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Enhancing Type 2 Diabetes Management: The Role of Pharmacist-Led Education and Booklets

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A B S T R A C T

Type 2 diabetes mellitus (T2DM) is a global health concern, necessitating effective management to prevent complications. Pharmacists, as accessible healthcare professionals, can play a pivotal role in patient education and self-management support. This study aimed to evaluate the impact of pharmacist-led education and booklets on glycemic control and self-management behaviors in patients with T2DM. A quasi-experimental study was conducted at a hospital in Central Java, Indonesia. Patients diagnosed with T2DM for at least six months were recruited. The intervention group received pharmacist-led education and a booklet, while the control group received standard care. Fasting blood glucose (FBG) and self-management behaviors were assessed at baseline and after three months. The intervention group demonstrated a significant reduction in FBG levels compared to the control group ($p < 0.05$). Additionally, the intervention group showed improvements in self-management behaviors, including medication adherence, dietary control, and physical activity. Pharmacist-led education and booklets are effective in improving glycemic control and self-management behaviors in patients with T2DM. This intervention can be integrated into routine diabetes care to enhance patient outcomes.

1. Introduction

Type 2 diabetes mellitus (T2DM) has emerged as a pressing global health challenge, characterized by chronic hyperglycemia stemming from a complex interplay of insulin resistance and impaired insulin secretion.[1] The escalating prevalence of T2DM, with an estimated 537 million adults affected worldwide in 2021 and projections indicating a further surge to 783 million by 2045, underscores the urgent need for effective management strategies.[1] This alarming trend is mirrored in Indonesia, where the number of adults living with diabetes reached 19.5 million in 2021, placing a substantial burden on the nation's healthcare system.[1] The multifaceted nature of T2DM, encompassing genetic, environmental, and lifestyle factors, contributes to its complexity and necessitates a comprehensive approach to management.[2]

The ramifications of uncontrolled T2DM extend far beyond mere hyperglycemia. The chronic elevation of blood glucose levels sets the stage for a cascade of microvascular and macrovascular complications, profoundly impacting patients' quality of life and overall well-being. Microvascular complications, including retinopathy, nephropathy, and neuropathy, can lead to blindness, kidney failure, and nerve damage, respectively.[3] Macrovascular complications, such as cardiovascular disease and stroke, are major contributors to morbidity and mortality in individuals with T2DM.[3] The cumulative burden of these complications not only affects patients' physical health but also exacts a toll on their mental and emotional well-being, underscoring the imperative for proactive and effective T2DM management. The cornerstone of T2DM management lies in empowering patients to

actively participate in their care through self-management. This multifaceted approach encompasses a range of behaviors and practices, including medication adherence, dietary modifications, regular physical activity, blood glucose monitoring, and meticulous foot care.[4] By diligently adhering to these self-management recommendations, individuals with T2DM can achieve optimal glycemic control, mitigate the risk of complications, and enhance their overall quality of life. However, the path to successful self-management is often fraught with challenges. Patients may encounter barriers such as lack of knowledge, limited motivation, inadequate support systems, and socioeconomic constraints, hindering their ability to effectively manage their condition.[2]

In the face of these challenges, pharmacists have emerged as key players in the multidisciplinary team approach to T2DM management. Their accessibility, expertise in medication management, and patient-centered approach position them uniquely to provide comprehensive education and support to individuals with T2DM.[5] Pharmacist-led interventions have demonstrated efficacy in improving various aspects of T2DM care, including glycemic control, medication adherence, and patient satisfaction.[3] These interventions encompass a wide array of activities, such as medication counseling, lifestyle recommendations, blood glucose monitoring assistance, and patient empowerment strategies. By leveraging their knowledge and skills, pharmacists can bridge the gap between patients and their healthcare providers, fostering a collaborative and patient-centered approach to T2DM management. Patient education serves as a cornerstone of pharmacist-led interventions in T2DM management. By equipping patients with the knowledge and skills necessary to understand their condition, make informed decisions, and adopt healthy behaviors, pharmacists can empower them to take an active role in their care.[6] Educational interventions can address a wide range of topics, including the pathophysiology of T2DM, potential complications, medication management, lifestyle modifications, and self-monitoring techniques. Through clear and concise communication, pharmacists can dispel misconceptions, address concerns, and foster a sense of self-efficacy in patients, enabling them to navigate the complexities of T2DM management with confidence. Educational materials, such as booklets, can serve as valuable adjuncts to pharmacist-led education in T2DM management. These booklets provide patients with a tangible and readily accessible resource that reinforces key messages and facilitates behavior change.[7] By presenting information in a clear and concise manner, incorporating visual aids, and offering practical tips, booklets can enhance patient understanding and retention of information. Moreover, booklets can be shared with family members and caregivers, fostering a supportive environment that promotes adherence to self-management recommendations. Building upon the existing evidence base, this study aimed to evaluate the impact of pharmacist-led education and booklets on glycemic control and self-management behaviors in patients with T2DM.

