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RESEARCH ARTICLE

Diabetes-related patients' profile and strategy in improving their knowledge and adherence: A mixed method study

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Abstract

Background: Effective education and information during diabetes patients' treatment to enhance their knowledge could impact their medication adherence to improve therapeutic outcomes. This study aims to explore diabetes-related patient profiles, including knowledge, adherence, and medication nonadherence factors among diabetic patients. Also, it explores the implemented pharmacists' strategies to raise knowledge and adherence. **Methods:** This study had two phases. The first phase focused on diabetic patients, assessing their profiles, knowledge about diabetes, medication adherence, and factors contributing to nonadherence. The second phase examined pharmacists' strategies to improve patients' knowledge and adherence. Using a mixed-methods design, participants were recruited from primary healthcare in Yogyakarta. Medication adherence was measured with a four-item Morisky, Green, and Levine Medication Adherence Scale (MGLS), while knowledge was assessed using a 10-item adapted questionnaire from the Diabetes Knowledge Questionnaire (DKQ-24). **Results:** This study enrolled 104 patients and 24 pharmacists. Most patients (40.4%) had low knowledge of disease and medication related to diabetes. A quarter of the participants (26%) exhibited poor adherence. Almost all of the pharmacists have developed strategies to enhance patients' knowledge and adherence (95.8%), providing drug information services and medication control cards. **Conclusion:** Improving patient knowledge, addressing non-adherence, and standardising pharmacists' strategies are necessary, alongside developing a comprehensive service model to enhance therapeutic outcomes.

Introduction

Chronic diseases encompass the most burdensome health conditions with long-term impacts on patients' clinical, humane, and financial outcomes (Bindu Murali *et al.*, 2016). Diabetes mellitus (DM), particularly type 2 DM (T2DM), accounts for 90% of all diabetes cases, with its prevalence rapidly increasing across most countries (Singh *et al.*, 2022). Recent data indicates that Indonesia has a diabetes prevalence rate exceeding 6% of the adult population, affecting approximately 10 million people, making it one of the highest prevalence rates in the world (International Diabetes Federation, 2021).

Diabetes mellitus requires prudent management to control glucose levels. Sustained uncontrolled glucose levels may lead to a negative impact and result in serious complications (AlShayban *et al.*, 2020). Poor medication adherence has been reported as a barrier to achieving effective management of DM. Patients with T2DM reported varying rates of poor medication adherence, ranging from 38% to 93%, which might be due to various reasons such as side effects, treatment failure, or other factors. Poor glucose control, elevated medical expenses, and substantial increases in

mortality rates are linked to poor medication adherence (Cramer, 2004; Polonsky & Henry, 2016). Adherence to medication markedly reduces the progression of DM complications and increases patients' quality of life (Kassahun *et al.*, 2016). Providing effective education and clear information during patient treatment can enhance their knowledge, improving medication adherence and leading to better clinical outcomes (Singh *et al.*, 2022).

A recent study found that pharmacists can help people with diabetes adhere to their medications (Presley *et al.*, 2019; Singh & Dokun, 2023). The pharmacists' common strategies included education, consultation, drug information services supported with printed and digital materials, and maintaining daily record books (Presley *et al.*, 2019). A pharmacist's involvement in managing diabetes could assist patients in acquiring improved treatment results.

Therefore, this study aims to explore diabetes-related profiles, including knowledge, medication adherence, and factors related to medication nonadherence among DM patients. Moreover, it also explores pharmacists' strategies implemented to raise knowledge and medication adherence among diabetes patients. This study contributes to developing a medication therapy management model for diabetes patients in primary healthcare settings in Indonesia.

Methods

This study consisted of two phases. The first phase focused on diabetic patients, examining their profiles, knowledge about diabetes, medication adherence, and factors contributing to nonadherence. The second phase explored pharmacists' strategies for improving patients' knowledge and medication adherence (Figure 1). This research employed a mixed-methods design with an explanatory sequential approach (Rao & Shiyanbola, 2022). The cross-sectional study adhered to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines, while the qualitative portion followed the National Institute for Health and Care Excellence (NICE) methodology checklist (von Elm *et al.*, 2008; National Institute for Health and Care Excellence, 2012).

