

THE EFFECT OF PHARMACIST INTERVENTION THROUGH TELEPHARMACY SERVICES ON COMPLIANCE AND FASTING BLOOD SUGAR LEVELS IN DIABETES MELLITUS TYPE 2 PATIENTS AT NATALIA FARMA PHARMACY

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ABSTRACT

Diabetes Mellitus is a disease that cannot be cured; thus, it requires high compliance to control blood sugar levels and prevent complications. Telepharmacy can help improve Type 2 Diabetes Mellitus Patients (T2DM) compliance by providing information and education about the disease, medications, and how to use the medication appropriately. The purpose of this study is to analyze the level of compliance and the fasting blood sugar levels of T2DM patients after receiving telepharmacy services by pharmacists at Natalia Farma Pharmacy. This study uses a cohort design with a purposive sampling technique. The research population is the diabetic patients at Natalia Farma Pharmacy in Ende Regency, with a sample size of 60 subjects. In this study, there were two groups observed, namely the intervention and control groups. The intervention group received additional telepharmacy services through WhatsApp for 3 months, including education, drug therapy monitoring, and reminders to take medication. Patient compliance and blood sugar measurement were carried out before and after administering the intervention. The data obtained were then analyzed using SPSS with the t-test. The results showed that telepharmacy affected both patient compliance and fasting blood sugar level, with p-values of 0.002 and 0.009, respectively. Therefore, the existence of telepharmacy intervention can significantly enhance patient compliance and help to control fasting blood sugar levels in T2DM patients at Natalia Farma Ende Pharmacy.

Keywords: Pharmacy; Diabetes Mellitus; Compliance; Telepharmacy

1. INTRODUCTION

Type 2 Diabetes Mellitus (T2DM) is a chronic disease with increasing prevalence in Indonesia. According to the International Diabetes Federation (IDF), approximately 19.46 million people in Indonesia suffer from diabetes, representing an 81.8% increase compared to 2019. This places Indonesia as the country with the fifth-highest number of diabetics in the world (after China, India, Pakistan, and the United States). In addition, Indonesia is the only country in Southeast Asia included in the top 10 countries with the most cases. This number is predicted to continue rising until it reaches 30.3 million people by 2045 (IDF, 2021).

In East Nusa Tenggara, the number of Diabetes Mellitus cases in 2018 was 74,867, which decreased to 30,557 in 2019. Among these cases, there were 21,784 patients (71.6%) who received health services according to standards. It can be seen from the East Nusa Tenggara Health Profile that, in 2018, Ende Regency ranked 11th among regencies and cities in the province in terms of Diabetes Mellitus cases, with a total of 700 cases, all of whom (100%) received health services. Based on data from the Ende Regency Health Profile in 2019, Diabetes

Mellitus is still one of the degenerative diseases that are a priority, with 1098 cases. By 2022, the number of cases had increased to 2,704 and 2,595 cases of services (Dinkes, 2022).

Self-management in DM patients is an important effort in controlling blood sugar levels and preventing complications, both microvascular and macrovascular, as such requires high compliance with medication. Non-compliance among diabetic mellitus patients can lead to adverse such as worsening the patient's condition, decreasing the quality of life, and increasing the risk of complications, which in turn leads to higher treatment costs. Non-adherence to treatment can be controlled by several methods, including education, treatment regimen management, clinical pharmacist consultations, medication reminders, cognitive behavioral therapy, and financial incentives. Telepharmacy services can also be applied to overcome the problem of non-compliance with medication. Therefore, in this era of modernization, there needs to be efforts to help T2DM patients control their blood sugar levels, such as the use of technology in improving blood sugar control management (Bingham et al., 2021; Raafi et al., 2021).

