



Application of Home Medication Review (HMR) on Patient Adherence in Type 2 Diabetes Mellitus (T2DM) Blood Sugar Management

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ABSTRACT: Non-adherence of type 2 diabetes mellitus (T2DM) patients in treatment will impact expected clinical outcomes, risk of complications, and poor quality of life. Home medication review (HMR) is designed to help achieve optimal treatment, such as patient adherence. This study aimed to determine adherence levels and T2DM blood sugar management. This study with a pretest-posttest control group design was carried out at Andalas Public Health Center, Padang City, West Sumatra-Indonesia with 62 randomly selected respondents and then divided into two groups (pillbox and non-pillbox). The adherence levels were assessed by the pill count method. Changes in blood sugar levels are associated with adherence levels. The results showed an increase in the T2DM adherence level of patients using the pillbox at 7.360% and a decrease in blood sugar levels in those who used the pillbox at 61.161 mg/dL. There was a significant difference in the adherence between patients' levels using the pillbox and non-pillbox with a value of 0.011 ($p < 0.05$). Similarly, the patient's blood sugar levels between the two groups showed a significant difference with a value of 0.007 ($p < 0.05$). The application of HMR to patient adherence is considered to have a role in managing T2DM blood sugar.

Keywords: T2DM; adherence; home medication review; HMR; pillbox.

ABSTRAK: Ketidakepatuhan pasien diabetes melitus tipe 2 (DMT2) dalam pengobatan akan berdampak pada luaran klinis yang diharapkan, risiko komplikasi, dan kualitas hidup yang buruk. *Home Medication Review* (HMR) dirancang untuk membantu mencapai pengobatan yang optimal, seperti kepatuhan pasien. Penelitian ini bertujuan untuk mengetahui tingkat kepatuhan dan manajemen kadar gula darah DMT2. Penelitian dengan desain *pretest-posttest control group design* ini dilakukan di Puskesmas Andalas, Kota Padang, Sumatera Barat-Indonesia dengan 62 responden yang dipilih secara acak kemudian dibagi menjadi dua kelompok (*pillbox* dan *non-pillbox*). Tingkat kepatuhan dinilai dengan metode *pill count*. Perubahan kadar gula darah berhubungan dengan tingkat kepatuhan. Hasil penelitian menunjukkan peningkatan tingkat kepatuhan pasien DMT2 yang menggunakan pillbox sebesar 7,360% dan penurunan kadar gula darah pada yang menggunakan pillbox sebesar 61,161 mg/dL. Terdapat perbedaan bermakna tingkat kepatuhan antara pasien yang menggunakan *pillbox* dan *non-pillbox* dengan *p-value* 0,011 ($p < 0,05$). Demikian pula kadar gula darah pasien antara kedua kelompok menunjukkan perbedaan bermakna dengan *p-value* 0,007 ($p < 0,05$). Penerapan HMR terhadap kepatuhan pasien dianggap memiliki peran dalam pengelolaan gula darah DMT2.

Kata kunci: DMT2; kepatuhan; *home medication review*; HMR; *pillbox*.

Introduction

Diabetes Mellitus is a non-communicable disease with increasing prevalence globally and nationally occupies the top ten conditions with the most causes of death and cases [1]. Diabetes mellitus is characterized by increased blood glucose levels exceeding normal and disturbances of carbohydrate, protein, and fat metabolism caused by insulin deficiency, impaired insulin response, or both [2].

The International Diabetes Federation (IDF) 2021 predicts an increase in the number of people with diabetes mellitus globally from 537 million in 2021 to 643 million by 2030 and 783 million by 2045 [3]. This disease affects

people of all ages but is typically prevalent in people over 65 years of age [4]. Based on the 2018 Basic Health Research (Riskesdas) report, the prevalence of diabetes mellitus in Indonesia based on a doctor's diagnosis from a population aged 15 reached 2%. The prevalence of diabetes mellitus in West Sumatra Province based on a doctor's diagnosis from a population aged 15 years in 2013 reached 1.3% and increased in 2018 to get 1.64% [5].