2. Methods

The study employed a quasi-experimental design, utilizing a cross-sectional approach to assess the impact of the intervention at a specific point in time. The quasi-experimental nature of the study was chosen due to the practical constraints of assigning patients randomly to intervention and control groups in a real-world clinical setting. The cross-sectional design allowed for efficient data collection and analysis, providing a snapshot of the intervention's effects. The research was conducted within the premises of Hospital X, situated in the Central Java region of Indonesia. The hospital serves a diverse population and offers a range of healthcare services, including outpatient diabetes care. The study spanned a period of three months, commencing in February 2024 and concluding in April 2024. This timeframe was deemed adequate to observe potential changes in glycemic control and self-management behaviors

following the intervention. Prior to the initiation of the study, ethical approval was sought and obtained from the Hospital X Ethics Committee. This ensured that the research adhered to ethical guidelines and protected the rights and well-being of the participants. All potential participants were provided with a comprehensive explanation of the study's purpose, procedures, and potential risks and benefits. Written informed consent was obtained from each participant before their enrollment in the study. The confidentiality and anonymity of the participants' data were maintained throughout the research process.

The study population comprised adult patients diagnosed with type 2 diabetes mellitus (T2DM) who were receiving treatment at the outpatient diabetes clinic of Hospital X. The inclusion criteria were carefully defined to ensure the selection of a homogenous sample that would allow for meaningful comparisons between the intervention and control groups. The inclusion criteria encompassed: Patients within the age range of 35 to 50 years were included. This age group was targeted as it represents a significant proportion of the T2DM population and is often associated with challenges in self-management due to work and family responsibilities; Only patients who had been diagnosed with T2DM for a minimum of six months were considered eligible. This criterion ensured that participants had sufficient experience with their condition and were likely to have established self-management routines; Patients receiving either oral antidiabetic medications or insulin therapy were included. This allowed for the evaluation of the intervention's impact across different treatment modalities; Female patients were required to not be pregnant at the time of enrollment. This exclusion criterion was implemented to avoid any potential risks to the fetus associated with the intervention; Participants needed to be free from any cognitive impairments that could hinder their understanding of the educational materials or their ability to provide informed consent. Additionally, they were required to have adequate communication skills to interact effectively with the pharmacist during the education sessions; Only patients who voluntarily expressed their willingness to participate in the study and provided written informed consent were enrolled. Conversely, certain exclusion criteria were applied to safeguard the validity of the study and ensure the safety of the participants. These exclusion criteria included: As mentioned earlier, pregnant women were excluded to avoid any potential harm to the fetus; Patients with cognitive impairments that could affect their comprehension or decision-making capacity were excluded; Individuals who declined to participate in the study were not included.

The recruitment process involved identifying potential participants from the outpatient diabetes clinic's patient records. Eligible patients were then approached by the research team and invited to participate. Those who met the inclusion criteria and expressed interest were provided with detailed information about the study and given the opportunity to ask questions. Upon providing written informed consent, they were enrolled in the study and assigned to either the intervention or control group based on a predetermined schedule. The study employed a purposive sampling technique to assign participants to the intervention and control groups. This non-random sampling method was chosen to ensure a balanced distribution of participants with varying characteristics across the two groups. The assignment was based on the patient's appointment dates at the outpatient diabetes clinic. Patients attending the clinic on specific days were allocated to the intervention group, while those attending on other days were assigned to the control group. This approach aimed to minimize selection bias and enhance the comparability of the two groups.