Ethics approval for the study was obtained from the Medical and Health Research Ethics Committee, Faculty of Medicine, Public Health, and Nursing, Universitas Gadjah Mada, under letter number KE/FK/0710/EC/2019. Informed consent was obtained from all participants prior to the study.

Phase 1: Study on diabetes-related patient profile

Study design and reporting

A cross-sectional study collected sociodemographic data, knowledge levels, and medication adherence among diabetic patients. Additionally, in-depth interviews were conducted using qualitative methods to explore the reasons for nonadherence.

Setting, subject of the study, and sampling technique

The study was conducted over five months in primary healthcare centres around Yogyakarta City, Indonesia. The Lemeshow formula determined the sample size, requiring at least 96 diabetic patients (Lemeshow, 1990). Subjects were recruited through consecutive sampling from five healthcare centres with more diabetic patients. Participants included adults diagnosed with type 2 diabetes who had been using oral antidiabetic medication for at least one month. Exclusion criteria included mental incapacity, unwillingness to provide consent, pregnancy, and health workers.

Instrument and data collection

Data were collected using a questionnaire divided into four sections. Part A covered sociodemographic characteristics and medical history. Part B assessed patients' knowledge of diabetes using a 10-item questionnaire adapted from the 24-item Diabetes Knowledge Questionnaire (DKQ-24) (Hsieh *et al.*, 2022), with good internal consistency (Cronbach's alpha = 0.688) (Salsabila, 2020). Part C measured medication adherence using the 4-item Morisky, Green, and Levine Medication Adherence Scale (MGLS), which also showed reliability in a pilot study (Cronbach's alpha = 0.697) (Kristina *et al.*, 2019; Ridhayani, 2020). Part D examined nonadherence-related factors through a self-developed questionnaire based on literature and expert input.

Knowledge levels were classified as high (scores 8-10), medium (scores 6-7), and low (scores 0-5). Adherence was assessed with yes/no questions and categorised as high (score 0), medium (score 1-2), or low (score 3-4). As a therapeutic outcome, data on glucose levels were also obtained from patient records and classified based on treatment goals for diabetic patients according to the guidelines. Controlled glucose levels were defined if the fasting blood sugar < 126 mg/dL and/or random blood sugar < 200 mg/dL.

Semi-structured interviews were conducted by trained researchers over three months at healthcare centres, focusing on reasons for medication nonadherence. Researchers ensured that no new significant insights would be discovered by the end of the interviews, as no

additional individual interviews would be conducted in the next session. All researchers audio-recorded, transcribed, and verified the interviews for accuracy. A triangulation method was used for data collection, ensuring comprehensive insight into nonadherence factors (Mays & Pope, 2000).

Data analysis

Chi-square tests were used to analyse the relationship between variables such as knowledge level, adherence, and therapeutic outcomes, with a significance level of $p < 0.05$. Factors related to medication nonadherence were analysed descriptively in percentages. Transcriptions of the interviews were completed for analysis.

Phase 2: Study on pharmacists' strategies to raise knowledge and medication adherence level

Study design and reporting

A mixed-methods design with a cross-sectional approach explored pharmacists' strategies for enhancing patient knowledge and adherence. A focus group discussion (FGD) gathered detailed insights.

Setting, subject of the study, and sampling technique

Pharmacists from primary healthcare centres in Yogyakarta were invited to participate in a survey and FGD at the Faculty of Pharmacy, Universitas Gadjah Mada. All participating pharmacists actively practised in Yogyakarta.

Instrument and data collection

In this study, the data collection process adopted a triangulation method (Mays & Pope, 2000). A survey was administered to collect data on pharmacists' strategies for improving diabetic patients' knowledge and adherence. The FGD further explored these strategies, discussing challenges and solutions for improving medication outcomes.

