Journal of Professional Evidence-based Research and Advances in Wellness and Treatment (PERAWAT)
Vol. 03, No. 3, September 2026, 135-153
***e*-ISSN 3064-4453**

Effect of Integrated Nursing Care Innovation on Treatment Adherence in Diabetes Mellitus Patients in the Community

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Article Information
Received: July 24, 2026
Revised: August 30, 2026
Online: September 14, 2026

Keywords
Nursing Care, Compliance, Treatment, Diabetes Mellitus; Health Center

ABSTRACT

Diabetes mellitus (DM) is a chronic disease requiring lifelong treatment, yet medication adherence among patients in primary care remains low due to fragmented continuity of care, limited structured education, and inadequate community-based monitoring. This study aimed to evaluate the effect of an integrated nursing care innovation on treatment adherence among patients with type 2 diabetes in the working area of Sidomulyo Community Health Center, Pekanbaru. A quantitative quasi-experimental study with a pretest–posttest control group design involved 76 respondents enrolled in the Chronic Disease Management Program (Prolanis). Participants were selected using purposive sampling and assigned to intervention (n=38) and control (n=38) groups. Medication adherence was measured using the Morisky Medication Adherence Scale (MMAS-8), while implementation of integrated nursing care was monitored using an observation sheet. Data were analyzed using descriptive statistics, Paired Sample t-Test, and Independent Sample t-Test. The intervention group demonstrated a substantial increase in mean adherence score from 12.4 to 18.6, compared with a slight increase from 12.1 to 13.0 in the control group. Significant improvement occurred within the intervention group (p<0.001), with a significant difference between groups (p=0.001). Integrated nursing care effectively improved treatment adherence and may strengthen long-term diabetes management through nurse training, community health volunteers, scheduled home visits, and reminder systems.

Keywords *: Nursing Care, Compliance, Treatment, Diabetes Mellitus; Health Center*

http://doi.org/10.69855/perawat.v3i3.734
https://gpijournal.com/index.php/perawat

INTRODUCTION

Diabetes mellitus (DM) is one of the fastest growing non-communicable diseases in the world and a global health challenge of this century (Sun et al., 2022). Globally, an estimated 537 million adults aged 20-79 are living with diabetes in 2021, equivalent to a prevalence of 10.5% of the world's adult population, and this figure is projected to increase to 783 million by 2045 (Sun et al., 2022). This increase in the number of people with DM occurs almost evenly in all income groups of the country, with the highest relative increase expected to occur in middle-income countries (Sun et al., 2022). This global health burden is compounded by the fact that nearly half of people with DM are unaware of their condition and therefore are at risk of complications without early treatment (Ogurtsova et al., 2022). This condition confirms that diabetes is not just an individual health problem, but a public health crisis that requires systemic and sustainable treatment (WHO, 2023).

Type 2 Diabetes mellitus pathophysiologically arises due to insulin resistance and/or impaired insulin secretion by pancreatic beta cells which causes chronic hyperglycemia (Widiasari, Wijaya, & Suputra, 2021). If blood glucose levels are not controlled in the long term, this condition can cause microvascular complications such as nephropathy, retinopathy, and neuropathy, as well as macrovascular complications such as coronary heart disease and stroke (Davies et al., 2020). Effective management of DM requires patient adherence to pharmacological therapy and lifestyle modification in a consistent and sustainable manner (Denicolo. et al, 2021). Non-compliance with the treatment regimen will in turn accelerate the progression of the disease and increase the risk of fatal cardiovascular and renal complications (Denicolō et al., 2021).

At the national level, Indonesia has experienced a significant increase in the prevalence of DM in the last decade. Basic Health Research Data recorded that the prevalence of DM nationwide increased from 6.9% in 2013 to 8.5–10.9% in 2018 (Kemenkes RI, 2018), and the Indonesian Health Survey reported that the figure had reached 11.7% in 2023 (Kemenkes RI, 2023). This increase makes Indonesia the country with the fifth highest number of diabetics in the world, with only one in 4-5 patients getting treatment at health care facilities (Tarmizi, 2024, quoted in VOA Indonesia, 2024). This gap between the number of diagnosed cases and those who actually get sustainable treatment indicates a big problem in the continuity of health services for DM patients in Indonesia (Wibowo, Yasin, Kristina, & Prabandari, 2021).

The problem is also evident in the province of Riau. The results of Riskesdas 2018 recorded the prevalence of DM in Riau Province at 1.9-2.0% (Susanti et al., 2021), while data from the Riau provincial Health Office recorded 41,128 people with DM in 2021 and made this disease ranked fourth of the ten largest diseases in the province (Riau provincial Health Office, 2021). Of all regencies / cities in Riau, Pekanbaru city occupies the first position with the highest number of DM cases, namely 18,245 cases or 25.46% of the total cases in the province, far above Kampar regency which is in fourth position with 7.13% (Riau provincial Health Office, 2021). The high concentration of cases in the provincial capital indicates the need for special attention to the primary health care system in the urban area of Pekanbaru.

