Utilizing a journey map to understand the needs of patients with Diabetes Mellitus (DM) on oral medication with a view to enhance medication adherence: Design research for patient-centered digital health interventions.

Sun Kyung Kim, Hye Ri Hwang, Kimmi Ko

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Abstract

Background: Patient journey mapping is a visual representation that illustrates the various touchpoints and interactions a patient has with a healthcare system over time. Patient-centered care (PCC) has been valued in diabetes mellitus (DM) patients, where current digital technology has shown potential to optimize medication management.

Objective: This qualitative study was performed to develop a journey map to ascertain DM patients' needs for PCC and digital health technology at touchpoints where barriers exist for medication adherence.

Methods: The study consisted of four phases: 1) in-depth interviews were first conducted with 12 diabetes mellitus (DM) patients, followed by 2) a systematic review of systematic reviews to identify digital health technologies, which 3) were synthesized with PCC opportunities. Lastly, 4) a patient journey was mapped to highlight touchpoints requiring PCC intervention within the context of digital health. The study unravels the intricate journey from diagnosis to ongoing medication for long-term use. Personas were used to independently explain how patients either adhere well to or poorly follow their regimen. The touchpoints were tailored where digital health technology enables opportunities for PCC in medication management.

Results: Findings from the qualitative analysis shed light on personalized user experiences, accessibility challenges, and motivational dynamics affecting adherence. A review of 11 recent systematic reviews synthesized digital health technologies for medication adherence, identifying five key technologies that support PCC through enhanced symptom assessment, shared decision-making, and support optimized self-management, and improved communication with peers and providers. Three phases in the patient journey have been identified: diagnosis, medication start, and ongoing medication.

Conclusions: This study contributes qualitative insights to the realm of PCC, shifting away from a clinic-based fragmented approach towards a seamless experience incorporating digital health interventions in the medication journey. Digital technologies would better support patients to be fully informed about their illness and treatment, amplifying engagement in care activities and planning with good medication adherence.

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Keywords: patient journey mapping, digital technology, patient-centered care, qualitative, interview

Introduction

Diabetes Mellitus (DM) affects approximately 9.3% of the population, requiring lifelong management that directly costs around $760 billion annually worldwide [1]. Patients diagnosed with DM often begin medical treatment with lifestyle modifications and oral medication [2,3]. The longer patients remain at this stage, the higher the chances of lowering the risk of complications [4]. Medication adherence behavior is intrinsically complex and dependent on multiple factors, including healthcare system and factors related to the disease and patient conditions [5].

The term "digital intervention" is commonly used in healthcare to describe methods that provide health services electronically, encompassing both formal and informal care [6,7]. Digital health interventions (DHIs) leverage technologies such as the internet and mobile phones, ranging from accessible electronic medical records for healthcare providers to mobile health applications that consumers use for guidance and support in maintaining healthy behaviors and managing their health [6]. Additionally, advanced data analytics and artificial intelligence (AI) can be used as interventions or integrated components within digital technologies [8]. It has demonstrated promising results supporting disease management behavior [9,10], providing convenience, flexibility, and easier access to healthcare interventions for daily management.

Diverse tools and strategies have emerged, including telehealth, mHealth, wearables, IoT devices, and AI, enhancing the efficiency and accuracy of healthcare practices. Designed to optimize medication therapies, these interventions foster interaction with health providers, data tracking, and personalized care planning [11]. Figure 1 below illustrates an overview of digital health interventions.

Figure 1 - Overview of digital health intervention (Adopted from Ko. 2022)

Previous studies have identified insufficient effectiveness of health solutions adopting a "one-size-fits-all" approach, failing to account for diverse needs and conditions of individuals[12]. Considering the complexity of healthcare, there has been an increasing demand for patient-centered care (PCC), which takes individual preferences into account when designing healthcare interventions. The use of digital health has also been focused on customization and personalization to meet individual needs and values [13]. Design disciplines could ensure a patient-centered view when developing new healthcare solutions using digital health interventions [14]. Additionally, user experience is enhanced through the integration of easy channels to interact with health providers and peers [15,16,17].

Digital health has further brought opportunities for PCC, assisting in accessing information and social interactions [11]. In this regard, medication adherence outcomes are promising with more agreeable and ready-to-follow treatment regimens [18]. A PCC approach recognizes that each person is unique and that their experiences, values, and goals should be considered in their disease journey. Healthcare providers are more likely to facilitate medication adherence, leading to better patient outcomes and satisfaction seamlessly.

A patient journey map is a visual tool used to explicate disease-related experiences within a care path from a patient's perspective [19,20]. It is a novel approach that ensures a comprehensive understanding of how patients enter, experience, and exit health services [21]. Defined as "a map of steps a patient takes as a person progresses through different stages of a disease, often from diagnosis to interaction with given healthcare services" [22,23], the rationale for undertaking this mapping process involves better understanding patients' experiences in detail, identifying challenges or barriers when accessing health services [24,25,26].

