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## Improvement of random blood glucose on diabetes mellitus type ii patients with medication box interventions and individual education methods

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### Abstract

**Introduction:** Diabetes caused 1.5 million deaths in 2012. High blood glucose resulted in an additional 2.2 million deaths, by increasing the risk of cardiovascular and other diseases. Non-compliance with treatment diabetes mellitus patients can potentially increase morbidity, mortality and treatment costs. The aim of this study is to improve medication adherence and controlled random blood glucose in the hope reduce mortality and morbidity of diabetes.

**Method:** Quasi experimental in Posbindu RW 003 and 006 Kedaung Kaliangke with samples of diabetes mellitus type 2, the sampling method was total sampling. The independent variable was an intervention that was carried out in the form of giving a medicine box, calendar, individual education and taking medication. The dependent variable was the change in RBG.

**Result:** 20 respondents who met the inclusion criteria. The mean RBG before intervention was 253 (201 - 591) mg / dL and the mean RBG after intervention was 182.5 (130 - 220) mg / dL. Wilcoxon Test showed that there were significant differences in RBG levels between before and after the intervention (p-value: 0.001).

**Conclusion:** Knowledge enhancement through individual education has proven to be effective in increasing adherence to type 2 diabetes mellitus treatment and controlled RBG.

**Keywords:** Diabetes; random blood glucose; medication box interventions; individual education methods; public health

### 1. Introduction

Diabetes is a serious chronic disease that occurs because the pancreas does not produce enough insulin (a hormone that regulates blood sugar or glucose), or when the body cannot effectively use the insulin it produces. Diabetes is an important public health problem, being one of the four priority non-communicable diseases that are being targeted by world leaders. The number of cases and the prevalence of diabetes have continued to increase over the past few decades [1, 2].

Criteria for diagnosis of diabetes mellitus (DM) according to American Diabetes Association (ADA) 2011 and Perkumpulan Endokrinologi Indonesia (PERKENI) 2011 guidelines: [1] Fasting plasma glucose  $\geq 126$  mg / dl with concomitant classic symptoms; [2] Glucose 2 hours after loading  $\geq 200$  mg / dl; [3] Random plasma glucose when  $\geq 200$  mg / dl if there are classic DM complaints such as urinating (polyuria), drinking a lot (polydipsia), eating a lot (polyphagia), and weight loss that can't be explained [3-5]. Whereas the diagnosis criteria for DM in Indonesia according to the PERKENI 2015 consensus are: [1] Fasting plasma glucose examination  $\geq 126$  mg / dl. Fasting is a condition of no calorie intake of at least 8 hours, OR [2] Examination of plasma glucose  $\geq 200$  mg / dl 2 hours after Oral Glucose Tolerance Test (OGTT) with a glucose load of 75 grams, OR [3] Examination of plasma glucose during  $\geq 200$  mg / dl with classic complaints (polyuria, polydipsia, polyphagia and unexplained weight loss), OR [4] HbA1c examination 16.5% using a standardized method by the National Glycohaemoglobin Standardization Program (NGSP) [6].

WHO data shows that the incidence of non-communicable diseases in 2004 which reached 48.30% was slightly greater than the incidence of communicable diseases, which amounted to 47.50%. In fact, non-communicable diseases are the number one cause of death in the world (63.50%) [7].

Diabetes caused 1.5 million deaths in 2012. Blood glucose higher than the maximum limit resulted in an additional 2.2 million deaths, by increasing the risk of cardiovascular and other diseases. Forty-three percent (43%) of these 3.7 million deaths occurred before the age of 70 years. The percentage of deaths due to diabetes that occurs before age 70 is higher in low and middle income countries than in high income countries [1,2].

WHO estimates that 422 million adults over the age of 18 lived with diabetes in 2014. The largest number of people with diabetes is estimated to come from Southeast Asia and the Western Pacific, accounting for about half the cases of diabetes in the world. Around the world, the number of diabetics has increased substantially between 1980 and 2014, increasing from 108 million to 422 million or around four times [1,2].