The intervention group received a multifaceted intervention comprising pharmacist-led education and a specifically designed booklet on T2DM self-management. The educational component involved personalized sessions conducted by a qualified pharmacist who had undergone specialized training in diabetes education. These sessions were tailored to the individual needs and knowledge levels of each

participant. The pharmacist utilized a patient-centered approach, actively engaging the participants in discussions and addressing their specific concerns. The educational content covered a wide range of topics essential for effective T2DM self-management. These topics included: Understanding T2DM: The pharmacist explained the pathophysiology of T2DM, its potential complications, and the importance of maintaining optimal glycemic control; Self-Management Strategies: Participants were educated on various self-management strategies, including medication adherence, dietary modifications, physical activity, blood glucose monitoring, and foot care; Medication Counseling: The pharmacist provided detailed information about the participants' prescribed medications, including their mechanism of action, dosage, potential side effects, and interactions; Lifestyle Modifications: Participants received guidance on adopting healthy lifestyle habits, such as following a balanced diet, engaging in regular physical activity, and avoiding smoking and excessive alcohol consumption; Blood Glucose Monitoring: The pharmacist instructed participants on the proper techniques for blood glucose monitoring and interpretation of results; Foot Care: Participants were educated on the importance of foot care and preventive measures to avoid complications. In addition to the pharmacist-led education, participants in the intervention group were provided with a comprehensive booklet on T2DM self-management. The booklet was designed to be user-friendly and visually appealing, incorporating illustrations and clear language to facilitate understanding. It served as a valuable reference tool, reinforcing the key messages conveyed during the education sessions and providing additional information and practical tips for self-management. The control group received standard care, which typically involved brief medication counseling by the pharmacist and the provision of general diabetes information leaflets. The medication counseling focused primarily on ensuring patients understood their medication regimen and potential side effects. The information leaflets provided basic information about T2DM but lacked the depth and personalization of the pharmacist-led education and booklet provided to the intervention group.

Data collection was conducted at two distinct time points: baseline and three months post-intervention. At baseline, data were collected before the intervention group received the pharmacist-led education and booklet. This initial data collection served as a reference point to assess the participants' glycemic control and self-management behaviors prior to the intervention. The follow-up data collection took place three months after the intervention. This timeframe allowed for sufficient time for the intervention to potentially exert its effects on the participants. The same data collection procedures were employed at both baseline and follow-up to ensure consistency and comparability of the data. The data collected encompassed various aspects relevant to T2DM management, including: Demographic Information: This included age, gender, education level, and occupation. These variables were collected to characterize the study population and identify any potential confounding factors; Clinical Characteristics: Information on the duration of diabetes, current medication use, and the presence of any comorbidities was gathered. These data provided insights into the participants' disease severity and potential impact on self-management; Fasting Blood Glucose (FBG) Levels: FBG levels were measured using standardized laboratory procedures. FBG is a key indicator of glycemic control and was used as the primary outcome measure in this study; Self-Management Behaviors: A validated questionnaire was utilized to assess various self-management behaviors, including medication adherence, dietary control, and physical activity. The questionnaire captured the frequency and consistency of these behaviors, providing a comprehensive picture of the participants' self-management practices. The data collection process was meticulously conducted to ensure accuracy and reliability. Trained research assistants collected the demographic and clinical data through interviews and review of medical records. FBG levels

were measured by qualified laboratory personnel using standardized protocols. The self-management questionnaire was administered by the research assistants, who provided clear instructions and ensured participants' understanding of the questions.

The collected data were entered into a secure database and analyzed using SPSS software (version 28). Descriptive statistics were employed to summarize the demographic and clinical characteristics of the participants, providing a clear overview of the study population. The independent t-test was utilized to compare the mean FBG levels and self-management scores between the intervention and control groups at both baseline and follow-up. This statistical test allowed for the assessment of the intervention's impact on these key outcome measures. Paired t-tests were also conducted to compare the changes in FBG levels and self-management scores within each group from baseline to follow-up. This analysis provided insights into the individual-level changes associated with the intervention and standard care. The level of statistical significance was set at $p < 0.05$. This threshold indicated that any observed differences between the groups or within each group were unlikely to have occurred by chance, suggesting a true effect of the intervention.

3. Results and Discussion

Table 1 presents the baseline characteristics of the participants in the intervention and control groups. The average age of participants in both groups is around 46 years old, with no significant difference between the groups (p=0.52). This suggests that both groups are comparable in terms of age. The majority of participants in both groups are female, with a slightly higher percentage in the intervention group (72.2% vs. 64.7%). However, this difference is not statistically significant (p=0.71), indicating that the gender distribution is balanced between the groups. Most participants in both groups have had T2DM for more than two years (80% overall), with a slightly higher percentage in the intervention group (83.3% vs. 76.5%). Again, this difference is not statistically significant (p=0.73). The vast majority of participants in both groups are taking oral antidiabetic medications (85.7% overall), with a slightly higher percentage in the intervention group (88.9% vs. 82.4%). The difference is not statistically significant (p=0.68). Overall, Table 1 demonstrates that the intervention and control groups are well-balanced in terms of key demographic and clinical characteristics at baseline. This comparability is crucial for ensuring that any observed differences in outcomes between the groups can be attributed to the intervention rather than pre-existing differences in the participants.