Padang City has a high incidence of diabetes mellitus in West Sumatra. Data from the Padang City Health Office 2020 shows 36,038 cases in the

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population aged 15 years and 9,471 people with diabetes mellitus. Andalas Public Health Center is the health center with the highest number of diabetes mellitus patients in Padang City, with a total number of cases of 1,017 in 2020 [6].

In general, patients with diabetes mellitus have problems with their non-adherence in undergoing the recommended treatment therapy. This non-adherence is because the diabetes mellitus therapy regimen is generally more complex, and the side effects of drugs occur during treatment. The patient must carry out various arrangements related to eating arrangements, regular exercise, and blood glucose control so that it interferes with patient comfort [7]. Non-adherence of diabetes mellitus patients in treatment will impact low clinical outcomes, risk of complications, and bad quality of life [1]. Complications that occur in people with diabetes mellitus are cardiovascular disease, neuropathy retinopathy, cerebrovascular disease, nephropathy, and peripheral vascular diseases. Therefore, it is necessary to control efforts that must be carried out by patients with diabetes mellitus [8].

Adherence to medication in people with diabetes mellitus has a crucial role in controlling blood sugar levels [8]. Adherence in patients with type 2 diabetes mellitus is defined as the level of behavior of a person receiving treatment to follow a diet, take medication and carry out a lifestyle by health care providers' recommendations [9]. Therefore, pharmacists are needed to improve the quality of patient-oriented health services [10].

Pharmacists are at the forefront of primary health care and are responsible for ensuring that patient medication use is safe, effective, and efficient. One of its roles is to provide counseling to patients that are useful for increasing patient adherence to drug use and reducing mortality due to diabetes mellitus [11], through Home Medication Review (HMR), which is a patient-focused, structured and collaborative health service to improve patient adherence in optimizing the use of medicines. HMR is designed to assist patients in maximizing the benefits of a treatment regimen and preventing treatment-related problems [12].

One of the pharmacist's roles in measuring patient adherence can be done using the pill counting method, namely by calculating the patient's remaining medication in the pillbox, which is designed to help patients forget to take their medication and also allows patients to adjust the drug to a single dose according to the time and day within a certain period to improve patient adherence [13,14].

Research Methods

Research Design

This research used a pretest-posttest control group design. Data sources were collected from patients with type 2 diabetes mellitus who have been recorded in Chronic Disease Management Program Community at the Andalas Public Health Center in Padang City, West Sumatra, Indonesia. The distribution system of respondents into the pillbox and non-pillbox groups was done randomly.

Patient Criteria

The inclusion criteria in this study were adult patients diagnosed with type 2 diabetes mellitus with or without other comorbidities who have received diabetes mellitus treatment for at least three months. Furthermore, the exclusion criteria in this study were patients who died in treatment and moved to health facilities.

Ethical Approval

This study obtained ethical approval from the Research Ethics Committee, Faculty of Medicine, Universitas Andalas, Indonesia (No. 685/UN.16.2/KEP-FK/2022). Patients who are willing to participate by filling out the Informed Consent.

Data Analysis

Measuring patient adherence can be done using the pill count method by calculating the remaining drug from the patient during therapy within a certain period so that the percentage of patient adherence is obtained. Calculating patient adherence is done using the Grymonpre formula, which is as follows:[15]

$$\% \text{ Adherence} : \frac{(X) - (Y)}{(A \times B)} \times 100 \%$$

Information:

X = amount of drug administered

Y = amount of remaining drug

A = number of drugs taken per day

B = number of days between award date and interview

The percentage of adherence then was classified into two categories, namely if the calculation results <80% are included in the "non-adherent" category and if the calculation results are 80-100% included in the "adherent" category. The advantages of pill count method are easy, objective, and quantitative.