In addition to cardiovascular disease, DM is also one of the main causes of kidney disease and blindness at the age of under 65 years, and also amputation [8]. Diabetes also causes amputations (which are not caused by trauma), disability, to death. Another impact of diabetes is reducing life expectancy by 5-10 years. Life expectancy for people with type 2 diabetes who suffer from serious mental illnesses, such as schizophrenia, is even 20% lower compared to the general population [7,9,10].

Indonesia is ranked 7th with the highest number of people with diabetes mellitus in the world. The International Diabetes Federation (IDF) states that in 2016 Indonesia had around 9.1 million people with DM. It is estimated that this number could increase to 12.4 million people in 2025 and reach 14.1 million in 2035 [11]. Infodatin in 2018 released data that the prevalence of people with Type 2 Diabetes Mellitus in Indonesia is 2.0%. This figure experienced a significant increase from 2013 which was only 1.5%. One of the regions with the highest number of diabetics in Indonesia is DKI Jakarta with a prevalence of DM sufferers of 3.4%, which ranks number 1 out of 34 provinces and includes 1 of 13 provinces with regional prevalence above the national prevalence. The prevalence of DM in DKI Jakarta has experienced a significant increase from 2013 which was only 2.5%. [12-14]

The Indonesian Nephrology Association (Pernefri) in 2006 released data on patients with chronic kidney failure in Indonesia of 12.5%. The accompanying diseases of stage 5 chronic kidney patients according to the Indonesian Renal Registry in 2018 are 51% hypertension and 21% diabetes mellitus type 2. [15]. Diabetes and its complications bring huge economic losses for diabetics and their families, the health system and the national economy through direct medical costs, job loss and income. Included in the main cost components are hospital and outpatient care, another factor that requires large costs is the increase in costs for analog insulin 1 which is increasingly being prescribed despite little evidence that this type of insulin has a significant effect compared to cheaper human insulin. It is therefore important to control blood glucose levels of diabetes mellitus type 2 patients before complications occur later in life. Controlling the random blood glucose content of DM patients through comprehensive treatment, namely management in a pharmacological and non-pharmacological manner [16].

A self-report scale to assess adherence to the use of antihypertensive drugs has been developed by Morisky. A study to test psychometrics and predict the validity of the

self report medication adherence structure was tested on 1367 hypertensive patients. Self report adherence to drug use was measured by the new 8 item self report Morisky Medication Adherence Scale (MMAS) [17].

Seeing the importance of adherence to taking medication in people with diabetes mellitus to prevent complications later in life. This research was conducted to improve medication adherence in patients with diabetes mellitus and provide education about the importance of taking medication regularly to random blood glucose (RBG) in the hope of reducing the morbidity and mortality rates of diabetes mellitus

## 2. Method and material

This research is a quasi-experimental study carried out in Posbindu RW 003 and 006 Kedaung Kaliangke Sub-District Jakarta in January 2020 to February 2020. The sample of this study was uncontrolled type 2 diabetes mellitus sufferers or Random Blood Glucose (RBG) when measurements were above 200 mg / dL. The estimated sample size in this study is 30 respondents with a total sampling method in the form of sampling. This experimental study doesn't include control grup. The inclusion criteria in this study were people with diabetes mellitus type 2 not controlled. Exclusion criteria in this study were patients with other non-communicable diseases besides diabetes mellitus type 2, diabetes mellitus type 1, gestational diabetes, and diabetes mellitus type 2 patients who had complications or treatment using insulin.

This research was carried out by measuring medication adherence and blood glucose before and after the intervention. The intervention was in the form of individual education for patients with type 2 diabetes mellitus, administration of taking medication boxes, as well as a calendar of reminders of control to the Puskesmas when the usual medication was consumed. The intervention lasted for 1 month and was monitored by the families of sufferers and local cadres. The independent variable in this study was an intervention that was carried out in the form of giving a medicine box, calendar, individual education and taking medication. The dependent variable in this study was the change in blood glucose at a time. Paired numerical categorical statistical analysis using the Pair T-Test statistical test with an alternative test in the form of Wilcoxon, and paired categorical categorization using the McNemar Test to assess the significance between the 2 groups. This study has obtained permission from the Puskesmas Kelurahan Kedaung Kaliangke and the Puskesmas Kecamatan Cengkareng.