Table 1. Baseline characteristics of the study participants.

Characteristic	Intervention Group (n=18)	Control Group (n=17)	Total (N=35)	p-value
Age (years)	46.2 ± 3.5	46.8 ± 3.8	46.5 ± 3.6	0.52
Gender				
Female	13 (72.2%)	11 (64.7%)	24 (68.6%)	0.71
Male	5 (27.8%)	6 (35.3%)	11 (31.4%)	
Duration of T2DM				
≤ 2 years	3 (16.7%)	4 (23.5%)	7 (20.0%)	0.73
> 2 years	15 (83.3%)	13 (76.5%)	28 (80.0%)	
Medication				
Oral antidiabetic agents	16 (88.9%)	14 (82.4%)	30 (85.7%)	0.68
Insulin	2 (11.1%)	3 (17.6%)	5 (14.3%)	

Table 2 showcases the changes in fasting blood glucose (FBG) levels from baseline to the 3-month mark for both the intervention and control groups, along with the statistical significance of these changes. The intervention group, which received pharmacist-led education and a booklet, demonstrated a notable decrease in FBG levels from 160.5 mg/dL at baseline to 135.2 mg/dL after three months. This reduction is statistically significant ($p < 0.01$), highlighting the effectiveness of the intervention in improving glycemic control. The control group, receiving standard care, also exhibited a decrease in FBG levels from 158.8 mg/dL to 152.4 mg/dL. However, this change was not statistically significant ($p > 0.05$), suggesting that standard care did not lead to a meaningful improvement in glycemic control. The difference in FBG reduction between the intervention and control groups was statistically significant ($p < 0.05$). This indicates that the intervention was more effective in lowering FBG levels compared to standard care, underscoring the positive impact of pharmacist-led education and booklets on glycemic management. Overall, Table 2 provides compelling evidence that the pharmacist-led education and booklet intervention had a significant positive effect on glycemic control in patients with T2DM. The intervention group not only experienced a substantial reduction in FBG levels but also outperformed the control group in terms of glycemic improvement.

Table 2. Changes in fasting blood glucose (FBG) levels.

Group	**Baseline FBG (mg/dL)**	**3-Month FBG (mg/dL)**	**p-value (within-group)**	**p-value (between-group)**
Intervention	160.5	135.2	< 0.01	
Control	158.8	152.4	> 0.05	< 0.05

Table 3 displays the changes in self-management behaviors (medication adherence, dietary control, and physical activity) from baseline to the 3-month follow-up for both the intervention and control groups, along with the statistical significance of these changes. The intervention group, which received pharmacist-led education and a booklet, showed significant improvements in all three self-management behaviors: Medication Adherence: The score increased from 3.5 to 4.8 ($p < 0.01$), indicating better adherence to their medication regimen; Dietary Control: The score improved from 2.8 to 3.6 ($p < 0.01$), suggesting better dietary management; Physical Activity: The score rose from 2.2 to 3.0 ($p < 0.01$), signifying increased physical activity levels. The control group did not exhibit any statistically significant changes in any of the self-management behaviors. The scores remained relatively stable from baseline to the 3-month follow-up, suggesting that standard care did not lead to improvements in these behaviors. The between-group comparisons at 3 months reveal significant differences in favor of the intervention group for dietary control ($p < 0.01$) and physical activity ($p < 0.05$). Although the intervention group also showed a numerical improvement in medication adherence compared to the control group, this difference did not reach statistical significance. Overall, Table 3 provides strong evidence that the pharmacist-led education and booklet intervention was successful in promoting positive changes in self-management behaviors among patients with T2DM. The significant improvements in dietary control and physical activity, coupled with the trend towards better medication adherence, highlight the potential of this intervention to empower patients and enhance their self-care practices.

Table 3. Changes in self-management behaviors.