Vast data collection and analytic approaches are included (e.g., physical tracking of patients' movements, interviewing) that reveal key touchpoints of individuals in their journey seeking health services and support. Journey mapping provides opportunities to identify gaps in treatment and unmet needs, and offer better guidance [24]. As an improvement tool, digital technologies within patient journeys address barriers identified in patients' disease-related experiences, creating opportunities to provide better healthcare services to patients [27].

The aim of this study is to identify gaps where obstacles to medication management exist and to ascertain DM patients' needs for digital assistance for their medication management. Specifically, we aimed to explore which digital technology patients would like to see implemented into their medication management journey to help improve adherence and provide PCC. We assumed that digital technology can improve medication adherence by valuing individuals' autonomy and preferences. A clear pathway visualizing patients' medication treatment pathways would ensure feasible digital health interventions.

Methods

The Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist was used for reporting the methods and results [28]. This study was conducted between July 2023 and June 2024 in four phases: 1) using qualitative interviews to focus on medication adherence issues, 2) using a review of systematic reviews for digital health tool observation, 3) patient-centered digital health design and synthesis, and 4) creation of Personas and Structuring the Patient Journey Map.

Ethical Considerations and

The current study was approved by the Institutional Review Board of M University in Korea (IRB no. MNUIRB-230609-SB-008-01). The research assistant who supported the data translation process signed a non-disclosure agreement.

Phase 1: Using qualitative interview to focus medication adherence issues

Recruitment of the participants

Using purposive sampling, the inclusion criteria were: 1) patients diagnosed with type 2 diabetes, 2) who had oral medication prescriptions, and 3) had experience with self-management for medication. Exclusion criteria were: 1) patients diagnosed with type 1 diabetes and 2) unable to provide informed consent. A total of 30 participants were approached, of whom 12 completed the interview, 11 declined, and 7 did not meet the inclusion criteria. The interviewees were recruited from July 2023 at Mokpo Hankook Hospital (Mokpo, South Korea) and the interviews were completed until October 2023 at one general hospital located in M city, Korea. A researcher scheduled interview dates by phone call before the interview.

Data collection

We conducted semi-structured interviews using a list of questionnaires (Appendix 1) developed based on a literature review [29,30,31,32] by a team of experts (nursing faculty, physician, and registered nurses). After four pilot test interviews (with individuals who were not study participants), in-person interviews were conducted in quiet environments. The interview duration varied between patients, but the average was 30-60 minutes. The obtained data was converted to written manuscripts. In this conversion process, the Clover app [33] was used, and then the final manuscript was completed by a research assistant and confirmed by one of the main authors. These audio files were stored by individual researchers and were only accessible to them.

Phase 2: A review of systematic reviews for digital health tool observation

To develop technologies adaptable to the medication adherence journeys of diabetic patients, we analyzed how digital health approaches were utilized within the context of medication management through a review of previous review studies. We conducted searches using keywords "digital health" and "systematic review" in the PubMed database. This study included systematic literature reviews published in English since 2023, focusing on interventions utilizing digital health technologies to enhance medication management. Studies that did not measure the effects of interventions, applied different study designs, or were reported only as study protocols or abstracts were excluded. Our literature research initially identified 63 articles. The screening of titles and abstracts yielded 60 relevant articles. The full-text screening process resulted in a final study sample of 11 articles. The flow diagram and the screening process are provided in Figure 2.

Figure 2. Flow diagram of the article selection process.

Phase 3: Person centered digital health design and synthesis

Based on previous studies[11,34], there are four key domains where digital health significantly contributes to the enhancement of PCC. Working toward the preferences and values of patients, digital health has the following potential opportunities to enhance individualized symptom assessment, foster shared decision-making, support self-management, and improve communication with peers and providers.

Individualized Symptom Assessment: The use of digital health enables self-testing and screening, meeting patients' desire to monitor their health status [35]. Along with enabling earlier detection of potential issues, the use of digital technologies empowers individuals to have greater control over their disease and symptom management. **Shared Decision-Making**: Digital health ensures that information is easily shared through reliable software, benefiting both patients and healthcare providers [36]. By facilitating the seamless sharing of information, individuals can actively participate in their health decisions with a better understanding of their treatment options. **Supporting Optimized Self-Management**: Digital health provides opportunities to enhance individuals' ability to manage their own health conditions by supporting proactive steps such as adhering to treatment plans and making lifestyle changes[34]. Digital tools offer personalized assistance that helps individuals become more interactive with their care. By aligning with the specific needs that truly matter to each person, real-time monitoring and timely interventions significantly contribute to improved health outcomes. **Improving Communication with Peers and Providers**: Technology enhances the therapeutic alliance by ensuring connection and encouraging active participation in health behavior change [37]. By staying connected with their healthcare team and peers, patients build collaborative relationships that better promote motivation for health behavior change through a sense of support.