## 3. Results

Hasil dan pembahasan hasil dan pembahasan hasil dan pembahasan. The data collection process was carried out in January 2020 - February 2020 by conducting a survey through a questionnaire that we gave to patients with diabetes mellitus type 2 at Puskesmas Kelurahan Kedaung Kaliangke. Screening was carried out in January - February 2020 in posbindu RW 003 and 006, followed by 20 respondents with 4 (20%) male respondents and 16 (80%) women. The average age of 57 years with an age range is 22-78 years. Generally respondent education is Elementary School with 11 respondents (55%). Respondents generally work as housewives by 13 respondents (65%). The characteristics of respondents are in table 1.

**Table 1:** Demographic Characteristics of Respondents in Posbindu RW 003 and 006, Kedaung Kaliangke Sub-District, Cengkareng District, Jakarta

Parametric	N (%)	Mean (SD)	Med (Min – Max)
<b>Gender</b>			
Male	4 (20%)		
Female	16 (80%)		
<b>Age</b>		52,32 (9,52)	57 (22 – 78)
<b>Educational</b>			
No School	2 (10%)		
Elementary School	11 (55%)		
Middle School	5 (25%)		
High School	2 (10%)		
University	-		
<b>Work</b>			
Housewives	13 (65%)		
General employees	2 (10%)		
None	5 (25%)		

Profile history of diabetes mellitus type 2 patients is described in table 2. Generally respondents suffer from type 2 diabetes mellitus for 1-5 years ie 10 respondents (50%). History of diabetes mellitus control to the Puskesmas or Posbindu generally controlled by 17 respondents (85%). Generally patients 16 (80%) do not have a history of type 2 diabetes mellitus in the family. The characteristics of the respondents are listed in table 2

Family History	N (%)
No	4 (20%)
Yes	16 (80%)

**Table 2:** Historical Characteristics of Diabetes Mellitus Type 2 Patients in Posbindu RW 003 dan 006, Kedaung Kaliangke Sub-District, Cengkareng District, Jakarta

Parametric	N (%)
<b>Time of Diabetes Mellitus type 2</b>	
Less than 1 year	3 (15%)
1- 5 years	10 (50%)
5-10 years	3 (15%)
Above 10 years	4 (20%)
<b>Control Diabetes Mellitus type 2 to the Puskesmas or Posbindu</b>	
Yes	17 (85%)
No	3 (15%)

Compliance Profile Taking Medication Respondents before the intervention can be said to be quite bad with the number of respondents who forgot to take medication 16 (80%), did not take medication for various reasons 15 (75%), reduced or stopped the drug without the knowledge of doctors 16 (80%), forgot to bring medication 16 (80%), did not take medication yesterday 13 (65%), stopped taking medication when there were improvement in symptoms 14 (70%), felt disturbed to ask for medication 14 (70%), and difficulty remembering medication taken 18 (90%). Providing individual and in-depth education is carried out to all individuals and taking a medication compliance profile measurement one month later and the results obtained are improved in all aspects of the question being assessed (*p*-value <0.05)

**Table 3:** Compliance Profiles of Respondent Medication Taking Before and After Intervention

No	Items	Pre Intervention		Post Intervention		P
		Yes	No	Yes	No	
1	Do you sometimes forget to take your medications?	16 (80%)	4 (20%)	6 (30%)	14 (70%)	<0.05
2	People sometimes miss taking their medications for reasons other than forgetting, Thinking over the past two weeks, were there any days when you did not take your medicine?	15 (75%)	5 (25%)	1 (5%)	19 (95%)	<0.05
3	Have you ever cut back or stopped taking your medication without telling your doctor, because you felt worse when you took it?	16 (80%)	4 (20%)	-	20 (100%)	<0.05
4	When you travel or leave home, do you sometimes forget to bring along your medications?	16 (80%)	4 (20%)	-	20 (100%)	<0.05
5	Did you take your medications yesterday?	7 (35%)	13 (65%)	20 (100%)	-	<0.05
6	When you feel like your condition is under control, do you sometimes stop taking your medicine?	14 (70%)	6 (30%)	-	20 (100%)	<0.05
7	Taking medication everyday is a real inconvenience for some people. Do you ever feel hassled about sticking to your treatment plan?	14 (70%)	6 (30%)	-	20 (100%)	<0.05
8	How often do you have difficulty remembering to take all your medications?	18 (90%)	2 (10%)	6 (30%)	14 (70%)	<0.05