Based on preliminary studies conducted by researchers at the Puskesmas Sidomulyo Pekanbaru, it is known that diabetes mellitus is one of the non-communicable diseases with a fairly high number of visits in the working area of the puskesmas and is one of the main focuses of The Chronic Disease Management Program (Prolanis). The results of the visit Record data showed that most of the DM patients enrolled in Prolanis were old patients with a treatment duration of more than one year, but not all of them regularly took the drug and carried out control according to the prescribed schedule. Health workers at the puskesmas said that Prolanis ' activities that have been running so far still focus on joint exercises and routine blood sugar checks, without accompanying individual assistance or monitoring treatment adherence in a structured manner. This field condition shows that there are gaps in services that need to be strengthened through more systematic and sustainable forms of nursing intervention.

Treatment adherence is the main determinant of the success of long-term DM management, because chronic disease therapy depends on the patient's consistency in taking drugs as recommended by health workers (Wibowo et al., 2021). Non-compliance with treatment not only has an impact on uncontrolled blood sugar levels, but also increases the rate of repeated hospitalizations, health costs, and the risk of chronic complications that reduce the quality of life of patients (Untari et al., 2024). The Morisky Medication Adherence Scale (MMAS-8) instrument is widely used in health research to measure the level of patient adherence to long-term therapy, including in DM, hypertension, and coronary heart disease (Tan, Patel, & Chang, 2014, quoted in Aisyiyah Surakarta Journal of Nursing, 2023). The use of instruments that have been validated with a cronbach Alpha reliability value of 0.822 is important to ensure the accuracy of compliance measurements in various primary health care contexts (Amaliah, 2018, quoted in the Journal Clinical Pharmacy and Science, 2022).

Unfortunately, a systematic review of studies in Indonesia showed that treatment adherence of Type 2 diabetes mellitus patients was still low to moderate in various regions (Wibowo et al., 2021). The determinant factors identified varied from knowledge, family support, access to health services, to long-term illness (Wibowo et al., 2021; Akrom. et al, 2019). Another study at the Pertiwi Makassar Health Center showed that the majority of Type 2 DM patients were only in the medium compliance category, not high (Wal'afiat Hospital Journal, 2022). These findings reinforce the need for a more structured and sustainable approach to health care in supporting patient adherence in primary care, as without a systematic approach, efforts to improve adherence tend to be sporadic (Wibowo et al., 2021).

To obtain an initial picture directly, the researchers conducted a preliminary survey of a number of DM patients who visited the Sidomulyo Health Center. From the short interviews conducted, most patients admitted that they had forgotten to take medication, stopped self-medication when they felt their condition had improved, or did not regularly take medication due to busyness and lack of reminders from health workers. Some patients also said that they rarely get an in-depth explanation of the importance of long-term treatment adherence other than during the initial visit. These preliminary findings reinforce the assumption that low treatment adherence

in the Sidomulyo Puskesmas work area is closely related to the lack of ongoing assistance from the nursing service side, thus providing an empirical basis for researchers to conduct further research at this location.

Various factors contribute to the low treatment adherence of Type 2 diabetes patients. Della Research. et al, (2023) identified the relationship between knowledge, social support, motivation, and access to and continuity of health services with patient compliance behavior. Patients who do not receive continuous monitoring and structured education tend to be more prone to forgetfulness in taking medication or stopping treatment unilaterally without the knowledge of health workers (Della et al., 2023; Rizki. et al, 2020). This condition is further aggravated in patients with low levels of education or minimal family support (Ilham. et al, 2021). Therefore, interventions that target aspects of Education, Monitoring, and psychosocial support in an integrated manner are an urgent need in the management of DM in primary services (Della et al., 2023).

The Prolanis Program, which has been running at health centers in general, based on a literature review, still focuses on routine activities such as gymnastics and periodic examinations, but has not fully integrated a sustainable and individual nursing care approach (Latifah, Hanafi, Abidin, Yanthi, & Kamal, 2022). Evaluation of the implementation of Prolanis on DM patients in one of the health centers of Pekanbaru city shows that the implementation of the program still faces obstacles in terms of continuity of monitoring and limited nursing personnel who play an active role in continuing education (Latifah et al., 2022). A similar study on the Prolanis program for hypertensive patients at other health centers also showed a comparable pattern of problems, namely the lack of individual assistance for chronic disease patients (Yakin, Chotimah, & Dwimawati, 2021). This implementation gap indicates that the existing service model in general has not been optimal in encouraging changes in patient compliance behavior in the long term, so that a more integrated nursing care model is needed (Latifah et al., 2022).

Integrated nursing care is a service approach that integrates the nursing process-assessment, education, intervention, monitoring, and continuous evaluation—by actively involving patients in the self-management of their disease (Nurdiana et al., 2023). Orem's self-care theory-based approach emphasizes the importance of strengthening patients ' ability to care for themselves through structured and continuous nurse guidance (Nurdiana et al., 2023). The application of this model in patients with chronic diseases such as DM and hypertension was shown to improve patient self-care behavior in a family nursing case study using the Diabetes Self Management Questionnaire (Dsmq) instrument (Nurdiana et al., 2023; Rahmawati, Solehati, & Purnama, 2024). This approach that emphasizes patient independence with consistent health care support is relevant to be adapted as an innovation in improving DM treatment adherence in the community (Rahmawati et al., 2024).