Phase 4: Creation of Personas and Structuring the Patient Journey Map

Patient Journey Map

Based on the interview analysis conducted by the first and second authors, two personas were created, and the Patient Journey Map was organized into six layers: (1) Periodic phases - pre-diagnosis, medication start, and medication ongoing; (2) Locations - public health center, clinic,

pharmacy, home; (3) Touch points - key activities performed by patients at each stage; (4) Need statements - actionable problem statements summarizing a particular user's need and why the need is important to them; (5) Emotional journey - visually representing the patients' emotions; (6) Digital health intervention opportunities based on patient-centered care (PCC) for integration.

Results

Phase 1: Using qualitative interview to focus medication adherence issues

As no more new information or patterns were acknowledged, data saturation was reached after interviewing 12 patients with diabetes. Table 1 shows the characteristics of the 12 participants, with an average age of 54.0 (14.47) years, 66.7% of whom were male.

Table 1 . patient characteristics

NO	Age	Gender	Diagnosis (year)	Medication (year)	Previous use of mobile app
1	61	Man	10	10	No
2	30	Man	1	0.6*	Yes
3	69	Man	0.8	0.8	No
4	32	Woman	10	10	Yes
5	36	Woman	10	10	Yes
6	58	Man	5	5	No
7	72	Woman	17	17	No
8	59	Man	1	1	No
9	60	Man	20	10*	Yes
10	62	Man	10	10	No
11	64	Man	8	8	Yes
12	45	Woman	3	3	No

First, the patient journey was outlined in a timeline, and three phases were identified from the qualitative interview data: pre-diagnosis, medication start, and medication ongoing. The medication-starting phase, which lasts up to a month post-diagnosis, involves frequent hospital visits and intensive lifestyle modifications. The journey then moves to the medication-ongoing phase, where the medication regimen stabilizes with long-term clinic visits. Within these time phases, themes were identified that reflect the key experiences and challenges faced by patients.

Diagnosis

Suspicion of diabetes diagnosis during health check-up. Before being diagnosed with diabetes, they reported experiencing health check-ups at the hospital. The test results indicated a suspicion of diabetes, and further tests confirmed that medication was necessary. However, instead of visiting the hospital to receive information about their diabetes diagnosis, some individuals believed they could manage it on their own and sought information about diabetes independently.

"I was told that the test results suggested a suspicion of diabetes. It was hard to believe, so I visited several hospitals. The hospitals prescribed medication, but they didn't explain in detail why I needed to take it. Because of this, I thought I could manage it with diet alone.." [p2]

Experiencing symptoms of diabetes and visiting the hospital. After attempting to manage their condition on their own, they reported experiencing diabetes symptoms such as excessive thirst and frequent urination, prompting them to visit the hospital for a check-up. They were diagnosed with diabetes and informed that medication treatment was necessary. Some younger patients struggled to accept their diabetes diagnosis.

" Previously, they said it wasn't that serious... This time, after being diagnosed with diabetes in two consecutive medical check-ups, I decided to get tested again on my own. Because I felt unwell, I visited the hospital again..." [p2]

Medication Started (First prescription to 1 month)

First medication since diabetes diagnosis. The doctor explained that they would need to take medication for the rest of their lives. The lack of explanation about why lifelong medication was necessary caused delays in accepting their diabetes diagnosis.

"When first prescribed the medication, they told me I had to take it consistently, but I didn't really understand why, and they didn't explain the precautions either." [p5]

"Honestly, I was not sure. I'm taking it because the doctor told me to, but if they had explained it to me more clearly and made it easier to understand, I would feel more assured. But that's not the case, so it's a bit concerning." [p7]

Effort to medication management. Diabetes patients reported that they often miss taking their medication due to busy work schedules, forgetfulness, being away from home, and holidays. To improve medication adherence, they adopt strategies such as using pillboxes, setting alarms, and seeking support from family members. However, they often miss taking their medication, even with medication management.

"I normally bring my morning medication at work, but when I gets busy, I forget to take it. In the evening, I remind myself to take my medication, but I still sometimes forget." [p5]

"I use a pill organizer to ensure I don't forget to take my medication. I take it until Sunday, and when it's all gone, I refill it again that night." [p8]

Hypoglycemic experience. They reported experiencing hypoglycemia under circumstances such as forgetting to eat before taking their medication, inadvertently taking their medication twice, or during physical exercise. Some patients indicated that they did not recognize the symptoms of hypoglycemia.

"The first time, I felt the symptoms while exercising, I didn't realize it was due to low blood sugar. I just wondered why I felt so weak. Later, when I asked my friends, I learned that these were symptoms of hypoglycemia." [p9]

Medication ongoing (3 month and over)

Medication changes based on routine hospital examination results. Three months into taking the medication, patients reported visiting the hospital to refill their prescriptions and consult with their doctors, sharing their experiences with the medication. Patients showed their blood sugar records and exercise logs and received blood tests. The doctors explained the test results and adjusted the

medication accordingly. Some patients reported that their blood sugar was not well-controlled, leading to an increase in their medication dosage.