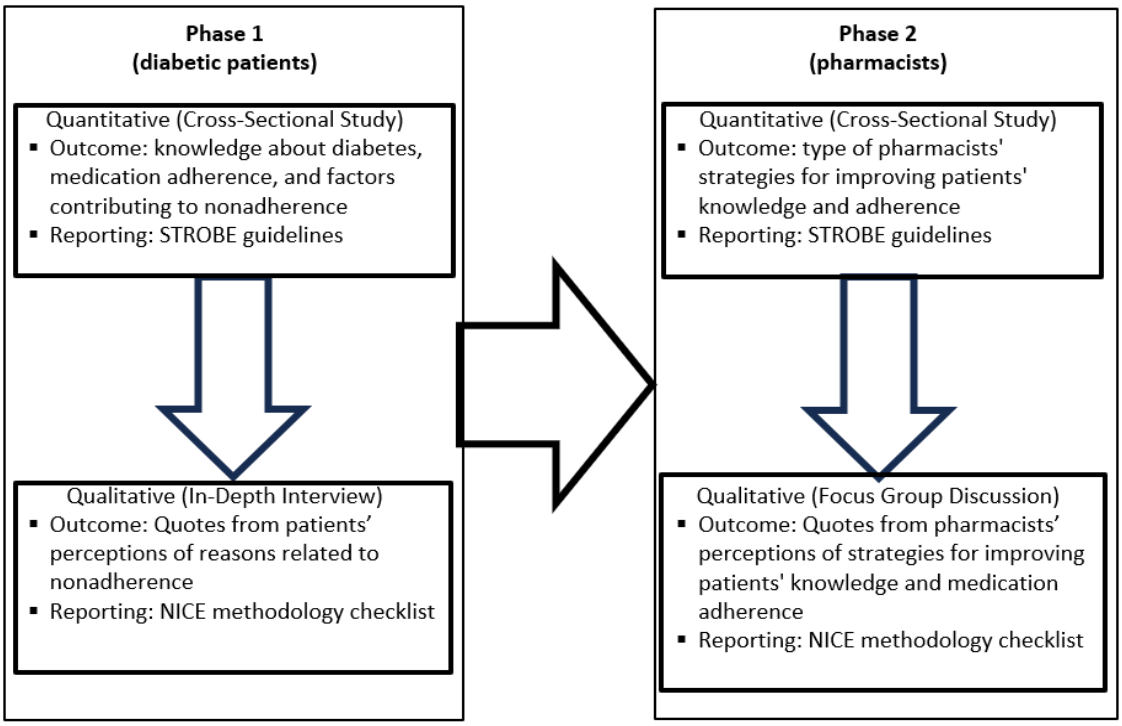

Figure 1: Diagram outlining the methodological steps and population

Focus group discussions were facilitated by researchers with expertise in pharmacy practice and qualitative methods. Focus group facilitators had no prior relationships with participants and initiated each session with a brief overview of the research team and the justifications behind carrying out the study. A summary of this study was presented at the start of each session, and a flexible topic guide with open-ended questions was used to steer the focus group discussion. This topic guide was established with the

assistance of the Normalisation Process Theory (Huddlestone *et al.*, 2020).

Apart from the topic guide, paper, pencil, and voice recorder were also needed during the discussion process. The sessions were recorded, transcribed, and verified for accuracy, though transcripts were not returned to participants for revision.

Data analysis

Pharmacists' strategies were described in percentages. Transcriptions from the FGD provided detailed insights into the strategies pharmacists implemented to enhance patient outcomes.

Results

A total of 104 T2DM patients agreed and were eligible to participate in the study. The characteristics of the participants with T2DM are shown in Table I. The mean age of participants was 63 years, and the majority (76.9%, n = 80) were female. It was observed that over half (55.8%, n = 56) of respondents had a middle and high school education, and most were unemployed (78.8%, n = 82). Nearly 60% of the participants took oral antidiabetic drugs for 1 to 10 years (n = 63), and most of them received less than five routine drugs (87.5%, n = 91).

Bivariate analysis (Table I) indicated no statistically significant differences between knowledge level and level of medication adherence about T2DM across variables such as sex, age, employment status, medication history, number of medications, number of oral antidiabetics, and types of comorbidities. Nonetheless, there was a significant correlation between educational attainment and knowledge level (p = 0.001). Patients with higher education levels showed higher levels of diabetes knowledge.