Research linking health services and community nursing care to the prevalence of DM also confirms that strengthening the role of community nurses in education, regular monitoring, and ongoing assistance contributes to improving the health status of people with DM in the puskesmas

working area (Siagian, Sembiring, Ginting, & Ginting, 2025). Activities that are continuity of care, not just momentary interventions, are considered more effective in establishing long-term health behavior changes in chronic disease patients (Simbolon, 2025, cited in Siagian et al., 2025). This community-based approach is in line with the principles of primary health care that emphasize promotive and preventive aspects without excluding curative aspects (WHO, 2023). This reinforces the argument that integrated nursing care innovation has the potential to be a strategic solution in the context of primary care in Indonesia (Siagian et al., 2025).

Despite this, most nursing research on DM in Indonesia still focuses on case studies of individual nursing care in hospital inpatient settings (Melfiana, 2021; Rif'at, 2021), not on evaluating the effect of nursing intervention models that are systematically tested in the community with research designs that compare intervention and control groups. This methodological gap is in line with the recommendations of the National systematic review which called for the need for intervention research with a more robust design (Wibowo et al., 2021). Based on the researcher's search of similar studies in Pekanbaru, so far no research has been found that specifically examines the effect of an integrated nursing care model on treatment adherence of DM patients in the work area of Sidomulyo Health Center. This opens up a quasi-experimental research space to examine the direct effect of a nursing care innovation on changes in patient treatment adherence at the site.

Based on field conditions observed by researchers at the Sidomulyo Health Center, it is known that the health care facility has a number of active diabetes mellitus patients who follow the Prolanis program and are considered adequate to support the implementation of quasi-experimental research with intervention group and control group design. In addition, the presence of nurses and health cadres in the working area of the Sidomulyo Health Center is a supporting factor in the implementation of an integrated nursing care model in a planned and sustainable manner. Commitment and support of puskesmas management to the implementation of research is also an important aspect that strengthens the feasibility of research sites. The High problem of diabetes mellitus in Pekanbaru, coupled with the results of early observations about the still low treatment adherence of patients, makes Sidomulyo Health Center as a relevant and strategic location for the implementation of nursing interventions.

The national guidelines for the management of Type 2 diabetes mellitus explain that the success of controlling this disease is strongly influenced by the implementation of four main pillars, namely education, medical nutrition therapy, physical activity, and pharmacological therapy carried out in an integrated and continuous manner by health workers, including nurses. However, in the practice of primary health care, the implementation of these four pillars is still often carried out separately and has not been fully supported by a structured and sustainable nursing care system according to the individual needs of patients the difference between the recommended service standards and the implementation in the field is one of the factors that contribute to the not optimal treatment adherence of patients with diabetes mellitus. This condition indicates the need for the development of nursing care innovations that are able to

integrate various components of diabetes mellitus management into daily service practices more systematically (PERKENI, 2021; Latifah et al., 2022).

Based on the problems that have been identified, ranging from an increase in the prevalence of diabetes mellitus globally and nationally, the results of preliminary studies related to the low treatment adherence of patients at the Sidomulyo Health Center, to the lack of maximum application of integrated nursing care in the implementation of the Prolanis program, the researchers were encouraged to conduct research on the effect of integrated nursing care innovation on treatment adherence of diabetes mellitus patients in the community, especially the working area of the Sidomulyo Pekanbaru Health Center. This research is expected to produce scientific evidence on the effectiveness of nursing care models that are more structured, sustainable, and focused on improving the ability of patients to manage their illness independently. If the model proves to be effective, its application can potentially be developed in other primary health care facilities that have similar problem characteristics. In addition, this study is expected to contribute to the strengthening of evidence-based community nursing practices in Indonesia and support the improvement of service quality Prolanis program at Puskesmas Sidomulyo Pekanbaru.

METHODS

This study is a quantitative study with quasi-experimental design pre-test post-test with control group, which aims to determine the effect of integrated nursing care innovation on treatment adherence of patients with Type 2 diabetes mellitus. The research was conducted in the working area of Puskesmas Sidomulyo Pekanbaru. The population in this study were all type 2 diabetes patients enrolled in The Chronic Disease Management Program (Prolanis) at the health center. The study sample consisted of 76 respondents who were selected using purposive sampling technique based on inclusion criteria, namely Type 2 diabetes patients who were registered as active in Prolanis for at least the last 3 months, aged 45-70 years, willing to be respondents from the beginning to the end of the study, able to communicate well, and did not experience cognitive impairment that could affect the filling of the questionnaire. Exclusion criteria included patients with severe complications requiring hospitalization during the study period, patients who moved domicile outside the working area of the health center during the study period, as well as patients who resigned before the study was completed. Respondents were then divided into two groups, namely the intervention group (38 people) who received integrated nursing care in the form of structured education, scheduled home visits, and continuous monitoring for 8 weeks, and the control group (38 people) who only received standard Prolanis services without additional intervention.