Telepharmacy, a component of telemedicine, offers an alternative healthcare service method by enabling pharmacists to provide pharmaceutical services remotely without face-to-face meetings. Previous research consistently indicates that pharmacists utilizing telepharmacy services can significantly improve compliance and assist in controlling blood sugar levels for patients with Type 2 Diabetes Mellitus. Consequently, the application of telepharmacy holds substantial potential for enhancing the quality of life for diabetic patients (Elnaem & Nuffer, 2022).

This study aims to evaluate the impact of telepharmacy services, delivered by pharmacists at Natalia Farma Pharmacy, on the compliance and fasting blood sugar levels of patients with Type 2 Diabetes Mellitus (T2DM). It is crucial to highlight that current evidence regarding the efficacy of telepharmacy within Indonesia remains notably scarce. This significant research gap underscores the importance of our study, as it seeks to provide essential empirical data on the effectiveness of telepharmacy interventions in the Indonesian healthcare landscape. Natalia Farma Pharmacy is dedicated to optimizing health services for T2DM patients and intends to integrate telepharmacy to enhance patient adherence and treatment outcomes. Telepharmacy offers a convenient alternative, enabling patients, particularly the elderly or those with mobility limitations, to consult pharmacists remotely without the need for in-person visits. Recognizing the limited exploration of telepharmacy's application for diabetic patients in Indonesia, this research endeavors to investigate the effects of pharmaceutical service interventions via telepharmacy on patient compliance and treatment targets at Natalia Farma Pharmacy, thereby addressing this critical void in the literature.

2. METHODS

This study is an observational study using a cohort design. This study was conducted from June to September 2024 at the Natalia Farma Pharmacy, Ende Regency. The population in this study was patients with T2DM who were treated at the Natalia Farma Pharmacy. The sampling technique was carried out by purposive sampling with a sample size of 60 subjects who met the inclusion criteria. The inclusion criteria are as follows: age ≥ 18 years; newly diagnosed with T2DM; and T2DM patients at the Natalia Farma Pharmacy. The exclusion criteria in this study were patients who were unwilling to be participants; patients who were pregnant; patients who were also treated at other health facilities. The data were collected through questionnaire completion, interviews, and observations by measuring blood sugar levels. In this study, there were two groups observed, namely the intervention and control groups. The telepharmacy intervention was carried out for 3 months using the WhatsApp application. The intervention included education, counseling, treatment monitoring, and reminders to take medicine. Fasting

blood sugar levels were measured four times (pre-intervention, 1st, 2nd, and 3rd months) in each group. Meanwhile, patient compliance data were collected through questionnaires and interviews following the intervention. The data from the research results were then analyzed using the SPSS application through t-test testing.

3. RESULTS AND DISCUSSION

3.1 *Characteristics of Respondent*

There were 60 subjects in this study with the following characteristics. Their characteristics are presented in [Table 1](#).

Table 1. Characteristics of respondents

Characteristic	Number/Percentage (n=60)
Gender	
Woman	32 (53.3%)
Man	28 (46.6%)
Age	
40-59	49 (81.67%)
≥60	11 (18.33%)
Fasting Blood Sugar Levels	
controlled (80-130 mg/dL)	0 (0%)
uncontrolled (>130 mg/dL)	60 (100%)

The results of the study showed that the majority of respondents were woman and were in the age range of 40-59 years. This age is included in the productive age category, which is susceptible to metabolic disorders, including disorders of blood glucose regulation. The findings are consistent with the study by [Alfaqeeh et al., \(2024\)](#), which indicates that the incidence of diabetes mellitus rises with age. The 45-64 age group faces a higher risk compared to the 15-44 age group. This is attributed to biological factors, such as the decline in pancreatic beta-cell function and the increase in insulin resistance as individuals age. In elderly individuals, diabetes is frequently associated with factors such as high body mass index (BMI), hypertension, coronary heart disease, and chronic kidney disease ([Zhao et al., 2024](#)).