Table I: Patients' characteristics

Characteristics		(N=104)		Diabetes knowledge level			*p*	Diabetes medication adherence level			*p*
		n	%	High	Medium	Low		High	Medium	Low	
Sex	Male	24	23.1	9	5	10	0.989	8	11	5	0.146
	Female	80	76.9	31	17	32		38	20	22	
Age (63.01±8.907)	<45	2	1.9	2	0	0	0.227	0	1	1	0.771
	45-65	62	59.6	20	16	26		27	19	16	
	>65	40	38.5	18	6	16		19	11	10	
Education	Illiterate and elementary school	30	28.8	5	8	17	0.001*	11	10	9	0.538
	Middle and high school	58	55.8	22	13	23		30	15	13	
	Higher education	16	15.4	13	1	2		5	6	5	
Employment	Employee	22	21.2	5	7	10	0.176	7	10	5	0.185
	Unemployed	82	78.8	35	15	32		39	21	22	
Medication history	< 1 year	16	15.4	4	2	10	0.398	7	6	3	0.895
	1-10 years	63	60.6	24	16	23		27	19	17	
	> 10 years	25	24.0	11	5	9		12	6	7	
Number of medications	< 5 drugs	91	87.5	33	22	36	0.124	43	26	22	0.250
	≥ 5 drugs	13	12.5	7	0	6		3	5	5	
Number of oral antidiabetics	Monotherapy	47	45.2	17	7	23	0.196	21	12	14	0.602
	Combination therapy	57	54.8	23	15	19		25	19	13	
Comorbidity	No comorbid	35	33.7	18	5	12	0.080	18	8	9	0.729
	Hypertension	47	45.2	14	9	24		20	16	11	
	Other diseases	22	21.1	8	8	6		8	7	7	

*Chi-Square test (*P*-value < 0.05)

According to the results of a self-developed questionnaire, The majority of the patients (40.4%, n = 42) demonstrated low knowledge about diabetes and related medications, while 38.5% had a high level of knowledge. Twenty-six percent of the participants had poor medication adherence. As pointed out in Table II, there is an association between medication adherence levels and therapeutic outcomes (P = 0.007). The contingency coefficient for this analysis is 0.296. Diabetic patients with high levels of medication adherence were more likely to have controlled therapeutic outcomes [O.R. = 2.263, 95% CI: 1.333–3.841] (Ridhayani, 2020; Salsabila, 2020). Controlled glucose levels are defined if the fasting blood sugar < 126 mg/dL and/or random blood sugar < 200 mg/dL.

Table II: Association between medication adherence level and among patients with DM type 2

Variables	Levels	n (%)	Therapeutic outcome		*P* value*
			Controlled	Uncontrolled	
Medication adherence (Mean score=1.34±1.40)	Low	27 (26.0)	12 (11.6)	15 (14.4)	**0.007**
	Medium	30 (28.8)	21 (20.2)	10 (9.6)	
	High	47 (45.2)	37 (35.6)	9 (8.7)	

*Chi-Square test (P-value < 0.05); DM: Diabetes Mellitus

The dominant factor as a reason for non-adherence to medications among patients with T2DM is issues related to diseases. Over half of the participants (73.0%, n = 76) reported complaints related to coronary artery diseases, including chest pain, fatigue, or shortness of breath, which worsened their DM condition. This reason was followed by approximately half of the respondents (51.0%, n = 53) complaining about vision problems or tingling in feet/hands that exacerbate their DM condition. Additionally, prolonged wait times for receiving medications emerged as a primary reason for nonadherence, alongside patients continuing to experience DM symptoms and having uncontrolled glucose levels despite medication use, at 49.0%, 45.2%, and 43.3%, respectively (Table III).

Table III: Factors as reason related non-adherence to medication among patients with DM type 2