Measurement of random blood glucose is done before and after the intervention in the form of administering pillboxes, calendars, individual education and taking medication. The mean random blood glucose before intervention was 253 (201 - 591) mg / dL and the mean random blood glucose

after intervention was 182.5 (130 - 220) mg / dL. Wilcoxon statistical test results showed there were significant changes in random blood glucose between before and after the intervention (*p*-value: 0.001)

**Table 4:** Mean Changes in Random Blood Glucose Respondent Pre-Post Interventions

Parametric	Normality	Mean (SD)	Med (Min-Max)	Mean Difference	Confidence Interval	p-value
<b>Random Blood Glucose</b>						
Pre-Intervention	0,001	280,15 (96,01)	253 (201 – 591)	103,5 (97,64)	57,80 - 149,20	< 0,001
Post Intervensi	0,060	176,65 (22,73)	182,5 (130 – 220)			

At the beginning of the study 20 respondents were obtained with blood glucose when uncontrolled or above 200 mg / dL. Interventions were given to all respondents in the form of interventions giving medicine boxes, calendars,

individual education and supervision of taking drugs. One month of intervention took place and the results showed that 18 (90%) of respondents experienced blood glucose regulation when controlled or below 200mg / dL.

**Table 5:** Changes in Blood Glucose Status Respondent Pre-Post Interventions

Parametric	Diabetic State Post Intervention		p-value
	Uncontrolled	Controlled	
Diabetic State Pre Intervention	Uncontrolled 2 (10%)	Controlled 18 (90%)	0,001
	Controlled -	-	

**4. Discussion**

Respondents who experience abnormal blood glucose based on changes in pancreatic hormones as regulators of the most important substances in the body's metabolism cause an increase in stress hormones, epinephrine and cortisol which increase glucose levels and fatty acids in the blood. High glucose levels stimulate the formation of glycogen from glucose, synthesis of fatty acids and cholesterol from glucose. High blood glucose levels can accelerate the formation of triglycerides in the liver. Triglyceride is one part of the fat composition in the body, where if triglyceride levels are within normal limits it has a function as a source of energy in the body while triglyceride levels in the abnormal range increase blood glucose levels as a cause of type II diabetes mellitus [18]

How to reduce blood glucose levels in Diabetes Mellitus Type II patients in addition to obediently taking medication on time and according to the recommended dosage of health workers also need to control weight through exercise and healthy eating. According to Bustan (2007) explains the form of weight control by doing 30 minutes of physical activity every day or exercising 5 days per week such as morning jogging, and doing healthy eating patterns by reducing glucose consumption and fatty foods [19, 20].

Knowledge is interpreted as the level of patient behavior in implementing diabetes mellitus type 2 treatment and the behavior suggested by doctors and others, and controlled diabetes is influenced by the level of diabetes patient's knowledge of his disease [21]. Patient's knowledge about DM is a tool that can help patients carry out DM management during his lifetime. Patient behavior based on positive knowledge and attitude will last. Knowledge given to patients with DM, will make patients understand about the disease and understand how to change behavior in dealing with the disease [22, 23].

Diabetes mellitus is a disease that has a lifetime, the role of general practitioners as the spearhead in primary health care is very important. Management of this disease requires the participation of doctors, nurses, nutritionists, and other health workers. Patients and their families are entitled to get knowledge and education about the course of the disease, prevention, complications, and management of DM [22, 23].

Adherence in patients with type 2 diabetes is generally defined as the level of behavior of someone who is getting treatment for diet, taking medication and carrying out a lifestyle in accordance with the recommendations of health

care providers [24] Patients who do not understand DM, often do not comply with DM treatment [25] The success of DM treatment is highly dependent on the patient's compliance with taking medication. Several previous studies on the relationship between knowledge and adherence to taking medication have shown different results [26-28].