All subjects in this study had uncontrolled fasting blood sugar (FBS) levels (>130 mg/dL). This condition indicates that the population studied as a whole was in a state of fasting hyperglycemia, which can be an indicator of the risk or condition of type 2 diabetes mellitus. Uncontrolled blood glucose levels can be caused by various factors, including an unhealthy diet, lack of physical activity, stress, and lack of compliance in treatment or disease management. The dominance of male respondents can also be associated with behavioral and lifestyle factors, such as consumption of foods high in sugar and fat and smoking habits, which are known to have a close relationship with impaired glucose metabolism.

3.2 *Patient Compliance*

The graph shows the level of patient compliance in two groups, namely the control and intervention groups, which are divided into three categories: low, medium, and high. In the control group, most patients (22 people) were at a low level of compliance, 8 people were at a medium level, and none achieved high compliance. In contrast, in the intervention group, most patients (25 people) were at a high level of compliance, 5 people were at a medium level, and none were at a low level of compliance.

A comparison chart of compliance between the control group and the intervention is shown in [Figure 1](#).

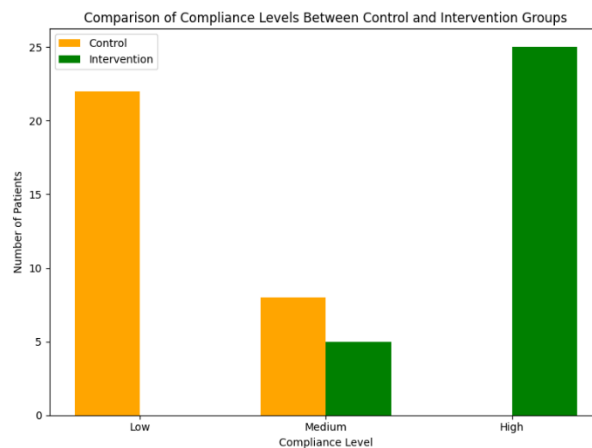


Figure 1. Comparison diagram of compliance between the control and intervention group

These data show that there is a significant difference in the level of compliance between the control and intervention groups. Most patients in the control group showed low levels of compliance, while the intervention group showed high compliance. Patients receiving telepharmacy education on diabetes management, particularly regarding consistent medication intake, have demonstrated improved adherence to treatment protocols. This enhanced adherence is crucial for better glycemic control and reducing diabetes-related complications ([Saswita et al., 2023](#); [Suprapti et al., 2022](#)).

This indicates that the intervention provided is effective in improving patient compliance. The intervention in question can be in the form of education, assistance, motivation, or other methods aimed at increasing patient awareness and behavior in undergoing therapy or treatment. The absence of patients with high compliance in the control group strengthens the evidence that without additional intervention, the level of compliance tends to be low. Conversely, the absence of patients with low compliance in the intervention group indicates that the method applied has succeeded in minimizing the risk of non-compliance. Thus, it can be concluded that the intervention has a significant effect on improving patient compliance, and its application can be considered in clinical practice to support long-term treatment success.

3.3 Fasting Blood Sugar Level

A comparison of compliance and fasting blood sugar level in the control group and the intervention group can be seen in the following [Figure 2](#).

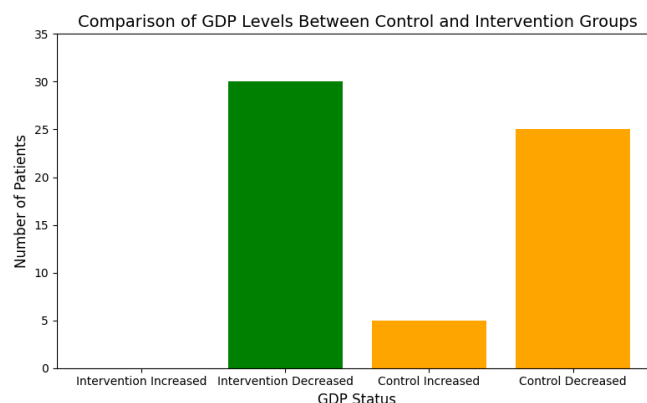


Figure 2. Diagram of the Fasting Blood Sugar Levels of control and intervention group