Factors	Reasons	n	%
Related to medication	Too many medications	29	27.9
	Patients need to pay for the medication	26	25.0
	Experienced adverse effects from anti-diabetic medication	25	24.0
	Stop taking medication due to medication shortage	27	26.0
	Feel uncomfortable after taking anti-diabetic medication	30	28.8
Related to disease	Uncontrolled glucose level after consuming medication	45	43.3
	Patients still experience DM symptoms after taking medication	47	45.2
	Complaints about vision problems or tingling in feet/hands that exacerbate DM	53	51.0
	Complaints about heart coronary artery disease (Chest pain, fatigue, and shortness of breath) that exacerbate DM	76	73.0
Related to medication information and health care services	Never received disease information related to DM during treatment by the doctor	20	19.2
	The patient never received medication information related to DM during treatment by the doctor	15	14.4
	The patient has yet to receive feedback from the doctor about queries and complaints related to medication and disease during treatment	16	15.4
	The patient has yet to receive feedback from the pharmacist about queries and complaints related to medication and disease during treatment	41	39.4
	Long waiting time	51	49.0
	Uncomfortable hospital facility	22	21.2
Related to patient	Never changes the lifestyle	15	14.4
	Not knowing what to do and avoid during DM treatment	26	25.0
	Supported by the family during DM treatment	34	32.7

DM: Diabetes Mellitus

Patients' perspective: Factors contributing to medication non-adherence

In addition to identifying the factors related to medication nonadherence, as shown in Table III, the researchers also explored other factors and clarified participants' responses through open-ended questions. Participants shared their stories about DM medication adherence, producing detailed descriptions that answered the research questions. The majority of participants reported being worried about the chemical drug's effect on their organs and still doubted the chemical drug's effectiveness. One of the participants recounted:

> *"After getting an explanation about herbal remedies from a salesman and hearing the stories from relatives about the side effects of chemical medicine, I feel like I've been concerned about my health condition after taking the DM medicine for a long ago. I really felt worried, especially while consuming the drug." (Patient5 interviewed by FR)*

Participants also expressed concerns about taking diabetes medications related to their condition. They revealed that the medication does not fully manage their disease and can still result in various complications, including tingling in the extremities and coronary artery disease.

> *"I still complained the feet tingling, chest pain, and blurred vision. I don't think my diabetes drug helps my condition." (Patient7 interviewed by FR)*

However, the focus extended beyond medication and disease aspects; medication information and healthcare services also played a crucial role in supporting medication adherence, particularly regarding the waiting time to obtain medication and the information provided about it.

> *"My health condition is valuable, but as a parent, I need to work to fulfill my family's needs, therefore I can't always bear a long wait only to acquire my prescription." (Patient12 interviewed by FAS)*

Apart from patients' medication nonadherence and knowledge aspects, this study assessed pharmacists' strategies to overcome these issues through a questionnaire followed by the FGD session. Twenty-four participants, all primary healthcare pharmacists (n = 24), took part in the FGD, which lasted 60 minutes.

Pharmacists' perspective: Pharmacists' strategies in managing patient-related medication

The pharmacists argued that some strategies are designed to improve patients' knowledge and adherence. Table IV shows that nearly all pharmacists (n = 23, 95.8%) employ various strategies to improve patients' health and healthcare services. The actions include providing drug information, counselling, a personal booklet, medication control card and notes, a leaflet, and online reminders for the drug administration schedule. They are eager to give in-depth information regarding disease knowledge and medication adherence through their several practice strategies.

To raise diabetes patients' awareness, most pharmacists deliver drug information services and patient counselling using a leaflet instrument that includes a disease description and a brief overview of drug usage.

> *"As a pharmacist, we provide leaflet media for drug information services that contain disease and drug usage descriptions, the proportion is 30% and 70% respectively. We also have a counselling form." (FGD, Pharmacist1)*

Table IV: Types of implemented pharmacist strategies to overcome knowledge and adherence issues

Aspects	N (%)	Types of strategies
Knowledge	23 (95.8%)	1. Drug information services and patient counselling with or without leaflets 2. Educating patients and communities 3. Providing home care visit 4. Delivering health promotion related to non-communicable diseases through videos 5. Labeling the drug using a sticker with detailed drug information 6. Delivering the questionnaire to evaluate patient knowledge and belief
Adherence	23 (95.8%)	1. Providing medication control card 2. Providing patients with personal booklet and notes 3. Counselling 4. Educating patients, including drug consumption habits 5. Applying visit attendance for medication collection 6. Providing home care visit 7. Reminding the schedule to visit the doctor through an online message

More strategies have been generated to assist T2DM patients adhere to their medications. Pharmacists offer services to patients holistically, focusing not only on medication delivery but also on individual conditions and optimising their strategies to cover all of the medication adherence problems by providing a variety of helper tools, including medication control cards, patient's booklets, and notes.