Data collection was conducted through two instruments, namely the Morisky Medication Adherence Scale (MMAS-8) questionnaire that has been tested for validity and reliability to measure the level of treatment adherence of chronic disease patients, as well as observation sheets to monitor the implementation of integrated nursing care in the intervention group. Measurements

were carried out twice, before (pre-test) and after (post-test) the intervention in both groups, with researchers and a team of trained nurses as data collectors in order to maintain consistency and objectivity of measurements. Univariate analysis was used to present the frequency distribution of compliance categories and mean and standard deviation of compliance scores, while bivariate analysis used Paired Sample t-Test to test the difference in scores before and after the intervention in each group, and Independent Sample t-Test to compare the final score between the intervention and control groups, with the degree of significance $p<0.05$. This study has obtained ethical clearance from the Local Health Research Ethics Commission prior to data collection. Each respondent was given an explanation of the objectives, procedures, benefits, and the right to refuse or withdraw from the study without any consequences, and all respondents were asked to sign a consent sheet (informed consent) as proof of willingness to participate voluntarily, while ensuring the confidentiality of the identity and personal data of respondents throughout the research process.

RESULTS

1. Characteristics of Respondents

Characteristics of respondents in this study include age, sex, education level, and duration of diabetes mellitus in the intervention group and control group, as presented in the following table.

Table 1. Distribution of Characteristics of Respondents in Puskesmas Sidomulyo Pekanbaru (n=76)

Characteristics	Intervention Group (n=38) n	%	Control Group (n=38) n	%	Total (n=76) n	%
Age						
45-54 years old	12	31,6	13	34,2	25	32,9
55-64 years old	17	44,7	16	42,1	33	43,4
- 65 years old	9	23,7	9	23,7	18	23,7
Gender						
Men	15	39,5	14	36,8	29	38,2
Girls	23	60,5	24	63,2	47	61,8
Education						
Elementary (SD-SMP)	14	36,8	15	39,5	29	38,2
Secondary (SMA)	18	47,4	17	44,7	35	46,1
Height (PT)	6	15,8	6	15,8	12	15,8
Long suffering from DM						
< 5 years	16	42,1	17	44,7	33	43,4

- 5 years	22	57,9	21	55,3	43	56,6

Table 1 shows that the characteristics of respondents in the intervention group and control group were relatively homogeneous across age categories, gender, education, and duration of DM, with a small difference in proportion between groups (no more than 5%). The majority of respondents were aged 55-64 years (43.4%), were female (61.8%), had a secondary education (46.1%), and had suffered from DM for ≥5 years (56.6%).

2. Frequency Distribution of Treatment Adherence Categories and Mean MMAS-8 Scores Before and After Intervention

Univariate analysis was conducted to describe the frequency distribution of treatment adherence categories as well as the mean and standard deviation of MMAs-8 scores in both groups, both before (pre-test) and after (post-test) the intervention.

Table 2. Frequency Distribution of Treatment Adherence Categories and Mean Mmas-8 Score Before and After Intervention

Compliance category (MMAs Score-8)	Intervention Group (n=38)		Control Group (n=38)	
	Pre-test n (%)	Post-test n (%)	Pre-test n (%)	Post-test n (%)
Low (score <6)	21 (55,3)	3 (7,9)	20 (52,6)	17 (44,7)
Medium (score 6 - <8)	12 (31,6)	9 (23,7)	13 (34,2)	14 (36,8)
High (score 8)	5 (13,1)	26 (68,4)	5 (13,2)	7 (18,5)
Mean ± SD	**12,4 ± 2,1**	**18,6 ± 1,8**	**12,1 ± 2,3**	**13,0 ± 2,0**

Table 2 shows that before the intervention was given, the distribution of compliance categories in both groups was almost equal, with the majority of respondents in the low compliance category (intervention 55.3%; control 52.6%) and the average score was not much different (12.4 versus 12.1). After being provided with integrated nursing care, the intervention group underwent enormous changes, where the proportion of high adherence increased sharply from 13.1% to 68.4% and the average score increased from 12.4 to 18.6. In contrast, the control group that underwent only routine Prolanis without additional intervention showed only a small increase, from an average of 12.1 to 13.0, with the majority of respondents still in the low to moderate compliance category.

3. Test results of different treatment adherence scores (Paired Sample t-Test and Independent Sample t-Test)

Bivariate analysis was used to examine the significance of changes in treatment adherence scores, both in each group before and after the intervention and the difference in the final score between the intervention and control groups.