The graph shows changes in FBS levels in two groups, namely intervention and control, with four categories, namely intervention increased: 0 patients, intervention decreased: 30

patients, control increased: 5 patients, and control decreased: 25 patients. From the data, it is known that all patients in the intervention group experienced a decrease in FBS levels (30 patients), without any increase. In the control group, 25 patients experienced a decrease in FBS levels, while 5 patients experienced an increase.

These results strongly indicate that the intervention had a positive effect on reducing FBS levels in patients. The observed decrease in FBS across all patients in the intervention group highlights the success of comprehensive approaches, which often include nutritional education, behavioral intervention, and controlled pharmacological therapy. This aligns with findings from [Suprapti et al. \(2022\)](#), who reported that patient education on diabetes management, encompassing treatment adherence and healthy lifestyle adoption, leads to significant reductions in blood glucose levels following telepharmacy interventions. The consistent decrease in FBS within the intervention group, without any increase, suggests that the telepharmacy service effectively facilitated improved glycemic control.

On the other hand, although most patients in the control group also experienced a decrease in FBS, there were 5 patients who experienced an increase. This indicates that without additional intervention, blood sugar control is not optimal and can be at risk of fluctuation or even increase.

The distinct outcomes between the two groups support the hypothesis that the intervention provided is more effective in controlling blood sugar levels compared to standard care (control) alone. Generally, this graph reinforces the importance of an interventional approach in the management of patients with hyperglycemia or diabetes, particularly to mitigate the risk of complications arising from uncontrolled blood sugar levels.

3.4 The Effect of Pharmacist Intervention Through Telepharmacy Services on Compliance in Type 2 Diabetes Mellitus Patients at Natalia Farma Pharmacy, Ende Regency

Based on the results of the t-test, a p-value of 0.002 was obtained, which means that telepharmacy interventions have a significant effect on the compliance of type 2 diabetes mellitus patients. The results of the test can be seen in the following [Table 2](#).

Table 2. Independent T-Test Results Effect of Intervention on Compliance

Variable	Group	N	Mean $\pm$ SD	t	df	p-value
Patient Compliance	Intervention	30	8.27 $\pm$ 0.69	-19.801	58	0.002*
	Control	30	6.53 $\pm$ 0.73			

*p-value <0.05

Poor adherence is a major obstacle to achieving the desired therapeutic goals in Diabetes Mellitus, as it is associated with poor glycemic control in patients with type 2 diabetes mellitus. Our findings, with a p-value of 0.002, indicate a significant effect of telepharmacy interventions on compliance among Type 2 Diabetes Mellitus patients at Natalia Farma Pharmacy. This aligns with previous research demonstrating that pharmacist-led interventions utilizing online technology (telepharmacy) can improve medication adherence and help control chronic conditions. The use of phones in telepharmacy has specifically been shown to increase patient awareness about diabetes, medication adherence, self-care routines, and glycemic control ([Khan et al., 2022](#); [Peasah et al., 2020](#)).

Such advancements in telecommunication technology facilitate access to information and insights, although it is noted that this does not automatically translate to reduced pharmaceutical costs ([Saswita et al., 2023](#)). Furthermore, pharmacist involvement and follow-up through telepharmacy have been shown to address suboptimal compliance and treatment targets, which are often hindered by limited healthcare worker engagement and

patient awareness (Novita & Aditama, 2025). Telepharmacy also offers a viable solution to enhance access to treatment and ensure proper medication management, potentially reducing drug-related problems. Follow-up through telepharmacy conducted by pharmacists has been shown to significantly improve adherence to Type 2 DM treatment, with studies indicating an increase in adherence by over 80% (Pambagyanik et al., 2023; Saswita et al., 2023).