Data analysis was carried out using descriptive statistics to obtain an overview of the frequency distribution and the percentage proportion of the variables studied, such as gender, age, education, occupation, comorbidities,

and type 2 diabetes mellitus therapy. The Chi-Square test is used to see the difference in the proportion of each characteristic variable between the pillbox and non-pillbox groups. The Mann-Whitney Test compares changes in adherence and blood sugar level between those groups. The test was carried out with a 95% confidence level or significant level ($p < 0.05$).

Results and Discussion

The total number of patients used as research samples was 62 people who were divided into two groups, namely the pillbox and the non-pillbox groups were selected randomly using randbetween.

The sociodemographic characteristics results of patients with type 2 diabetes mellitus can be seen in [Table 1](#). Patients based on gender generally suffered more from women as 27 people (87.10%) using pillbox and 23 people (74.19%) in the non-pillbox group compared to men in both groups. The study results are in line with Resti et al. (2021) found that women with diabetes mellitus suffered the most, as many as 91 people or 72.2% [\[16\]](#). More women suffer from diabetes mellitus because of differences in body composition and sex hormone levels between men and women. Women have more fatty tissue than men. This can be seen from the difference in normal fat levels between adult men and women, where fat tissue in men ranges from 15-20% while in women about 20-25% of body weight. The decrease in the concentration of the hormone estrogen in women, especially during menopause, causes an increase in body fat reserves,

especially in the abdominal area, which will increase the release of free fatty acids. Both conditions cause insulin resistance; therefore, women are at risk for diabetes mellitus [\[16\]](#).

Based on the results of the study, the adult age group (45-59 years) had the highest number in both groups, around 17 people (54.84%) in the pillbox group, meanwhile in the non-pillbox groups about 19 people (61.29%). This study's results align with research by Kekenusa et al. (2013) which found that the incidence of type 2 diabetes mellitus in the age group 45 years was 56.3% more than in those aged < 45 years. Between age and the incidence of Type 2 DM ($p = 0.000$) with an OR value of 7.6, meaning that a person aged 45 years is 8x more likely to develop type 2 diabetes mellitus compared to people aged <45 years [\[17\]](#). Based on the American Diabetes Association (2021), most people have diabetes between the ages of 45-64 years because that age range is associated with various degenerative diseases. The aging process causes a decrease in pancreatic beta cells' ability to produce insulin to increase blood sugar levels [\[18\]](#).

Based on the latest education level of T2DM patients, most are middle class in education, including Junior High School and Senior High School (SMA), which is 17 people (54.84%) and 19 people (61.29%) for the pillbox and the non-pillbox group respectively. The results follow research conducted by Anggraeni et al. (2020) that the majority of T2DM patients have the last education in High School (SMA), as many as 39 people or 34.18% [\[19\]](#). This is in line with the theory, which states that the level of education dramatically influences changes in attitudes and behavior

Table 1. Data on sociodemographic characteristics of patients with type 2 diabetes mellitus between the pillbox and non-pillbox groups.

Respondent Data	Category	Pillbox (N= 31)		Non-Pillbox (N=31)		p-value *
		Number of Patients (n)	Percentage (%)	Number of Patients (n)	Percentage (%)	
Gender	Male	4	12.90%	8	25.81%	0.199
	Female	27	87.10%	23	74.19%	
Age	Adult (45-59)	17	54.84%	19	61.29%	0.607
	Elderly ≥ 60	14	45.16%	12	38.71%	
Education level	Low	9	29.03%	6	19.35%	0.670
	Middle	17	54.84%	19	61.29%	
	High	5	16.13%	6	19.36%	
Profession	Work	4	12.90%	7	22.58%	0.319
	Not Working	27	87.10%	24	77.42%	

Note: *Chi-square, significant ($p < 0.05$)

Table 2. Data on clinical characteristics of type 2 diabetes mellitus patients between pillbox and non-pillbox groups.