"I heard that the HbA1c test reflects blood sugar levels over the past three months, and I was told that the levels drop significantly, the medication will change accordingly." [p5]

" This time, my HbA1c was 7.4, so they made some adjustments to my medication. Even though I avoid sweets, it seems like my blood sugar is still out of control." [p4,8]

Blood sugar management. They were advised to follow a diet and exercise regimen. However, they expressed difficulties in finding a diet and exercise routine that suited them and complained about the challenges of adjusting their eating habits.

"Last time, when my blood sugar level went up, my physician increases my medication. I was encouraged to exercise more and change my diet, but it's not easy." [p10]

"I often wonder if it's okay to eat certain foods. I worry a lot about whether they contain too much sugar." [p5]

Considering stopping medication. Patients often consider discontinuing their medication without consulting their healthcare provider. They wonder whether they can stop their medication when their blood sugar levels are well-controlled or when their blood sugar remains stable even after missing a few doses.

"I've been taking my medication as prescribed, but since my blood sugar is well-controlled, I wondered if I could stop taking it. I think I would be ok without medication" [p7]

"This time, I went without taking my medication for over a month, and my test results were good. Seeing this, I thought maybe I don't need to take the medication anymore." [p11]

Phase 2: A review of systematic reviews for digital health tool observation

From the 63 records screened, 11 records met the inclusion criteria. The main digital health interventions identified included mHealth (mobile apps), telemedicine, electronic health records (EMR), IoT devices, and AI systems (Table 2).

Phase 3: Integration with digital health technology and PCC

The types of digital health technologies derived from this systematic review have been matched to opportunities for PCC**. Individualized symptom assessment** can be enabled through real-time information-seeking and data collection technologies. Ranging from simple symptom trackers to sensor-based assessments, these tools empower individuals by providing them with the information needed**. Shared decision-making**, with easy access to health records, ensures that treatment-relevant data is accessible, enabling patients to make informed decisions. Online portals allow patients to access their electronic health records (EHRs) without restrictions of time and location [38]. Devices such as electronic pill dispensers ensure timely and accurate medication intake[39]. **Supporting optimized self-management**, reminders aid in behavior modification. Additionally, recommendations can be tailored to customize diet and exercise, while predictive systems can alert users to potential hypoglycemia, enhancing overall health management [40]. Online social communities allow users with similar health conditions to share experiences and support one another, while telemedicine enables medical counseling and monitoring regardless of physical distance [41], **improving communication with peers and providers**.

PCC opportunities		Digital health technology
Individualized symptom assessment	→	Mobile app :Self-checklist[42], Tailored-information[43] IoT devices - Wearable sensors : Continuous Glucose Monitoring-Libre[44]
Shared decision making	→	Electronic health Record : Online portal allowing patient's access to data[38,41]
Supporting optimized self-management	→	Mobile app with IoT Devices : Electronic pill dispenser[39] : AI-driven assistants[38]
Communication with peer and provider	→	Web / app based communities[43] Telemedicine[43]

Phase 4: Creation of Personas and Structuring the Patient Journey Map

Based on the interview analysis conducted by the first and second authors, the medication experiences of diabetes patients were reviewed, gaps were identified, and a Patient Journey Map was constructed. The patient medication journey in Figure 3 illustrates the commonly shared experiences of diabetes patients, using two personas to represent both positive and negative experiences. Within the same phase, there were similar issues such as obtaining prescriptions, forgetting medication, experiencing side effects, and changing medications. Personas who make efforts to adhere to the medication regimen develop their own ways to overcome these challenges. In contrast, individuals with low adherence put in less effort to develop strategies and tend to resist engaging in medication and disease management behaviors. Subsequently, desired Patient-Centered Care (PCC) principles and relevant digital health technologies were integrated as potential solutions to create a comprehensive medication journey map. Where there is a need for autonomy, digital technologies are used to share personal health data, facilitating participation in decision-making. For timely access to information, raising awareness of disease conditions, and promoting early prevention through individualized monitoring, mobile and wearable devices with data analysis capabilities are recommended. Additionally, technologies that enable interactions through online and remote connections are suggested for patients in the community who require external support.

Figure 3. Patient journey map integrating patient centered digital health technologies

Table 2.Digital health technology SR

Author (Year)	Design	Number of studies	Population	Intervention	Outcome	Digital health technology
Zangger et al., (2023) [45]	Systematic review and Meta analysis	130 RCTs	Adult patients with cancer and their family members.	Website, app, and wearable-designed to deliver health information for remote patients.	-Physical activity and physical function -Depression -Anxiety -HRQOL -Adverse events	-mHealth solutions -mHealth and eHealth -eHealth solutions -Digital devices
Moschonis et al., (2023) [46]	Systematic review and Meta analysis	56 RCTs	Adults with type 2 diabetes and hypertensio n	Digital health intervention (except for tele-counselling or telemonitoring)	-HbA1c -Blood pressure -Lab (Cholesterol, triglycerides, fasting plasma glucose) -Changes in medication -Anthropometric outcomes	-Smartphone application -SMS -Web-based interventions
Wu KA et al., (2023) [47]	Systematic review	15 studies - 9 RCTs - 6 cohort	Patients undergoing cardiac surgery	Mobile or web-based application.	-Patient engagement -Satisfaction -Healthcare utilization	-Mobile application -Web-based application
Saif-Ur-Rahman et al., (2023) [38]	Systematic review	48 studies (RCTs, mixed-methods, cross-sectional, qualitative and ect)	Primary health care patients	Digital health interventions	-Recording -Documentation -Waiting time -Efficiency of services -Client satisfaction -Quality of service.	-mHealth -SMS -Electronic health record (EHR) -Electronic device -Machine learning
Siopis et	Systematic	29 RCTs	Adults with	Digital health	-Blood pressure	- Mobile application