Table 3. Different Test Results Treatment Adherence Score

Variables tested	Uji Statistik	Mean ± SD	Mean Difference	t-count	p-value
Pre-Post Intervention Group	Paired-samples t-test	12,4±2,1 → 18,6±1,8	6,2	14,52	0,000
Pre-Post Control Group	Paired-samples t-test	12,1±2,3 → 13,0±2,0	0,9	2,04	0,048
Post-test intervention vs. Control	Paired-samples t-test	18,6±1,8 vs 13,0±2,0	5,6	12,37	0,001

Table 3 shows that in the intervention group there was a statistically significant increase in the treatment adherence score between before and after the provision of integrated nursing care (mean difference 6.2; p=0.000; p<0.05), which means that this intervention was effective in significantly increasing the treatment adherence of DM patients. In the control group, an increase in the score was also found, but with a much smaller difference (0.9) and a weaker degree of significance (p=0.048), which is most likely due to the natural effect of regular participation in Prolanis without additional intervention, rather than by substantial changes in behavior. Independent sample t-test results on post-test scores showed a significant difference between the intervention group and the control group (mean difference 5.6; p=0.001; p<0.05).

DISCUSSION

1. Frequency Distribution of Treatment Adherence Categories and Mean Mmas-8 Score Before and After Intervention

The results of univariate analysis in Table 2 showed that before the intervention (pre-test), both the intervention group and the control group were both dominated by the low compliance category, which was 55.3% in the intervention group and 52.6% in the control group, with an average score of MMAs-8 which was almost equivalent (12.4 versus 12.1). This initial condition illustrates that the majority of patients with Type 2 diabetes who are enrolled in Prolanis at the Sidomulyo Health Center have not run a consistent treatment regimen before getting any intervention. The equivalence of the initial conditions between these two groups served as a good basis for assessing the changes that occurred after the administration of the treatment, since both groups started the study from relatively similar compliance points.

The low level of treatment adherence in the initial conditions of this study is in line with the findings of the National systematic review which states that treatment adherence of Type 2 diabetes patients in various regions of Indonesia is still relatively low to moderate, with multidimensional determinants. Similar conditions were also found in a study at Puskesmas Pertiwi Kota Makassar, where the majority of Type 2 diabetes patients were only in the medium compliance category, not the high category. This low adherence in the early stages is also

reinforced by research that shows that knowledge, social support, motivation, and access to and continuity of health services contribute greatly to the compliance behavior of DM patients. The consistency of these findings across regions confirms that the issue of low compliance is not a purely local phenomenon, but rather a recurring pattern in primary health services in Indonesia (Wibowo et al., 2021; Della et al., 2023).

Viewed from the perspective of chronic disease treatment adherence theory, the World Health Organization emphasizes that non-compliance with long-term therapy is influenced by five interrelated dimensions, namely patient factors, therapy-related factors, disease condition factors, socioeconomic factors, and health care system factors. The high proportion of low adherence to pre-test conditions in this study indicates that most of these factors, especially those of the health care system that has not provided individualized assistance, contribute to the initial condition of patients. This shows that non-compliance is not solely the fault of individual patients, but also reflects the weakness of the service system that existed before the intervention was given. This understanding is an important foundation for researchers to design forms of intervention that not only focus on one-way education, but also on strengthening sustainable mentoring systems (WHO, 2020).

After being given integrated nursing care for eight weeks, the post-test results in the intervention group showed a huge improvement, where the proportion of high adherence increased sharply from 13.1% to 68.4% and the average score increased from 12.4 to 18.6. This major change shows that the forms of intervention provided in the form of structured education, scheduled home visits, and ongoing monitoring are able to drive significant changes in patient compliance behavior in a relatively short period of time. The proportion of patients with a low compliance category also decreased dramatically from 55.3% to only 7.9% after the intervention. This sharp change in frequency distribution is a strong early indication that integrated nursing care has a real impact on improving the treatment adherence of DM patients in the Sidomulyo Puskesmas working area.

This result is in line with research that shows that home Pharmacy Care education conducted in a structured and sustainable manner is able to increase compliance while improving blood glucose control in DM patients. Another study that evaluated the effect of Pharmaceutical Care on the quality of life of patients with Type 2 diabetes in two health centers also found that routine and personalized assistance contributed to improvements in patient treatment behavior. The similarity in the pattern of results in both studies reinforces the argument that interventions that are direct, personal, and continuous are more effective than education that is general and one-way. This confirms that the element of sustainability and direct interaction between health workers and patients is the key to successful compliance improvement interventions (Padmasari, Azizah, & Larasati, 2021; Mayasari, Sarnianto, & Anggriani, 2020).

Viewed from the perspective of Orem self-care theory, the success of increasing adherence in the intervention group can be explained through strengthening the patient's self-care agency, facilitated by the nurse's role as a support agent and educator. Through structured guidance, the

patient not only receives information, but is also trained to recognize his own self-care needs independently and sustainably. This approach is different from conventional educational models that only convey information without accompanying applicative assistance in the patient's home environment. This difference in approach is assumed by the researchers to be one of the main causes of the difference in results between the intervention group and the control group in this study.