Behavior	Group	Baseline score	3-month score	p-value (within-group)	p-value (between-group)
Medication adherence	Intervention	3.5	4.8	< 0.01	
Medication adherence	Control	3.8	3.7	> 0.05	
Dietary control	Intervention	2.8	3.6	< 0.01	< 0.01
Dietary control	Control	3	3.1	> 0.05	
Physical activity	Intervention	2.2	3	< 0.01	< 0.05
Physical activity	Control	2.5	2.6	> 0.05	

The findings of this quasi-experimental study provide compelling evidence for the efficacy of pharmacist-led education coupled with the provision of booklets in enhancing the management of type 2 diabetes mellitus (T2DM). The significant reduction in fasting blood glucose (FBG) levels and the notable improvements in self-management behaviors observed in the intervention group underscores the potential of this intervention to empower patients and foster better glycemic control. The results align with the growing body of evidence supporting the pivotal role of pharmacists in diabetes care, extending beyond traditional medication dispensing to encompass patient education and self-management support. The substantial decrease in FBG levels in the intervention group compared to the control group highlights the effectiveness of the educational intervention in promoting better glycemic management. This finding resonates with previous research demonstrating the positive impact of pharmacist-led interventions on glycemic control in T2DM patients. The personalized education sessions, tailored to individual needs and knowledge levels, likely played a crucial role in enhancing patients' understanding of their condition, treatment options, and self-management strategies. The interactive nature of these sessions, fostering open communication and addressing patient-specific concerns, may have further contributed to improved adherence and glycemic outcomes.[7,8]

The provision of a comprehensive booklet on T2DM self-management served as a valuable adjunct to the pharmacist-led education. The booklet, designed to be user-friendly and visually appealing, likely reinforced key messages and provided patients with a readily accessible reference tool. The inclusion of illustrations and practical tips may have facilitated understanding and retention of information, empowering patients to implement self-management strategies effectively. The observed improvement in glycemic control can be attributed to several factors. Firstly, the enhanced understanding of T2DM and its potential complications may have motivated patients to take a more proactive role in their care. Secondly, the education on medication adherence, dietary modifications, and physical activity likely equipped patients with the knowledge and skills necessary to make informed decisions and adopt healthier lifestyle habits. Thirdly, the ongoing support and encouragement provided by the pharmacist during follow-up visits may have fostered a sense of accountability and sustained motivation for self-management. The significant improvements in self-management behaviors, including medication adherence, dietary control, and physical activity, observed in the intervention group further attest to the effectiveness of the pharmacist-led intervention. These findings are consistent with previous studies demonstrating the positive impact of pharmacist interventions on various aspects of self-management in T2DM patients. Medication adherence is a critical determinant of glycemic control, and pharmacist-led interventions have been shown to improve adherence rates through medication counseling, addressing barriers to adherence, and providing ongoing support.

In this study, the personalized education sessions and the booklet likely contributed to improved medication adherence by enhancing patients' understanding of their medications, clarifying any misconceptions, and emphasizing the importance of consistent medication use.[8,9]

Dietary modifications and physical activity are integral components of T2DM management, and pharmacist-led education can play a crucial role in facilitating behavior change in these areas. The education sessions and booklet likely provided patients with practical guidance on healthy eating habits and exercise routines, empowering them to make sustainable lifestyle changes. The pharmacist's support and encouragement may have further motivated patients to adhere to these recommendations. The positive impact of the intervention on self-management behaviors can be attributed to several factors. Firstly, the patient-centered approach adopted by the pharmacist, focusing on individual needs and concerns, may have fostered a sense of empowerment and self-efficacy among the participants. Secondly, the comprehensive and easily understandable information provided in the education sessions and booklet likely enhanced patients' knowledge and skills, enabling them to make informed decisions about their self-management. Thirdly, the ongoing support and follow-up provided by the pharmacist may have helped patients overcome barriers to behavior change and maintain their motivation over time. The findings of this study can be interpreted through the lens of several theoretical frameworks that shed light on the mechanisms underlying the observed improvements in glycemic control and self-management behaviors.[9,10]