al., (2023) [48]	review and Meta analysis		hypertensio n.	interventions (except for tele-counselling or telemonitoring)	-Lab (Cholesterol, triglycerides, fasting plasma glucose) -Changes in medication -Anthropometric outcomes	-SMS -Web-based interventions
Barnett et al., (2023) [49]	Systematic review and Meta analysis	39 studies - 37 RCTs - 2 non-RCTs	Patient with diet-related chronic conditions (heart disease, stroke, hypertensio n, obesity)	Digital health interventions (except for only telephone and video conferencing interventions)	- Diet - Quality of life -Blood pressure -Blood glucose control -BMI, weight, waist circumference, -Self-efficacy -Hospitalization -Mortality	- mHealth - eHealth technologies - Mobile application and messaging systems - Electronic system and software
Katz et al., (2023) [50]	Systematic review and Meta analysis	28 studies - 27 RCTs - 1 cohort	Adults with hypertensio n	Digital health interventions	Blood pressure	- Mobile application - IoT device(Wearable, Sensor) - Web-based interventions - Artificial Intelligence - Telemonitoring - SMS
Boima et al., (2023) [51]	Systematic review and Meta analysis	22 RCTs	Adults with hypertensio n	Digital health interventions	- Blood pressure - Lifestyle behaviors (diet, physical activity, ect) -Medication adherence	- Mobile application - SMS - Mobile phone calls - Telemonitoring - Wearable & Bluetooth
Zhang et al., (2023) [52]	Systematic review and Meta	65 studies - 48 RCTs - 17 quasi-	Adults with cancer and their family	Nonpharmacologi cal therapeutic intervention via a	Psychosocial outcome	- eHealth - Mobile application - Webs-based intervention

	analysis	experimental	members	digital health mechanism		- Virtual reality - Telehealth - Electronic health information
Alfian et al., (2023) [53]	Systematic review of Quantitative and Qualitative studies	16 studies - 13 quantitative - 1 qualitative - 2 mixed-method	Chronic patient in low-and middle-income countries	mHealth and e-Health	- Health related outcomes (medication adherence, advise the patient to stop smoking, cessation of drug therapy) - Patient satisfaction	- Mobile application - Mobile phone calls - Text messages - Home telemonitoring - Internet-based drug information centers
Azizi et al., (2023) [54]	Systematic review	5 all RCTs	Heart failure patient in underserved rural areas	Mobile health, wearables, text messaging, telehealth, or web-based platforms for remote monitoring	-Health care resource usage - Biomarkers -Self-care behaviors -Knowledge - Anxiety	- Telemedicine & Telemonitoring - IoT device(wearable device) - Mobile phone calls - Mobile application

Discussion

This study provides an overview of patient journey mapping in PCC management using digital health to support medication adherence among patients with DM. Overall, it shows a complex journey that requires patients to have better information and change behaviors, with multiple moments requiring a PCC approach to improve medication adherence. The results further discussed the use of digital health technologies, which raised PCC opportunities. Focusing on apparent issues, persistence, and individualized interventions using digital health might contribute to improving medication adherence.

The current mapping process identified three key phases in the journey of DM patients taking oral medications. Consistent with prior studies [55,56], the journey begins with patients experiencing signs and symptoms of the disease, which leads to a diagnosis in a clinical setting. There remains a risk of uncontrolled patient behavior, even during the ongoing medication phase when hospital visits are spaced at long intervals [57,58]. This highlights the importance of sustainable interventions that digital technologies can optimize, given their accessibility without time or space constraints. Currently, various digital tools (mobile apps, smart pill dispensers, wearable devices, etc.) enable the continuous provision of information and support, tailored to individual needs and preferences. Therefore, it is essential for healthcare providers to fully understand the benefits of applying these digital health technologies at different stages of the medication journey for DM patients.

Emphasis on the importance of medication is a recurring need throughout the journey, as individuals showed incompetence in fully understanding their disease and medication. Lifelong management is essential, yet interviewed patients reported skepticism about medication effects and often wondered if or when they might be able to stop taking them. As indicated in the National Institute for Health and Care Excellence (NICE) guideline[59], shared decision-making is key to engaging patients in treatment, making them responsible for their care planning [60]. Digital health empowers patients with full access to their health records, such as online portals [61] that enable patients to inform themselves about their health conditions and incorporate their values and preferences. Through this, patients can review their personal health data, recognize their condition, understand the necessity of taking medication, and be motivated to adhere to their treatment.