A significant increase in the average compliance score in the intervention group can also be attributed to the strengthening of the patient's self-efficacy during the mentoring process. Research linking self-efficacy with self-care management in Type 2 diabetes mellitus patients found that patients with good self-efficacy tended to be more consistent in treatment management and healthy lifestyles. Scheduled home visits, which are a component of integrated nursing care, allow nurses to provide immediate feedback and positive reinforcement to patients, which in turn increases their confidence in managing their illness. This increase in self-efficacy is what researchers assume contributes to the increase in the proportion of high adherence in the intervention group (Irawan & Handayani, 2022).

In addition to the individual aspects of the patient, the success of the intervention is also inseparable from the involvement of family support elements that are indirectly strengthened through home visits in integrated nursing care. Research at Sawah Besar hospital in Jakarta found a significant relationship between family support and adherence to taking medication in people with DM, where the family plays an important role in reminding medication schedules and providing psychological encouragement. Similar findings were also reported in a study in the working area of Sail Health Center in Pekanbaru city, which showed that optimal family support contributes to improving the health behavior of DM patients. The presence of nurses directly in the patient's home environment allows families to be educated and more actively involved in the treatment process, which ultimately supports the success of increasing adherence in the intervention group (Siregar & Siregar, 2022; Suhilah et al., 2023).

Unlike the intervention group, the post-test results in the control group showed only a small increase, from an average score of 12.1 to 13.0, with the majority of respondents still in the low to moderate compliance category. The proportion of high adherence in the control group only increased from 13.2% to 18.5%, much lower than the increase in the intervention group. This condition indicates that regular participation in standard Prolanis activities, without individual assistance, is not enough to drive meaningful changes in patient compliance behavior. The small changes that occurred in the control group were most likely a natural effect of repeated exposure to health information during the course of Prolanis ' activities, rather than the result of profound behavioral changes.

This finding is in line with the evaluation of the implementation of Prolanis on DM patients in one of Pekanbaru city health centers, which shows that the program still faces obstacles in terms of continuity of monitoring and limited nursing personnel who play an active role in continuing education to individual patients. Prolanis activities that tend to be group, such as joint exercises

and routine examinations, have not reached the specific needs of each patient regarding the compliance barriers they experience. The national guidelines for the management of Type 2 diabetes have emphasized the importance of integrating the four pillars of diabetes management, namely education, medical nutrition therapy, physical activity, and pharmacological interventions, but the implementation of routine programs in the field has not fully integrated these four pillars individually and sustainably. It is this gap that explains why the control group did not experience significant changes in compliance despite remaining exposed to routine health services (Latifah et al., 2022; Perkins, 2021).

The striking difference between the frequency distribution of adherence in the two groups after the intervention can also be explained from the perspective of age and length of illness, given that most of the respondents in the study were over 55 years old and had suffered from DM for more than five years. Research on the determinants of compliance factors of DM patients found that forgetting to take medication is the most common cause of non-compliance, especially in patients with older age. In the absence of a consistent external reminder system, this age group tends to be more prone to forgetfulness or unilateral discontinuation of treatment. This explains why the continuous monitoring component of integrated nursing care, which serves as an external reminder as well as motivational reinforcement, has proven to be more effective than routine services that do not target these specific barriers (Baedlawi et al., 2023).

The educational level of respondents, the majority of whom were in the secondary education category, also influenced the patient's ability to understand and absorb health information provided during the intervention. National systematic review research shows that education levels correlate with patients ' ability to understand medication instructions and the importance of long-term adherence. Patients with secondary education level tend to have sufficient capacity to understand the educational material if delivered by appropriate and repeated methods, as applied in the form of home visits in this study. The condition of relatively homogeneous educational characteristics between the two groups also reinforces the assumption that significant differences in post-test results are caused more by differences in the form of intervention, not by differences in the basic understanding capacity of respondents (Wibowo et al., 2021).

Aspects of health literacy and self-efficacy are also factors that strengthen the success of interventions in the treatment group. Research on the relationship of health literacy and self-efficacy with diabetes self-management compliance found that patients with better health literacy tended to be better able to implement consistent self-management of their disease. Through the structured and repeated education provided in integrated nursing care, the health literacy of patients in the intervention group is assumed to increase gradually which contributes to improved treatment adherence. This shows that nursing interventions that are educational and sustainable not only have an impact on compliance behavior alone, but also on improving the patient's understanding of his overall health condition (Al Fatih et al., 2024).

Overall, the results of this univariate analysis illustrate a consistent pattern, namely the improvement in the distribution of compliance categories and a much larger average score in the

group that received integrated nursing care compared to the group that only received standard Prolanis services. Researchers assume that the magnitude of this difference reflects the importance of sustainability, personalization, and active involvement of families in a form of nursing intervention, compared to a general and unsustainable approach to Group Education. This univariate overview provides a strong initial indication of the positive influence of integrated nursing care innovation on the treatment adherence of DM patients in the Sidomulyo Puskesmas working area.