> *"Pharmacy team develop notes for assessing patients "visit attendance, provide medication control card, and facilitate patients with personal booklet and notes." (FGD, Pharmacist10)*

Moreover, as the first point of contact in primary healthcare, pharmacists faced increasing challenges in fulfilling their ideal role due to various limitations. The pharmacists stated that improving pharmacy services requires expanding counselling rooms and developing standardised guidelines for all pharmacists in primary healthcare. The pharmacists reported:

> *"As a pharmacist, I want to perform a counselling session with my patients, but the room conditions are not spacious and do not support, also limited time availability due to high workload, it makes me only deliver simple drug information services." (FGD, Pharmacist5)*

> *"I'm not sure how to create decent strategies for optimising the patients' knowledge and medication adherence, it isn't a simple thing, I believe the only solution is to elaborate the strategies and develop a standard guideline for implemented strategies." (FGD, Pharmacist10)*

Discussion

An in-depth evaluation of patient's knowledge about their disease and their level of medication adherence, along with an analysis of pharmacists' strategies as healthcare providers, is anticipated to form the foundation for creating an optimal pharmacy service framework for primary healthcare in Indonesia (Bindu Murali *et al.*, 2016; Kassahun *et al.*, 2016; Ligita *et al.*, 2019). The recent model focuses on extending pharmacists' service beyond their usual activities involving patients and other health workers to achieve excellent therapeutic outcomes, specifically for individuals with chronic diseases (Bindu Murali *et al.*, 2016).

The study collected data from 104 patients with T2DM in Yogyakarta, Indonesia, to measure their knowledge and medication adherence related to T2DM. The mean age of participants was 63 years, and the largest proportion (76.9%, n = 80) were females. Trusda et al. reported that the characteristics of patients with T2DM are dominated by females and age ranges between 55–65 years (Trusda *et al.*, 2021). The prevalence of T2DM rises substantially with age, whereas about 25% of adults 65 years or older experience diabetes. This condition is due to impaired pancreatic islet function and insulin resistance correlated with ageing (Rooney *et al.*, 2021). This suggests that older individuals are at greater risk, highlighting the need for targeted measures to address the disparity between age groups, even though the findings of this study indicate a good level of knowledge among patients over 65 years old.

This study shows that an illiterate's knowledge of diabetes was significantly lower than that of people with a higher secondary education ($P = 0.001$). This is not remarkable since that information is acquired through their education. This finding was supported by research from Indonesia and Thailand (Phoosuwan *et al.*, 2022; Wijayanti, 2022). Lower educational levels might result in low self-management skills and poor health-seeking behaviours. Unfortunately, most patients in this study (40.4%) had low knowledge. Thus, as recommendations, providing health education from health workers, especially pharmacists, can improve diabetes-related knowledge levels that would be effective in reducing diabetic morbidity as well as mortality (Kassahun *et al.*, 2016; Wijayanti, 2022).

In this study, most individuals had high degrees of medication adherence and controlled glucose levels, 45.2% and 67.4%, respectively. Although these figures are higher than those previously reported in Indonesia (37.1% and 44.0%) and Northwest Ethiopia (23.1% and 25.3%), the prevalence of T2DM in the current investigation highlights diabetes as a significant health concern that necessitates strategic management to continue optimising glucose target achievement (Saibi *et al.*, 2020; Sendekie *et al.*, 2022). This study also found that medication adherence is a key factor significantly affecting glucose level control as a therapeutic outcome [O.R. = 2.263, 95% CI: 1.333–3.841], highlighting the importance of strategic management. This aligns with findings from Malaysia, which indicate that adherent patients with DM are twice as likely to achieve better glycemic control compared to those who are nonadherent [O.R. = 2.688, 95% CI: 1.534–4.708] (Chin *et al.*, 2023). These study findings highlight the importance of medication adherence for optimising therapeutic outcomes, including achieving better glycemic control and minimising eventual disease consequences among individuals with DM.