Category	Pillbox (N= 31)		Non-Pillbox (N=31)		p-value *
	Number of Patients (n)	Percentage (%)	Number of Patients (n)	Percentage (%)	
Without comorbidities	8	25.81%	14	45.16%	0.111
Comorbidities	23	74.19%	17	54.84%	

Note: *Chi-square, significant ($p < 0.05$)

in healthy living. Patients with a low level of education will find it difficult to understand and receive health messages conveyed, affecting their ability to respond to a problem. Otherwise, patients who have a higher education have broader knowledge about diabetes mellitus, including various risk factors, symptoms, and complications, and also allows patients to control themselves in overcoming the problems they face, how to deal with events, and quickly understand what is recommended by the doctor health worker [20].

From the research data on profession, the most unemployed group, as many as 27 people (87.10%), used the pillbox, while 24 people (77.42%) did not. This study is in line with the results of research conducted by Anggraeni et al. (2020) which states that most people with diabetes mellitus have jobs as housewives, as many as 31 people or 27.7% [19]. Based on research, housewives tend to have less physical activity, thus becoming one of the risk factors for diabetes mellitus [21]. Indonesian Endocrinology Association / PERKENI (2021) states that physical activity is one of the four pillars of diabetes mellitus management. Physical activity helps control blood sugar and improve cardiovascular risk factors such as lowering body fat, increasing insulin sensitivity, and lowering blood pressure. Regular physical activity causes cells to become more sensitive to insulin, so glucose intake carried by glucose transporters into cells increases and can reduce blood sugar levels [22].

Based on clinical characteristics data, it showed that most patients diagnosed with T2DM at the Andalas Health Center had comorbidities around 23 people (74.19%) in the pillbox group and 17 people (54.84%) in the non-pillbox group (Table 2). Similar to research conducted by Saibi et al. (2020), respondents diagnosed with diabetes mellitus mostly have comorbidities [23]. The most common comorbidity of T2DM was hypertension in both groups, which was 15 people (65.22%) in the pillbox group and 12 people (70.59%) in the non-pillbox group (Table 3). The study results follow the research conducted by Mahfudzoh et al. (2019), it was found that the majority of people with T2DM had comorbid hypertension, as many as 47 people or 58.8% [24]. This follows the theory that states that hypertension is a significant risk factor for the occurrence of diabetes mellitus. Hypertension can make cells insensitive to insulin or insulin resistance. Excess insulin levels can cause an increase in sodium retention by the kidney tubules. It can cause hypertension, and sufficient insulin levels cause blood pressure to remain controlled. Meanwhile, blood pressure above 120/90 mmHg has a double risk of diabetes mellitus compared to normal blood pressure [25].

Management of type 2 diabetes mellitus requires appropriate pharmacological therapy to control blood glucose levels and prevent complications of various diseases. Oral antidiabetic pharmacological treatment is generally given single or in combination. Generally, oral

Table 3. Distribution of data on clinical characteristics of comorbidities in type 2 diabetes mellitus patients between the pillbox and non-pillbox groups.

Respondent Data	Category	Pillbox (N= 31)		Non-Pillbox (N=31)	
		Number of Patients (n)	Percentage (%)	Number of Patients (n)	Percentage (%)
Comorbidities	Hypertension	15	65.22%	12	70.59%
	Hyperlipidemia	2	8.70%	1	5.88%
	HT + Hyperlipidemia	4	17.39%	4	23.53%
	HT + Heart disease	2	8.70%	0	0.00%

Table 4. Drug therapy data for type 2 diabetes mellitus patients between the pillbox and non-pillbox groups.