Education and support also reinforce medication adherence by filling knowledge gaps and helping patients understand the importance of medication. Findings of this study indicated that patients with low adherence often showed misunderstandings and a lack of knowledge about the medication regimen and the chronic nature of their condition. Previous review studies highlighted the importance of a personalized, data-driven approach to information provision, considering the patient's level of understanding and disease condition[62,63]. Mobile app technologies that use algorithms can generate educational content tailored to the patient's most pressing needs and assess their understanding afterward to ensure comprehension [64]. By accommodating individual

differences, educational interventions can have varying effects, enabling individuals to develop more relevant, accessible, and actionable disease management strategies, which directly result in better medication adherence.

Another need was an individualized approach. One of the most important findings revealed that while some patients fully acknowledged and actively engaged in disease management, expressing a desire to understand their health and medication status, others struggled to accept their condition. The digital solution helped users develop a sense of control and awareness of their disease condition by providing personalized information [65]. Mobile health and wearables, in particular, represent a data-driven personalized approach that helps prevent side effects and further deterioration in a timely manner [43,44]. As indicated in previous studies [66], these technologies offer patient-centered experiences by enabling personalized health monitoring and tracking a range of health metrics, along with providing tailored advice based on the data collected.

A common challenge shared by most patients was establishing a medication routine. This aligns with previous reviews, which found that medication routines often overlap with individuals' daily lives, leading to skipped doses and modifications of the original regimens [67]. Compelling evidence highlights the need to analyze patient data to develop customizable plans [68,69,70]. Currently, various AI technologies are well-suited to match individuals' evolving health statuses and life circumstances [71,72,73,74,75]. Technology can help prevent not only misuse but also overuse of medication, using features like reminders and monitoring. By integrating additional systems related to daily diet and physical activities, AI-based analysis can offer customized plans for medication and lifestyle management, accurately predicting and preventing complications and potential side effects.

Emotional support was an important component that should be integrated into the digital healthcare system. In alignment with previous studies, feelings of despair as chronic disease patients and fear of side effects were found across the journey [76,77]. Initially, there may be an underestimation of medication management, as it seems simple and manageable. However, over time, negative emotions such as fear of side effects and anxiety about lifelong management may emerge. Participants also revealed anxiety about being unsure of their medication behavior with concerns about further deterioration due to their misbehavior. Due to the instability of their management strategies, individuals expressed a need for assistance to ensure their behaviors are effective [78,79,80,81]. Telemedicine is an effective strategy to alleviate the concerns of chronic disease patients regarding their treatment management. It allows emotional interactions with healthcare providers, fostering trust, which in turn improves treatment adherence [82]. Additionally, online communities provide consistent and easy access to emotional support and essential information, motivating patients to maintain their medication adherence [83].

Despite the cumulative evidence pointing to the effectiveness of digital health technology, concerns persist regarding their trustworthiness, reliability, and acceptance[84]. Currently, challenges exist in bridging the gap between practical application and ethical principles [85], emphasizing the need for transparency and user-

centric design to build trust [86]. In addition, it is crucial for healthcare professionals to adapt to this digital era[87], as multidisciplinary collaboration and proper guidance from health providers would improve autonomy and trustworthiness in digital health technology.

Conclusion

This journey mapping aimed to develop a patient-centered mobile application with a comprehensive understanding of the challenges and needs faced by DM patients in adhering to their medication regimens. By centering the needs and preferences of the users, technologies could ensure the patient-centeredness of digital interventions. Integration of various patient-centered features such as context-aware reminders, individualized educational resources, and interactive tools is expected to contribute to better medication adherence, ensuring a positive user experience and fostering long-term engagement and behavior change. In future studies, it is essential to conduct usability testing and pilot studies to evaluate the usability and effectiveness in real-world settings.

Acknowledgements

Conflicts of Interest

None decleared

Abbreviations

PCC : Patient centered care
DM : diabetes mellitus
DHIs : Digital health interventions
AI : artificial intelligence