The increasing diabetic population in Indonesia is a global health concern, as Indonesia is the only country in Southeast Asia included in the list of the ten countries with the highest diabetes prevalence worldwide. An important demographic characteristic to note in diabetes prevalence is its shift toward a younger age range, with the risk increasing with age but showing no significant difference between genders. This suggests that gender does not affect the risk of T2DM. Most DM patients are over 45 years old, indicating that the risk of T2DM increases with age. Individuals in private-sector jobs face a higher risk of T2DM because of high work demands, so that there is a reduction in time management (arrangement) for other activities such as sports and adequate rest. The longest treatment time falls within the range of 0-5 years, suggesting a growing number of newly diagnosed T2DM patients (Citta, 2024).

In this study, telepharmacy utilized the WhatsApp (WA) application, a widely used and cost-effective social media platform that enables private and direct communication. The use of this communication technology by pharmacists has been shown to improve medication adherence in chronic disease patients and help control their conditions. WA also serves as a tool for promotion, information, and appointment booking, simplifying the marketing process and enabling pharmacists to address patient concerns directly (Hakim et al., 2022).

This highlights the benefits of advancements in telecommunication technology in facilitating access to information and insights, which can also lead to reduced costs in the pharmaceutical field, such as for drug stability, drug dilution, pharmaceutical treatment, and medication adherence, as well as reducing the use of inappropriate and ineffective drugs. Prescription verification by a qualified pharmacist can also be applied to patients located far from healthcare centers (hospitals, pharmacies, clinics). This process helps ensure proper medication management and prevent potential drug interactions, both at the hospital and the pharmacy levels. Additionally, telepharmacy can be a solution to improve access to treatment, and its use will not have a negative impact on the quality of drug use.

However, the treatment target for type 2 diabetes, specifically a decrease in fasting blood sugar levels, has not achieved maximum results. Several factors may contribute to this, including individual variations in metabolic system, differences in daily activities and lifestyle, including DM patients who have high compliance. A high genetically determined basal metabolic rate (BMR) can be a protective factor against diet-induced obesity and most indicators of metabolic syndrome. Increased spontaneous activity correlates with high BMR and is an important factor affecting an individual's ability to maintain energy balance, even under energy-intensive diets (Citta, 2024; Setyani et al., 2023).

3.5 The Effect of Pharmacist Intervention Through Telepharmacy Services on Fasting Blood Sugar Levels in Type 2 Diabetes Mellitus Patients at Natalia Farma Pharmacy, Ende Regency

Based on the results of the t-test, a p-value of 0.009 was obtained, which means that telepharmacy interventions have a significant effect on the fasting blood sugar levels of type 2 diabetes mellitus patients. The results of the test can be seen in the following Table 3.

Table 3. Results of an Independent T-Test on the Effect of Intervention on Fasting Blood Sugar Levels

Variable	Group	N	Mean Reduction ± SD (mg/dL)	t	df	p-value
Fasting Blood Sugar Levels	Intervention	30	56.50±12.33	2.693	58	0.009*
	Control	30	18.50±10.74			

*p-value <0.05

Pharmaceutical care is an activity carried out by health workers, especially pharmacists, intending to improve health, the success of therapy, disease prevention, and prevent complications, so that the treatment provided is safe and effective. The main focus of *pharmaceutical care* is to improve the quality of life of patients and achieve the expected therapeutic outcomes. There are problems related to therapy that can hinder the success of treatment, and this is an area where pharmaceutical care can help overcome therapy difficulties, especially for patients (Yusniar et al., 2022).