The application of social cognitive theory (SCT) provides a robust framework for understanding the positive outcomes observed in this study. SCT posits that behavior change is a dynamic process influenced by the reciprocal interaction of personal factors, environmental factors, and behavioral factors. The pharmacist-led educational intervention, coupled with the provision of a self-management booklet, strategically targeted each of these factors to facilitate and sustain positive changes in patients' self-management behaviors. Self-efficacy, a central tenet of SCT, refers to an individual's belief in their ability to successfully execute a specific behavior. In the context of T2DM management, self-efficacy encompasses patients' confidence in their ability to adhere to medication regimens, make dietary modifications, engage in regular physical activity, monitor blood glucose levels, and perform proper foot care. The pharmacist-led education sessions played a pivotal role in bolstering patients' self-efficacy by equipping them with the knowledge and skills necessary for effective self-management. The educational content, tailored to individual needs and knowledge levels, empowered patients to understand their condition, its potential complications, and the rationale behind various self-management strategies. The pharmacist's expertise and guidance instilled confidence in patients, enabling them to make informed decisions about their care. The provision of a comprehensive booklet further reinforced this knowledge acquisition, serving as a readily available resource for patients to consult and review. The combination of personalized education and a tangible reference tool fostered a sense of competence and control, thereby enhancing patients' self-efficacy.[10,11]

Environmental factors, another key component of SCT, encompass the social and physical contexts that can either facilitate or hinder behavior change. In this study, the pharmacist's support and encouragement created a positive social environment that nurtured patients' self-management efforts. The pharmacist's empathetic and non-judgmental approach fostered a safe space for patients to express their concerns and challenges. The individualized attention and ongoing support provided by the pharmacist likely strengthened patients' motivation and commitment to self-management. Moreover, the hospital setting itself may have contributed to a supportive environment. The presence of other healthcare professionals and patients with similar health conditions may have fostered a sense of community and shared

responsibility for health. The accessibility of the pharmacist and the availability of educational resources within the hospital likely further facilitated patients' engagement in self-management. Behavioral factors, the third element of SCT, refer to the actual behaviors individuals engage in and the consequences of those behaviors. In this study, the improvements in self-management behaviors observed in the intervention group served as positive reinforcements, further strengthening patients' self-efficacy and motivation. As patients experienced the benefits of adhering to medication regimens, making dietary modifications, and engaging in physical activity, their belief in their ability to manage their condition likely grew stronger. The positive feedback loop created by the interaction of personal, environmental, and behavioral factors is a key mechanism through which SCT explains sustained behavior change. The pharmacist-led intervention, by targeting all three factors, likely initiated and perpetuated this positive feedback loop, leading to long-term improvements in self-management and glycemic control.[11,12]

The health belief model (HBM) offers a valuable lens through which to understand the positive outcomes observed in the intervention group of this study. The HBM posits that the adoption of health-promoting behaviors is contingent upon an individual's beliefs and perceptions about a health threat and the potential benefits and barriers associated with taking action. The pharmacist-led education and booklet intervention likely influenced several key constructs of the HBM, thereby facilitating behavior change and improved self-management among the participants. The HBM emphasizes the importance of individuals perceiving themselves as susceptible to a health problem. In the context of T2DM, this translates to patients recognizing their risk of developing complications such as cardiovascular disease, nephropathy, retinopathy, and neuropathy. The pharmacist-led education sessions likely heightened participants' awareness of these potential complications, emphasizing the link between uncontrolled blood sugar levels and the increased risk of long-term health problems. By providing clear and evidence-based information about the consequences of poor glycemic control, the intervention may have instilled a sense of vulnerability and heightened participants' perceived susceptibility to T2DM-related complications. The booklet provided to the intervention group likely further reinforced this perception by presenting visual representations of the potential complications and their impact on patients' quality of life. The vivid imagery and personal narratives included in the booklet may have made the potential consequences of uncontrolled T2DM more tangible and salient, prompting participants to reconsider their self-management practices.[12,13]

The HBM also underscores the significance of individuals perceiving the severity of a health problem. In the case of T2DM, this involves recognizing the potential seriousness and debilitating nature of the complications associated with the disease. The pharmacist-led education sessions likely emphasized the potential impact of T2DM complications on various aspects of patients' lives, including their physical health, emotional well-being, and social functioning. By highlighting the potential loss of independence, disability, and even premature mortality associated with uncontrolled T2DM, the intervention may have instilled a sense of urgency and motivated participants to take action to prevent or delay the onset of complications. The booklet provided to the intervention group likely further underscored the severity of T2DM complications by presenting detailed information about their symptoms, progression, and impact on daily life. The inclusion of testimonials from patients who had experienced complications may have served as a powerful reminder of the potential consequences of inadequate self-management, prompting participants to take their condition more seriously. The HBM posits that individuals are more likely to adopt health-promoting behaviors if they believe in the benefits of taking action. In the context of T2DM, this translates to patients recognizing the positive impact of self-management on their health and well-being. The pharmacist-led education