Drug Therapy	Drug	Pillbox (N= 31)		Non-Pillbox (N=31)	
		Number of Patients (n)	Percentage (%)	Number of Patients (n)	Percentage (%)
Single	Metformin 500 mg	8	25.81%	7	22.58%
	Glimepiride 2 mg	2	6.45%	3	9.68%
	Glikuidon	1	3.22%	1	3.22%
Combination	Metformin 500 mg + Glimepiride 2 mg	20	64.52%	20	64.52%

drugs used as therapy for type 2 diabetes mellitus at the Andalas Health Center were sulfonylureas (glimepiride and glikuidone), then the biguanide group (metformin), which can be seen in [Table 4](#). The results showed that the most widely used oral antidiabetic drug therapy by patients with type 2 diabetes mellitus at the Andalas Public Health Center, Padang City, was the combination drug therapy of metformin 500 mg and glimepiride 2 mg used by 20 people (64.52%) in each group. This study is on the results of research conducted by Widi et al. (2016) found that the most widely used oral antidiabetic combination therapy was the biguanide-sulfonylurea combination (metformin-glimepiride) in as many as 73 people or 35.6% [\[26\]](#). Most diabetes mellitus receive treatment with a combination of 2 oral antidiabetics because most of the patient's blood sugar levels are still not controlled. This drug is selected based on guidelines and national formulary policies at the health center.

The following results can be seen in [Table 5](#) T2DM patients in the pillbox group before being given the pillbox had a total of 23 patients (74.20%) who adhered to using the drug. Surprisingly, this number has increased to 30 patients (100%) after using the pillbox. On the contrary, in the non-pillbox group, there was a decrease in the number of adherent patients from 17 to 15 patients during the 30 days of observation. It can be concluded that there was an increase in the level of patient adherence after being

given intervention in the form of a pillbox compared to those who did not use a pillbox. The results of this study are in line with research conducted by Sentana et al. (2021) which stated that adherence to taking medication for diabetes mellitus patients after giving the medicine box increased from low adherence by 29 respondents or 88% to moderate adherence by 20 respondents or 61% and adherence as high as 13 respondents 39% [\[27\]](#). Adherence is one of the determining factors in the success of patient therapy, in addition to other factors such as the accuracy of the treatment regimen, accuracy in drug selection, and support for a healthy lifestyle from the patient. Patient non-adherence in undergoing therapy can lead to failure in controlling blood sugar. If this situation is left unchecked and lasts a long time, it will cause both macrovascular and microvascular complications. The reasons for patients' not-adherence to carrying out therapy in this study were factors for forgetting to take medication, patients already feeling healthy, complex therapy regimens, and patients feeling worried about the side effects of the drugs they took for a long time [\[28\]](#).

Then the calculation of the average difference in the adherence score of patients with T2DM between pillbox and non-pillbox groups is shown in [Table 6](#). The results showed the total increase in patients' adherence during the observation was 7.360% in the pillbox group compared to the non-pillbox group, which was 2.239%.

Table 5. Level of adherence of type 2 diabetes mellitus patients between pillbox and non-pillbox groups.

Group	Level of Adherence	Adherence		Non-adherence	
		Number of Patients (n)	Percentage (%)	Number of Patients (n)	Percentage (%)
Pillbox	Before	23	74.20%	8	25.80%
	After	31	100%	0	0%
Non-Pillbox	Before	17	54.84%	14	45.16%
	After	15	48.39%	16	51.61%

Table 6. Changes in adherence scores of patients with type 2 diabetes mellitus between the pillbox and non-pillbox groups.

Group	Level of Adherence	X (%)	ΔX (%)	SE	p-value*
Pillbox	Before	86.422	7.360	1.144	0.011
	After	93.782			
Non-Pillbox	Before	78.314	2.239	1.137	
	After	80.553			

Note: * Mann-Whitney Test, significant ($p < 0.05$)

The results of the Mann-Whitney Test showed significant results with a value of 0.011 ($p < 0.05$), meaning that there were differences in the level of adherence to therapy for T2DM patients using the pillbox and non-pillbox groups. The results of this study are under research conducted by Mahacita (2020) which states that there is a significant difference between the value of adherence before and after being given educational interventions and pillboxes for diabetes mellitus patients at the Tanjung Mataram Health Center ($p < 0.05$) [29].