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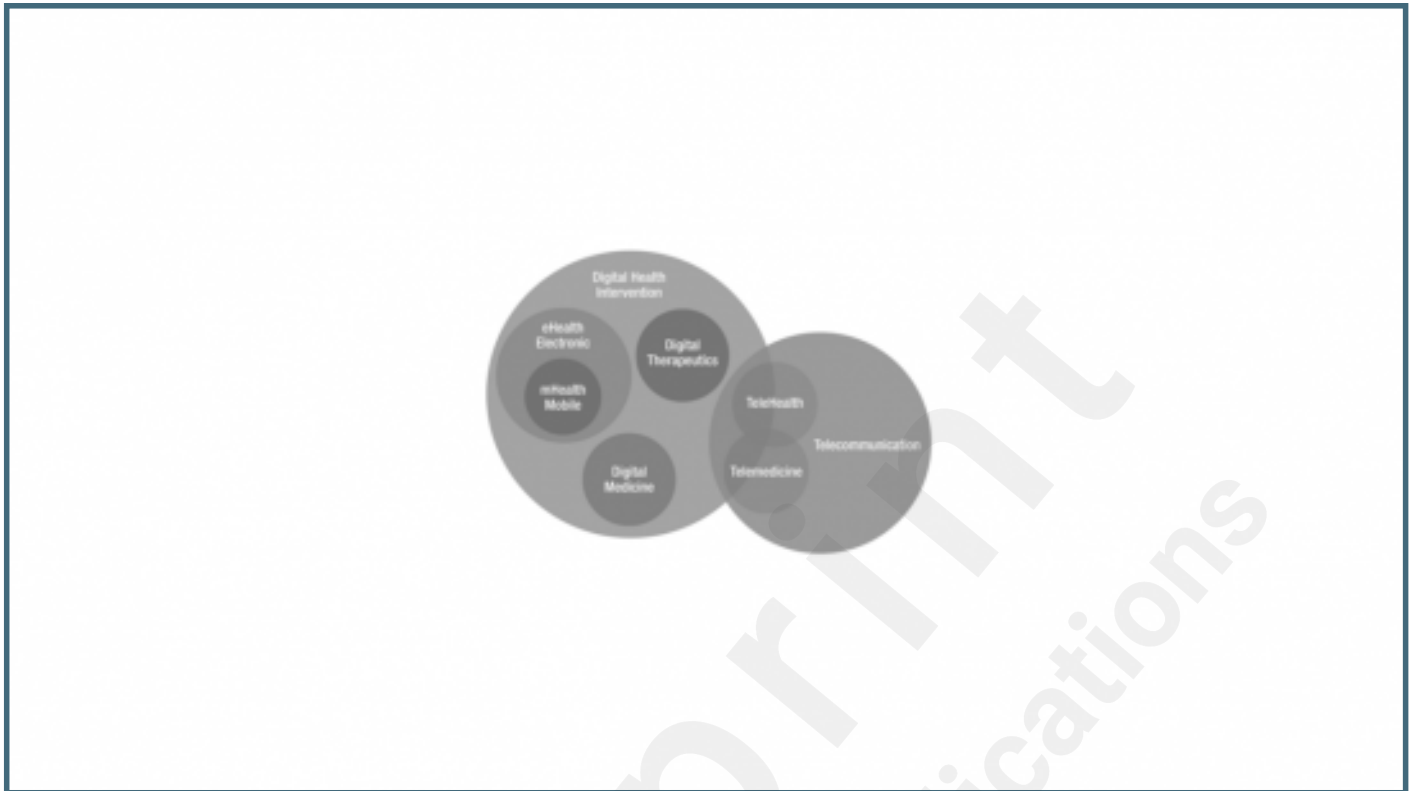**Supplementary Files**

Figures

This figure is a flow diagram of the article selection process.
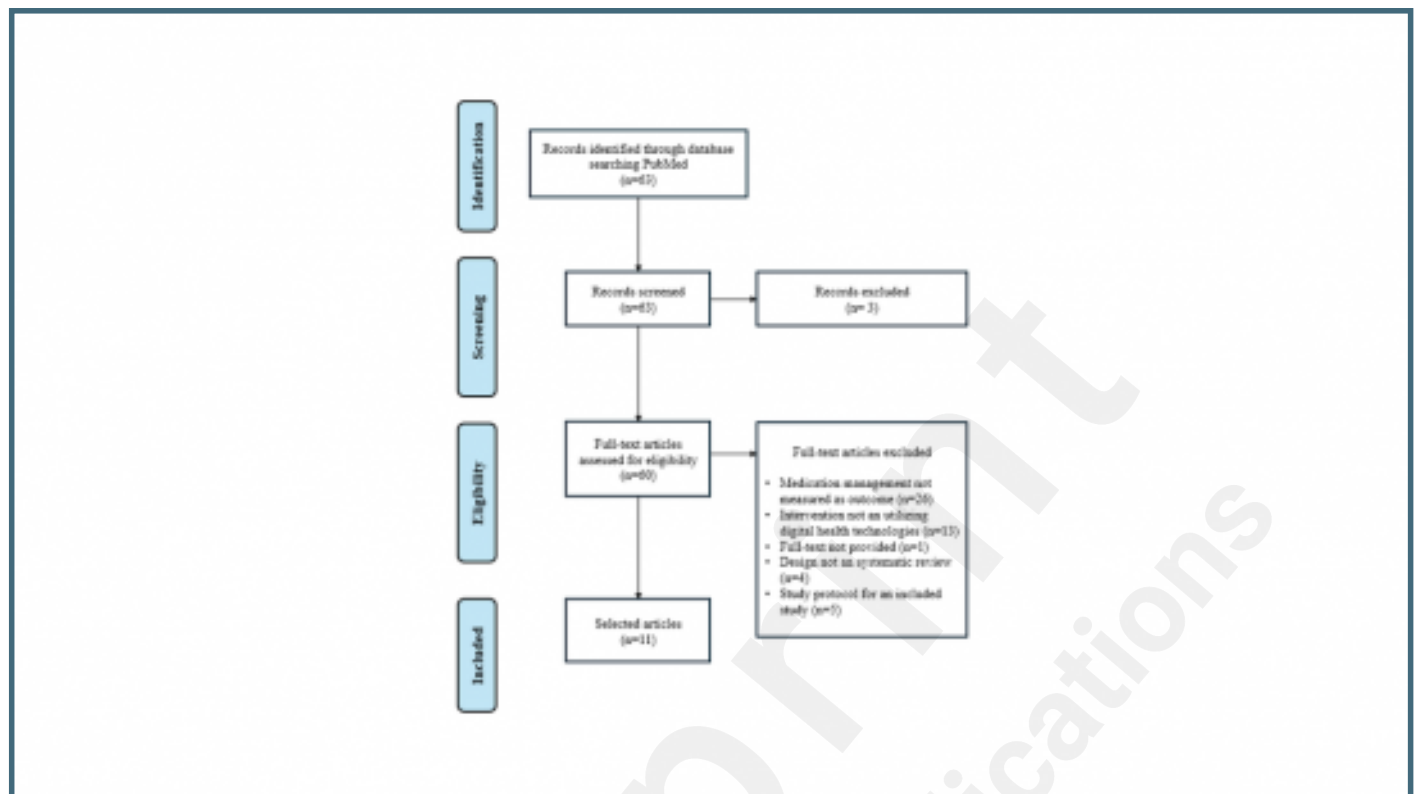
This figure provides an overview of the digital health intervention (adapted from Ko, 2022).