Diabetes management involves maintaining blood sugar levels within the desired range to prevent complications. This can be achieved through various approaches, including regularly monitoring blood sugar levels using a glucose measuring device or continuous glucose monitoring device (CGM), following a balanced diet. It involves consuming the right carbohydrates, controlling portion sizes, and paying attention to overall nutrient intake, as well as doing regular physical activity to increase insulin responsiveness and maintain a healthy weight. If needed, the doctor may prescribe medications such as insulin or oral anti-diabetic drugs to help control blood sugar levels, routinely have check-ups with a medical professional to monitor diabetes management, deal with problems that arise, and make necessary adjustments to the treatment plan (Setyani et al., 2023).

In addition to keeping blood sugar levels stable, diabetes management also includes measures to prevent complications and improve the quality of life of sufferers. The American Diabetes Association (ADA) has formulated several important self-care practices, such as monitoring blood sugar levels, adopting a healthy diet, exercising regularly, and taking good care of your feet (Khan et al., 2022).

Telepharmacy is designed to provide pharmaceutical operations and patient care remotely, expanding access to healthcare, improving patient safety and outcomes. A variety of technologies, treatment models and interventions are used to develop and provide telepharmacy services, serving diverse populations with different pathological conditions, including telepharmacy-assisted disease systems expanding services at a lower additional cost (Rasdianah et al., 2024). The economic benefits of telepharmacy depend on the potential for providing health services in the community at a lower cost than in hospitals because, for example, many pharmacies coordinated by a single team of doctors can serve several patients simultaneously over a large area. Moreover, telepharmacy also saves work and travel time, which is a major barrier for most individuals in the general public to access healthcare (Omboni & Tenti, 2019).

Based on the results of the t-test, comparing the mean absolute reduction in FBS between the groups, a p-value of 0.009 was obtained. This indicates that the pharmacist intervention through telepharmacy services had a significant effect on the fasting blood sugar levels of Type 2 Diabetes Mellitus patients at Natalia Farma Pharmacy, Ende Regency. The mean absolute FBS reduction for the Intervention group was 56.50±12.33 mg/dL, which is substantially greater than the reduction seen in the Control group, which was 18.50±10.74 mg/dL. This aligns with previous research where a significant impact on decreasing FBS levels was observed following telepharmacy

interventions. Therefore, it can be concluded that the MTM model telepharmacy can have a significant impact on decreasing fasting blood sugar levels in prolantic patients of the Babat Health Center (Novita & Aditama, 2025).

The provision of telepharmacy intervention using the Medication Therapy Management model by pharmacists can reduce drug-related problems in prolans patients with type 2 diabetes at Natalia Farma Pharmacy, Ende Regency. Before the intervention, DRP was categorized as suboptimal drug effects caused by inappropriate drug selection according to guidelines, intentional underuse of prescribed medication, overuse prescribed medication, and patients' misunderstandings regarding proper usage instructions. After the intervention, issues related to suboptimal drug effects remained, but telepharmacy intervention with the Medication Therapy Management model by pharmacists contributed to better management of fasting blood sugar targets in prolans patients with diabetes mellitus at the Babat Health Center. The results of the t-test showed a p-value of 0.001, indicating that there was a significant difference in the value of reducing fasting blood sugar before and after the intervention (Setiawan et al., 2024).

4. CONCLUSION

Based on the results of this study, it can be concluded that telepharmacy intervention significantly improves both compliance and fasting blood sugar levels in Type 2 Diabetes Mellitus patients at Natalia Farma Ende Pharmacy, with significance values of 0.002 and 0.009, respectively. These findings underscore the effectiveness of telepharmacy in enhancing patient self-management for diabetes mellitus.

Therefore, telepharmacy interventions are highly applicable in the context of diabetes mellitus patient self-management. For future research, it is recommended to explore the long-term sustainability and cost-effectiveness of telepharmacy services. Furthermore, we suggest investigating the broader implementation of telepharmacy within public health systems, such as Puskesmas or other primary healthcare facilities, to assess its scalability and impact on a larger population of diabetic patients in Indonesia.

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6. CONFLICT OF INTEREST

All authors declared that there was no conflict of interest.

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