sessions likely highlighted the potential benefits of medication adherence, dietary modifications, physical activity, and other self-management strategies. By emphasizing the potential for improved glycemic control, reduced risk of complications, and enhanced quality of life, the intervention may have instilled a sense of optimism and motivated participants to embrace self-management practices. The booklet provided to the intervention group likely further reinforced the perceived benefits of self-management by presenting success stories of patients who had achieved better glycemic control and prevented complications through lifestyle changes and adherence to their treatment plan. These positive examples may have served as a source of inspiration and encouragement for participants, demonstrating the tangible benefits of taking an active role in their care.[13,14]

The HBM also acknowledges the role of perceived barriers in influencing health behavior. In the case of T2DM, these barriers may include lack of knowledge, motivation, time, financial constraints, or social support. The pharmacist-led education sessions likely addressed these potential barriers by providing clear and practical information, offering strategies to overcome challenges, and connecting patients with resources and support services. By acknowledging and addressing these barriers, the intervention may have reduced the perceived difficulty of self-management and increased participants' confidence in their ability to make and sustain positive changes. The booklet provided to the intervention group likely further addressed perceived barriers by offering practical tips and solutions for common challenges faced by T2DM patients. The inclusion of troubleshooting guides and frequently asked questions may have helped participants anticipate and overcome obstacles, thereby facilitating adherence to self-management recommendations. The HBM also recognizes the role of cues to action in triggering health behavior change. These cues can be internal (e.g., experiencing symptoms) or external (e.g., receiving a reminder from a healthcare provider). The pharmacist-led education sessions and booklet likely served as external cues to action, prompting participants to reflect on their current self-management practices and consider making changes. The regular follow-up visits with the pharmacist may have provided additional cues to action, reinforcing the importance of self-management and providing opportunities for ongoing support and guidance. Self-efficacy, or an individual's belief in their ability to perform a specific behavior, is a central construct in the HBM and other social cognitive theories. The pharmacist-led education and booklet likely enhanced participants' self-efficacy by providing them with the knowledge, skills, and support necessary for successful self-management. The pharmacist's positive reinforcement and encouragement may have further bolstered participants' confidence in their ability to manage their condition effectively. The pharmacist played a pivotal role in the success of the intervention, serving as a knowledgeable and accessible source of information, support, and motivation. The pharmacist's expertise in medication management, coupled with their understanding of T2DM self-management, enabled them to provide tailored education and guidance to each participant. The pharmacist's interpersonal skills and patient-centered approach likely fostered a trusting relationship with the participants, facilitating open communication and enhancing engagement in the intervention. The pharmacist's role extended beyond the initial education sessions, as they provided ongoing support and follow-up during subsequent visits. This continuity of care likely reinforced the key messages conveyed during the education sessions and helped participants address any challenges or concerns that arose during their self-management journey. The pharmacist's accessibility and willingness to answer questions may have further empowered patients and strengthened their commitment to self-care. The findings of this study highlight the significant impact of pharmacist-led education and booklets on glycemic control and self-management behaviors in patients with T2DM. The intervention's success can be attributed to its

alignment with key constructs of the Health Belief Model, including perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy. The pharmacist's expertise, patient-centered approach, and ongoing support played a crucial role in facilitating behavior change and empowering patients to take an active role in their care. The results of this study have important implications for pharmacy practice and diabetes care. By integrating pharmacist-led education and booklets into routine diabetes management, healthcare providers can leverage the unique skills and knowledge of pharmacists to enhance patient outcomes and reduce the burden of T2DM complications. Future research should explore the long-term impact of this intervention and its potential for implementation in various healthcare settings.[14-16]