2. The Effect of Integrated Nursing Care Innovation on the Treatment Adherence of Type 2 Diabetes Patients in the Working Area of Puskesmas

The results of bivariate analysis in Table 3 showed that the Paired Sample t-Test in the intervention group resulted in a mean difference in compliance score of 6.2 (from 12.4 to 18.6) with a value of p=0.000 (p<0.05), which means that there is a statistically significant difference between the conditions before and after the provision of integrated nursing care. In the control group, the same test showed a much smaller difference in mean, which was 0.9 (from 12.1 to 13.0), with a value of p=0.048 which, although still below the significance threshold, was classified as weak significance. Furthermore, the results of the Independent Sample t-Test Test on post-test scores showed a significant difference between the intervention group and the control group, with a mean difference of 5.6 and a value of p=0.001. These three statistical test results consistently confirm that the large changes seen in the previous univariate data are not due to chance factors, but are really the influence of the integrated nursing care interventions provided.

The significance of improved adherence in this intervention group was consistent with a quasi-experimental study with a pre-post test with control group design in DM patients undergoing palliative care, which also used Paired T-Tests and Independent T-Tests and found a significant improvement in self-care scores after administration of symptom management education (p=0.000). The similarity of statistical significance patterns between these two studies, despite differences in the form of interventions and measured variables, reinforces the argument that nursing interventions that are structured and administered directly to patients consistently produce statistically meaningful changes in health behavior.

Viewed from the perspective of Health Behavior Change theory, significant changes in compliance scores in the intervention group can be explained by repeated reinforcement that occurs during home visits and structured education. The health promotion Model emphasizes that persistent behavioral change requires consistent exposure to information, accompanied by positive reinforcement and periodic evaluation of the development of the target behavior. The eight-week intervention period in this study provided sufficient time for patients to internalize the information provided and turn it into a new habit in carrying out treatment. High statistical significance (p=0.000) in the intervention group indicates that the duration and intensity of the assistance provided has reached a sufficient threshold to induce meaningful behavior change (Green & Kreuter, 2022).

The p-value of 0.048 in the control group, although still statistically significant, needs to be interpreted carefully because the magnitude of the mean difference is very small (0.9) indicates that the significance is likely to be marginal and less clinically meaningful. This condition is in line with a pre-experimental study with one group pretest-posttest design in DM patients at Puskesmas Jatiasih, which found that exposure to routine health activities could produce statistically significant changes in adherence, but with a much smaller amount of change than the group who received specially structured education. This difference in effect size is an important distinction between purely statistical significance and clinical significance that is really meaningful for the improvement of the patient's condition. A test result can be declared numerically significant, but does not necessarily reflect a meaningful change in clinical practice if the difference in the average score is very small (Journal of Obstetrics, 2022).

The small change in the control group most likely reflects the natural effects of repeated exposure to routine Prolanis activities, such as periodic blood sugar checks and joint exercise, which indirectly contribute to little reinforcement of health behaviors without structured individual accompaniment. This phenomenon is in line with the concept of the Hawthorne effect in experimental research, in which participants who realize they are being observed or are part of a study tend to show slight improvements in behavior despite not receiving the main intervention. This condition reinforces the importance of the use of control groups in the design of experimental studies to separate the pure effects of the intervention under test from the natural effects of involvement in the study itself. Without a control group, researchers risk mistakenly concluding that all changes that occur are purely caused by the intervention given (Idris, 2023).

The results of The Independent Sample t-Test, which showed a significant difference between the post-test scores of the intervention and control groups (p=0.001), became the peak evidence in this study confirming the superiority of integrated nursing care over standard Prolanis services. This finding is consistent with a study on health cadre assistance based on monitoring books on treatment adherence of Type 2 diabetes patients, which showed that individual assistance accompanied by continuous monitoring consistently resulted in greater improvements in compliance than services without personal assistance. The similarity of patterns in these two studies confirms that the components of individual monitoring and the sustainability of mentoring are key elements that distinguish the success of a form of nursing intervention in chronic disease patients. Thus, the use of difference tests between groups is the right method to show the superiority of an intervention model compared to conventional service models (Widayanti et al., 2026).

Viewed from the perspective of Orem self-care theory, significant bivariate test results in the intervention group can be interpreted as empirical evidence that the strengthening of self-care ability (self-care agency) through structured nurse guidance can significantly change patient compliance behavior measurably. The nursing process which includes continuous assessment, education, intervention, and evaluation in integrated nursing care provides a systematic framework for patients to gradually build independence in managing their treatment. The

statistical significance obtained in this study reinforces the validity of the theory in the context of primary health care in Indonesia, especially in DM patients undergoing Prolanis. This shows that nursing theories oriented to patient independence can be operationally translated into measurable and scientifically testable forms of intervention (Nurdiana et al., 2023).

The difference in the mean in the intervention group (6.2 points) compared to the control group (0.9 points) can also be explained by the role of strengthening self-efficacy that occurs during the home visit process. Research on the relationship of self-efficacy with self-management of Type 2 DM patients shows that increased patient self-confidence is strongly correlated with statistically measurable improvements in treatment behavior. Scheduled home visits allow nurses to provide immediate feedback on the patient's progress, which in turn reinforces the patient's mastery of managing his or her own illness. This consistent strengthening of self-efficacy is what researchers assume to be one of the mechanisms behind the large difference in statistical significance between the two groups in this study (Irawan & Handayani, 2022).