Strategic management is essential to address the potential issues identified in this study, as the majority of T2DM patients cited disease-related reasons for

their medication non-adherence, which could lead to a perception of ineffective therapy. Prior research has also connected the possibility of patient, drug, healthcare, provider, societal, and disease-related variables as impediments to T2DM patients' medication adherence (Alodhaib *et al.*, 2021; Zairina *et al.*, 2022; Upamali & Rathnayake, 2023). Diabetes complications afflicted a large number of patients. They felt that the medication was insufficient to prevent the condition's progression, so they discontinued it or reduced their adherence (Alodhaib *et al.*, 2021). All factors that have the potential role as barriers to medication non-adherence shall be considered by pharmacists to develop a more effective and efficient patient management framework to improve medication adherence. Hence, previously published studies suggest implementing medication therapy management as a pharmacist-led service to improve patient adherence, especially for diabetes medications (Bindu Murali *et al.*, 2016; Presley *et al.*, 2019).

Understanding the pharmacists' practice strategies as primary providers of pharmacy services is critical for determining the necessary interventions to ensure successful programme implementation, especially for improving patient medication adherence (Bindu Murali *et al.*, 2016; Kassahun *et al.*, 2016). According to the findings of this survey, almost all primary care pharmacist participants (n = 23, 95.8%) had favourable practices about standard pharmacy services and implemented a variety of strategies to tackle the knowledge and adherence issues existing among patients, despite the fact that various hurdles to pharmacy practice remain.

In practice, most pharmacists already initiated many strategies to elevate their patients' knowledge and medication adherence, such as offering drug information services and counselling, providing home care visits, and developing medication control cards, leaflets, personal booklets, and notes. Patient education leaflets and booklets have been found to be an effective method for communicating with diabetics. Other studies found that leaflets might enhance patients' awareness, allowing diabetes patients to commit to therapy and better control their disease (Al Assaf *et al.*, 2022; Laparidou *et al.*, 2022). Community pharmacists' actions, which included drug information services, counselling, leaflets, as well as personal notes and booklets, contributed to increased patient adherence and promoted diabetes-related self-empowerment by increasing medication awareness and encouraging positive behaviour changes through improved disease management (Al Assaf *et al.*, 2022).

On the other hand, this research pointed out some challenges to future ideal pharmacists' service adoption. The main barriers include a high workload that takes lots of pharmacists' time, limited time availability, the scarcity of counselling rooms, and the need for guidelines of standard strategies. This result was consistent with earlier research where pharmacists experience limited counselling room availability and lack of time as main challenges to incorporating pharmacy service into their workflow (Bou-Saba *et al.*, 2022; Arif *et al.*, 2023; Tadesse *et al.*, 2023). However, adequate time is crucial for pharmacists to thoroughly address and understand patients' therapy issues. Healthcare providers should address these barriers to support the effective implementation of standard pharmacy services and enhance health-related outcomes.

The government, primary healthcare providers, the Indonesian Pharmacists Association, and pharmacy service experts should collaborate to develop strategic steps to achieve better knowledge, medication adherence, and therapeutic outcomes. This initiative is expected to strengthen the essential function of primary healthcare as the gatekeeper of health in Indonesia. Thus, a new comprehensive model for primary healthcare pharmacy services in Indonesia is required. As a reference, implementing medication therapy management as a valuable pharmacist-led service that successfully enhances patients' adherence to medications and results in their clinical outcome improvement could be considered (Rodis *et al.*, 2017). A new pharmacy service model for primary healthcare in Indonesia might refer to medication therapy management (MTM) models with specific modifications based on existing pharmacy service concerns, community conditions, and the concept of standard pharmacy services in primary healthcare. This approach could lead to developing a comprehensive MTM model specifically designed for primary healthcare in Indonesia.

Limitations

Furthermore, this study was limited only to primary healthcare in the Yogyakarta area, so the findings of this study are insufficient to extrapolate to project diabetes-related knowledge, medication adherence among T2DM patients, and pharmacist strategies to overcome the health issues across the entire Indonesian community.

Conclusion

In conclusion, improving patient knowledge, addressing non-adherence, and standardising pharmacists' strategies are necessary, along with the

creation of a comprehensive service model to enhance therapeutic outcomes.

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Conflict of interest

The authors declare no conflict of interest.

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