Types of non-compliance with drug therapy include failure to redeem medication, missed doses, errors in drug administration time, and premature drug withdrawal. Non-compliance will result in the use of a drug that is less so that it makes the therapeutic benefits reduced. Non-compliance can also result in the use of excessive doses of the drug. If the dose is overused or if the drug is consumed more frequently than the recommended recommendation, it can create greater side effects. Problems like this often arise in patients who forget to take one dose of the drug and double the next dose [29]

The level of knowledge is one of the factors in influencing the level of adherence to take medication, so providing in-depth information about diabetes mellitus is very important to do so that the level of adherence to take medication increases and the risk of disease severity and complications decreases, and blood glucose can be controlled [26]

Knowledge is a very important domain for action to be formed, the necessary elements include understanding what is done, beliefs about the benefits and truth of what is done and the means needed to do it. Action is an internal response after thought and knowledge. This behavior or act of obedience is influenced by heredity, environment, and knowledge [30].

The success of therapy in patients with diabetes mellitus shows an increase in the quality of life of patients and avoid complications. The success of therapy is influenced by adherence, motivation, and family support. The success of diabetes mellitus therapy can be improved by regulating the diet, monitoring blood glucose levels, maintaining foot hygiene and the portion of exercise [31]. Improvement in the quality of life of patients with DM is influenced by the success of treatment. Less optimal treatment results are generally caused by patient non-compliance, inaccurate prescribing, and inaccurate monitoring [32]. Patient non-compliance increases the risk of complications and worsens the illness [33].

Study form Puspita Nur Hapsari (2014) was conducted in 92 patients with type 2 diabetes mellitus in outpatient RS X the control and getting oral antidiabetic in March 2014. The

conclusion of this study is a correlation between adherence scores with decreased fasting blood glucose levels very low which that medication adherence affects therapeutic outcome of 0,4% [31].

Research conducted at Mandau Health Center in Bengkalis Regency shows that the knowledge of DM Type 2 patients is generally at a moderate level and the level of medication adherence is relatively high. There is a relationship between knowledge of patients with diabetes Type 2 with adherence to take medication with a weak correlation level [26].

Research from Adelaide B, *et al.* (2019) explained that less than half (47.3%) of diabetes mellitus type II patients had moderate medication adherence and more than half (60.0%) of diabetes mellitus type II patients experienced abnormal blood glucose levels. while the Spearman rank correlation results obtained  $p$  value = (0.004) <(0.050) so that it can be concluded that there is a significant relationship between the level of adherence to take medication with blood glucose levels in patients with diabetes mellitus type II at Dinoyo Public Health Center, Malang [34].

The research form Oryza DN (2018) explains patients with unregulated blood glucose showed 46.2% people were obedient and 53.8% were not obedient in consuming anti-diabetic drugs. Patients with regulated blood glucose showed 92.3% people were obedient and 7.7% people were not obedient in consuming anti-diabetic drugs. Chi square test showed that there was a relationship between anti-diabetic drugs consumption adherence and blood glucose level regulation for diabetes mellitus patients with  $p = 0.015$  ( $p < 0.05$ ) and an OR value of 14 with a 95% CI (1.385-141.485), which means that unobedient have 14 times riskier suffered terrible blood glucose regulation than obedient patients [35].

Research conducted by Natalia and Dwipayant (2013), proves that there is a relationship between the level of adherence to take medication with blood glucose levels in DM Type II patients with a  $p$  value of 0.003. Prevention of increased blood glucose levels in patients with diabetes mellitus type II that is controlling weight by exercising and eating healthy. This form of control is done by losing a little weight (5-7% of total body weight) accompanied by 30 minutes of physical activity or exercise 5 days per week, adjusted for eating healthy enough [36].

## 5. Conclusion

Knowledge enhancement through individual education has proven to be effective in increasing adherence to type 2 diabetes mellitus treatment. Regular treatment will make changes in random blood glucose as meaningful being more controlled ( $p$ -value <0.05).

## Conflict of interest

All authors and parties declare that there is no Conflict of Interest

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## Ethical clearance

The research feasibility process and research ethics have been approved by the Cengkareng District Health Center

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