A similar study conducted by Wibowo et al. (2020) found that the provision of an intervention in the form of a medication reminder aid in diabetes mellitus patients showed a p-value of 0.000 which means that there was a significant effect between before and after the intervention was given. Research on patients with diabetes mellitus also confirms that there is a difference in the level of adherence between the group that was given medication reminder aids compared to the group that was not given medication reminder aids in patients with type 2 diabetes mellitus [30]. This foundation is also supported by a study conducted by Yunita (2016), it is known that Medication Reminder Chart could improve adherence of patients compared to the control group in Type 2 diabetes mellitus patients ($p = 0.000$) with a median difference of 0.5 [31].

According to the Guidelines for the Management and Prevention of Type 2 Diabetes Mellitus (PERKENI) 2021, the diagnosis of diabetes mellitus can be established

based on an examination of blood glucose levels. One of the blood sugar levels that can describe the condition of a person's blood sugar, especially people with T2DM is fasting blood sugar (GDP), which is a person's blood sugar level after fasting for at least 8 hours. Fasting blood sugar in patients with diabetes mellitus is said to be under control if < 126 mg/dL [22].

In this study, the clinical outcome of diabetes mellitus patients was fasting blood sugar in the group using the pillbox and the non-pillbox groups. It can be seen in Table 7 shows that the pillbox group before giving the pillbox had ten patients whose fasting blood sugar was controlled (32.26%). Then, after 30 days of using the pillbox an increase was found in the number of patients with controlled blood sugar to 19 patients (61.29%). This trend also occurs in the non-pillbox group. This could be because patients are still taking diabetes medication without being given a pillbox.

This study also calculated the difference in the average fasting blood sugar levels of T2DM patients at the beginning and end of observation in both groups which can be seen in Table 8. The results obtained in the pillbox group showed a reduction in fasting blood sugar of 61.161 mg/dL compared to the reduction rate in the non-pillbox group of 16.709 mg/dL. The results of the Mann-Whitney Test showed significant results with a value of 0.007 which means that there is a difference in fasting blood sugar between patients with type 2 diabetes mellitus

Table 7. Blood sugar levels of patients with type 2 diabetes mellitus between the pillbox and non-pillbox groups.

Group	Fasting Blood Sugar	Controlled		Not Controlled	
		Number of Patients (n)	Percentage (%)	Number of Patients (n)	Percentage (%)
pillbox	Before	10	32.26%	21	67.17%
	After	19	61.29%	12	38.71%
Non-Pillbox	Before	5	16.13%	26	83.48%
	After	11	35.48%	20	64.52%

Table 8. Changes in fasting blood sugar values in type 2 diabetes mellitus patients between the pillbox and non-pillbox groups.

Group	fasting blood sugar	X (mg/dL)	ΔX (%)	SE	p-value*
Pillbox	Before	204.355	61.161	12.816	0.007
	After	143.194			
Non-Pillbox	Before	177.935	16.710	8.878	
	After	161.225			

Note: * Mann-Whitney Test, significant ($p < 0.05$)

in both groups. The difference in results obtained in the pillbox group was more significant than in the non-pillbox group. The results of this study are per research conducted by Wibowo et al. (2020), where there was an increase in the achievement of therapeutic targets in the form of decreasing fasting blood sugar levels in the group who were given counseling with medication reminder aids in patients with diabetes mellitus [30]. Patient adherence affects the therapeutic success of treatment. Patient adherence to taking anti-diabetic drugs can affect the patient's blood sugar. Therefore, adherence to anti-diabetic drugs can be the patient's choice in controlling blood sugar. The higher the patient's medication adherence, the more blood sugar levels can be well controlled, which will drop. On the contrary, the lower the patient's medication adherence, the more blood sugar levels cannot be controlled, meaning blood sugar levels will remain high continuously increase in blood glucose levels can lead to long-term complications [32].

Conclusion

There was a significant difference in the adherence between patients' levels using the pillbox and non-pillbox with a value of 0.011 ($p < 0.05$). Similarly, the patient's blood sugar levels between the two groups showed a significant difference with a value of 0.007 ($p < 0.05$). The application of HMR to patient adherence is considered to have a role in managing T2DM blood sugar.

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