This is Patient journey map.

		PRE DIAGNOSIS	MEDICATION START				MEDICATION ONGOING		
Period		-	1~14days			1 month	3 months		6 months
Location		Medical center/Clinic/Public health center	Clinic/pharmacy/Public health center	Home	Home	Home	Clinic/pharmacy/Public health center	Home	Clinic/Public health center
Touch points		Health check-up indicated a suspicion of diabetes	Diagnosed with diabetes, received a prescription	Started monitoring blood sugar, diet, and exercise	Making efforts to adhere to medication	Experienced symptoms of hypoglycemia	Medication adjusted based on regular follow-up test results	Blood sugar management	Regular hospital visit schedule
PERSONA 1 Poor medication adherence	Need statement	I feel too young to have diabetes, and I just can't accept it.	Even though I've been prescribed medication, I might not always take it.	Due to my busy work life with frequent drinking and irregular eating habits, managing my blood sugar, diet, and exercise has been difficult. I'm experiencing the greatest fatigue I've ever felt.	I often forget to take my evening medication and end up taking it in the morning instead.	I have experienced cold sweats and I'm unsure what to do. It's frightening.	I have a lot of leftover medication from previous prescriptions, so I won't visit the doctor until I've finished it.	I randomly check my blood sugar, but since there haven't been any significant changes, I'm thinking of stopping the medication.	I'm not noticing any significant decline in my health, so I've decided to discontinue my medication and stop going to the hospital unless I experience significant symptoms.
	Emotional journey								
PERSONA 2 Better medication adherence	Need statement	I seek information about diabetes by asking acquaintances and browsing the internet.	I try to follow the medication instructions carefully, but managing them can be challenging with my busy daily life.	I record my diet, blood sugar, and exercise in a logbook and adjust my exercise intensity based on blood sugar changes, but I often forget to bring the logbook to work.	I sometimes forget to take my medication, so I started using a weekly pill organizer, but it feels inconvenient.	When I feel hypoglycemic, I immediately eat a snack, then realize I forgot to eat breakfast. This is a great concern for me.	After experiencing hypoglycemic symptoms, I reviewed my blood sugar log and HbA1c levels, which led to a change in my medication.	I'm putting more effort into consistently monitoring my diet, exercise, and blood sugar levels than I did before changing my medication.	I'm discussing the future course of treatment. Since diabetes management is a lifelong process, it's important for me to be mindful and follow my doctor's prescriptions.
	Emotional journey								
Patient Centred Care Opportunities		Individualized symptom assessment	Shared decision making	Individualized symptom assessment	Support optimized self management	Support optimized self management	Shared decision making	communication with peer and provider	communication with peer and provider
Potential Digital Health Interventions		Mobile app (Self check up, Tailored information and education) Leung et al. 2018	Electronic Health Record (Online portal allowing patients' access to data) Saif-Ur-Rahman et al. 2023	IoT Devices (watch, Libre) With Mobile app Shah & Lavey(2021)	IoT Devices Mobile health (electronic pill dispenser) Masouman Hosseini et al. 2023	AI-driven assistants (hypoglycemic prediction model) Alexiadis et al. 2024	Electronic Health Record Saif-Ur-Rahman et al. 2023	Mobile app (social community) (Sharma & Sharma, 2024)	Telemedicine (Sharma & Sharma, 2024)

Multimedia Appendixes

This Multimedia appendix is Interview questionnaires.
URL: http://asset.jmir.pub/assets/d8cae52efb85e0afe987d9d0081b0a37.docx