabetes care has not yet reached sufficient maturity, evidenced by unsatisfactory results in many situations. Some characteristics found were evident in common in different situations.

Some characteristics in the use of these technologies proved to agree, such as demographic analyses of application use, with results that demonstrate greater adherence of women to digital health services in diabetes (Anderson et al., 2021; Baptista et al., 2020b; Buss et al., 2022; Flitcroft et al., 2020; Freeman et al., 2022; Imai et al., 2022). Several studies also show low engagement (or low maintenance of engagement) in the use of applications due to some barriers (Adu et al., 2020a, 2020b; Galliford et al., 2022; Maharaj et al., 2021; Middleton et al ., 2021; Ng et al., 2019). This may be due to a lack of customization of use for the patient or groups of patients (personas) (Adu et al., 2020a, 2020b; Anderson et al., 2021; Baptista et al., 2020; Galliford et al., 2022; Gong et al., 2020; Maharaj et al., 2021; Menon et al., 2017; Ng et al., 2019; Trawley et al., 2017; Yin et al., 2021). The attractiveness decreases with time using applications, whether they are reminders, conversational agents or even due to the lack of acceptable results in improving patient management (Adu et al., 2020a, 2020b; Baptista et al., 2020; Buss et al., 2022; Fletcher et al., 2019; Flitcroft et al., 2020; Freeman et al., 2022; Gong et al., 2020; Imai et al., 2022; Maharaj et al., 2021; Menon et al., 2017; Plotnikoff et al., 2017; Ryan et al., 2021), despite acceptable levels of permanence in the programs (permanence) or low perception of effectiveness on the part of the patient themselves (Pang et al., 2021; Trawley et al., 2017). However, some features can increase engagement, such as relationships with peers in groups or forums (NG et al., 2017, 2019), physical activity tracking apps (Plotnikoff et al., 2017; Ryan et al., 2021), education, mainly with up-to-date and credible information (Anderson et al., 2021; Ng et al., 2017) and mental health approaches (Li et al., 2021; Ng et al., 2017; Ryan et al., 2021).

The digital technology actions that seem to result in meaningful outcomes are the analysis of specialized exams through telemedicine, which demonstrates a significant reduction in the time to access the necessary resources and a reduction in costs (Tahhan et al., 2020). Another essential aspect to be observed is the preference of patients for face-to-face consultations, despite the acceptability of remote interventions; this may be due to demographic issues, as the age range of diabetic patients is currently high and the severity of some situations, such as example the issue of diabetic foot (Pang et al., 2021). The analysis of these studies demonstrates that the effective use of digital technologies still requires more studies so that it is possible to overcome the currently existing barriers that hinder their full use and better results.

V. CONCLUSION

This study presented a mapping of the management of digital health technologies for patients with diabetes mellitus. Due to the importance of this pathology, both in public health and in economic terms (due to a real possibility of positive interventions that improve the patient's life and reduce the cost of health services), more studies are necessary for a more robust understanding of the subject—breaking its barriers of efficiency and applicability in search of its effective implementation that can generate practical results for patients and the health systems of the countries. Demonstrating evidence of low results and low patient engagement in these technologies represents an essential challenge for everyone involved in healthcare. At the same time, positive experiences must be valued as valuable points of success analysis for implementation in technologies where incipient results have been obtained. This review aimed to identify the current situation and check whether there are gaps in knowledge in the chosen area.

The quantity and quality of evidence found in this aspect means that more studies must be carried out on the use of digital health technologies in the care of diabetes mellitus in Australia, as well as some actions that can consolidate this objective, which is a national priority for the management of diabetes. Mellitus. One point that seems to be a crucial characteristic for improving results and acceptance is the understanding of the need to customize these services or stratify them into groups or 'personas,' the most frequent annotation found in the studies analyzed. These actions include the education and training of professionals and patients, a better approach to and development of applications and digital technology systems, objective implementation policies that consider the patient and their real needs, and evaluating what already exists to incorporate successful actions and overturn existing barriers.

We consider new studies with systematic reviews, meta-evaluation, and new evaluative studies, both local and international, to be fundamental, which can stimulate and evaluate the implementation of these digital health technologies and the actions already implemented, access to all levels of care, the effectiveness, coverage, and the impact of the political and economic context of the use of these technologies to promote more excellent resolution on the part of these various services, which are essential for managing chronic patients, such as diabetics, in the current digital health panorama.

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