The transtheoretical model (TTM), also known as the stages of change model, offers a valuable framework for understanding the process of behavior change, particularly in the context of chronic disease management like type 2 diabetes mellitus (T2DM). The model posits that individuals progress through a series of stages when adopting new health behaviors and that interventions can be tailored to facilitate movement through these stages. The pharmacist-led intervention in this study, comprising education and a booklet, likely played a crucial role in catalyzing this progression, empowering patients to transition from passive recipients of care to active participants in their own health management. The TTM outlines five distinct stages of change: Precontemplation: In this stage, individuals are not yet considering making any changes to their behavior. They may be unaware of the need for change or may be resistant to it. In the context of T2DM, patients in this stage may not perceive their condition as serious or may not believe that lifestyle changes can make a difference. Contemplation: Individuals in this stage are starting to consider making a change but have not yet committed to taking action. They may be weighing the pros and cons of change or may be ambivalent about it. T2DM patients in this stage may acknowledge the need for better self-management but may be hesitant due to perceived barriers or lack of confidence. Preparation: In this stage, individuals are actively planning to make a change in the near future. They may be setting goals, gathering information, or seeking support. T2DM patients in this stage may be making specific plans to improve their diet, increase physical activity, or adhere to their medication regimen. Action: Individuals in this stage are actively modifying their behavior. They are implementing their plans and making concrete changes. T2DM patients in this stage may be following a new diet, exercising regularly, and taking their medications as prescribed. Maintenance: In this stage, individuals have successfully sustained their behavior change for a significant period. They are working to prevent relapse and consolidate their gains. T2DM patients in this stage may have achieved good glycemic control and are continuing their self-management efforts.[16-18]

The pharmacist-led intervention in this study likely facilitated movement through the stages of change by addressing the specific needs and challenges of patients at each stage. Precontemplation to Contemplation: The educational component of the intervention, delivered by the pharmacist, may have raised patients' awareness of the need for change by highlighting the potential complications of uncontrolled T2DM and emphasizing the benefits of self-management. The booklet, with its clear explanations and illustrations, may have further reinforced these messages and stimulated contemplation of behavior change. Contemplation to Preparation: The pharmacist's support and encouragement may have motivated patients to move from contemplation to preparation by addressing their concerns, building their confidence, and helping them develop realistic action plans. The booklet may have served as a practical guide, providing specific strategies and tips for self-management. Preparation to Action: The pharmacist's ongoing support and follow-up may have been crucial in helping patients transition from preparation to action. By providing reminders, addressing barriers, and celebrating

successes, the pharmacist may have facilitated the implementation and maintenance of new behaviors. The booklet may have served as a constant reminder of the self-management goals and strategies. Action to Maintenance: The pharmacist's continued involvement and the availability of the booklet as a reference tool may have supported patients in sustaining their behavior change and preventing relapse. The pharmacist may have helped patients identify and address potential triggers for relapse and develop coping mechanisms to maintain their progress.[17-19]

Several theoretical mechanisms may explain how the pharmacist-led intervention facilitated movement through the stages of change: Consciousness Raising: The educational component of the intervention likely increased patients' awareness and understanding of T2DM, its complications, and the importance of self-management. This heightened consciousness may have motivated patients to consider making changes to their behavior. The intervention may have prompted patients to re-evaluate their current behaviors and their impact on their health. This self-reflection may have led to a shift in values and priorities, increasing the desire for change. The intervention may have helped patients recognize the impact of their behaviors on their social and physical environment. This awareness may have further motivated them to adopt healthier habits. The pharmacist's support and encouragement may have fostered a sense of self-efficacy and empowerment, enabling patients to believe in their ability to change and commit to action. The pharmacist's role as a trusted healthcare professional may have provided patients with a valuable source of support and guidance throughout the behavior change process. The intervention may have helped patients replace unhealthy behaviors with healthier alternatives. For example, patients may have learned to substitute sugary drinks with water or to incorporate physical activity into their daily routine. The booklet may have served as a visual cue, reminding patients of their self-management goals and strategies. The pharmacist's positive feedback and recognition of patients' progress may have reinforced their efforts and encouraged continued adherence to self-management recommendations. The transtheoretical model provides a valuable lens for understanding the complex process of behavior change in T2DM management. The pharmacist-led intervention in this study, by incorporating education, support, and a practical booklet, likely facilitated movement through the stages of change, empowering patients to adopt and sustain healthier behaviors. The observed improvements in glycemic control and self-management behaviors underscore the potential of this intervention to enhance patient outcomes and reduce the burden of T2DM complications. Future research should further explore the application of the TTM in pharmacist-led interventions and investigate the long-term impact of such interventions on patient health and well-being.[19,20]

4. Conclusion

This study provides robust evidence for the effectiveness of pharmacist-led education and booklets in improving glycemic control and self-management behaviors in patients with T2DM. The intervention's positive impact can be attributed to its patient-centered approach, comprehensive educational content, and ongoing support provided by the pharmacist. The findings underscore the crucial role of pharmacists in diabetes care and highlight the potential of this intervention to empower patients and optimize their self-management.

5. References

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