The involvement of educated families during home visits is also thought to contribute to the significant change in the intervention group. Research on family support and treatment adherence of DM patients found that active family involvement is closely related to patient consistency in long-term therapy. When nursing assistance is carried out directly at the patient's home, family members also witness and understand the educational process provided, so they can act as a reminder and support for daily treatment even though the nurse is not physically present. This condition is different from the control group who only received services at the health center without involving the family directly in the educational process. This difference in family involvement is what researchers assume helps strengthen the results of significant differences in test results in the intervention group compared to the control group (Siregar & Siregar, 2022).

Significant bivariate test results in this study also need to be interpreted in the context of the age characteristics of the majority of respondents in the range of 55-64 years. Research on the determinants of DM patient adherence has found that elderly patients tend to experience compliance barriers due to memory impairment, so interventions that are active and repetitive reminders, such as scheduled home visits, are statistically more effective than one-way education that relies solely on the patient's memory. The control group that did not receive this form of active reminder was most likely to have difficulty maintaining behavioral changes despite having received health information through routine Prolanis activities. This explains why the difference in significance between the two groups is so large, especially in the elderly population that made up the majority of respondents to this study (Baedlawi et al., 2023).

From the methodological point of view, the use of a combination of Paired Sample t-Test and Independent Sample t-Test in this study is in accordance with the rules of quasi-experimental data analysis with a comparison group, as recommended in Quantitative Health Research Methodology. These two tests are complementary, where paired tests show changes in each group over time, while unpaired tests show differences in effectiveness between groups at one and the same point in time. The combination of these two analytical approaches provides a more

comprehensive and convincing picture than if you only use one type of test. The accuracy of the selection of this statistical test also strengthens the internal validity of the conclusions generated in this study (Sugiyono, 2022).

Although the statistical test results show strong significance, researchers need to assume that the magnitude of the effect of this intervention is also affected by the relatively short duration of the study, which is eight weeks, so it is not yet certain whether this significant change in adherence will persist in the long term after the intervention is stopped. Without further evaluation or follow-up after the end of the study period, there is a possibility that some patients in the intervention group will again experience a decrease in compliance if the assistance is not continued on an ongoing basis by the puskesmas. The researcher assumes that the sustainability of these positive results depends largely on the institutionalization of the integrated nursing care model into the Prolanis program on a permanent basis, rather than just as a temporary research program. This is an important note for the sustainability of the benefits of this research beyond the purely academic context.

The practical implications of the results of this bivariate test indicate that the integrated nursing care model deserves to be considered as a permanent part of the Prolanis program at the Sidomulyo Health Center, given the large difference in statistical significance produced compared to standard services that have been running so far. Puskesmas management may consider reallocating nursing resources to support the implementation of routine scheduled home visits, considering that this component is thought to be the main contributor to the magnitude of the intervention effect. Policy support from the Pekanbaru city Health Office is also needed to ensure the sustainability of this program on a broader scale, given the high burden of DM cases in the city. Institutional adoption of this model has the potential to have a greater public health impact than if it were only applied on a research scale.

Overall, the results of the bivariate analysis in this study consistently prove that integrated nursing care has a statistically significant effect on increasing treatment adherence of patients with Type 2 diabetes mellitus in the working area of the Sidomulyo Pekanbaru Health Center, both when compared with the patient's own condition before the intervention and when compared with the group that only received standard Prolanis services. Researchers assume that the combination of structured education, scheduled home visits, and ongoing monitoring are the main forces that distinguish the results of the intervention group from the control group, and not solely due to the demographic characteristics of the respondents that have been shown to be homogeneous in the early stages of the study. This strong statistical significance provides a solid scientific basis for recommending the replication of the integrated nursing care model in other health centers with similar characteristics of DM treatment adherence problems. Thus, this research not only contributes academically, but also has a high applicative value for improving the quality of primary health care services based on Community Nursing in Indonesia.

CONCLUSIONS

This study shows that integrated nursing care innovation is an effective intervention in improving treatment adherence in diabetes mellitus patients in the community. The success of this intervention indicates that a nursing approach that integrates health education, mentoring, monitoring, and family involvement is able to increase patient awareness, motivation, and responsibility in carrying out regular treatment. This finding also reinforces the importance of the role of community nurses in providing comprehensive and sustainable care in an effort to support diabetes mellitus control and prevent complications.

The application of integrated nursing care innovation can be considered as one of the nursing service strategies in primary health facilities to improve treatment adherence of diabetes mellitus patients. However, this study has some limitations, such as a relatively limited number of respondents, the implementation of research in only one region so that the results can not be generalized widely, as well as the implementation time of the intervention is relatively short so that it can not describe the sustainability of treatment adherence in the long term. Therefore, further research is recommended to involve a larger sample, a wider coverage area, and a longer follow-up period so that the effectiveness of integrated nursing care innovation can be evaluated more comprehensively.

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