



ASSESSMENT OF E-WAITBOX PILL ORGANIZER FOR MEDICATION ADHERENCE AMONG ELDERLY DIABETIC PATIENTS OF KORONADAL CITY, SOUTH COTABATO

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KeyWords

e-WAITBox pill organizer, fasting blood glucose, medication adherence, glycemic control, elderly diabetic patients, fasting blood glucose

ABSTRACT

Introduction: Non-adherence to medications is a widespread issue that causes high costs all around the world (Cutler, 2018). Diabetes mellitus (DM) is a chronic disease with a high prevalence rate due to lifestyle changes that result in less physical activity and increased obesity (Goyal 2022). **Method:** A quasi-experimental research design was used to evaluate the influence of the e-WAITbox pill organizer on prescription adherence among elderly diabetic patients in Koronadal City, South Cotabato. The elderly diabetes patients were identified using purposive sampling based on inclusion and exclusion criteria. **Result:** No significant difference in FBS levels before, during, and after the intervention in both groups. In terms of medication adherence, before the intervention, majority reported difficulties in remembering medications, but after the intervention, there was a significant improvement in the treatment group. For the effect size, overall findings, highlight that the e-WAITBox pill organizer was effective in enhancing medication adherence but not in managing FBS level. **Conclusion:** According to the study's findings, both groups are not significant for FBS (fasting blood glucose) outcomes; however, for medication adherence, the treatment group is significant with the product. Furthermore, according to the study, the e-WAITBox pill organizer is ineffective at regulating FBS levels in both groups, except that it helps increase medication adherence among patients. Other methods/parameters, such as HbA1C, are suggested for further intervention.

INTRODUCTION

Medication adherence, or taking medications correctly, is defined as the extent to which patients take medication as prescribed by their doctors (U.S. Food and Drug Administration, 2019). The American Medical Association (2019) said that a patient is considered adherent if they take 80% of their prescribed medicine(s). If patients take less than 80% of their prescribed medication(s), they are considered as non-adherent. Medication non-adherence is a widespread problem that causes high costs worldwide (Cutler, 2018). Especially in chronic conditions with long-term therapies, adherence is important to achieve target outcomes but is often low (Sabate, 2018).

Medication non-adherence is a serious challenge to the self-management of DM among adults with DM, especially among older adults (Ningze, 2020). Wherein, older patients often find medication adherence difficult, A Pharmacy Times (2018) reported almost 20% of community-dwelling elders (65 years or older) take 10 or more medications. Sadly, multiple medication use created and contributed to adherence challenges in the aging population. Although non-adherence to prescribe medications affected all patients, regardless of their

age group, older adults were more susceptible to non-adherence because of cognitive and functional impairments, the prevalence of multiple comorbidities, and medications, as well as age-related changes in pharmacokinetics and pharmacodynamics. (Ningze, Xie, Chen, 2020)

In the Philippines, diabetes mellitus ranked as the fourth leading cause of death in 2020, with a staggering count of 37,265 fatalities, following heart diseases (99,680), cancer (62,289), and cerebrovascular diseases (59,736), according to data from the Philippine Statistics Authority. These alarming numbers highlighted the significant impact of diabetes, which is often referred to as a "silent and persistent problem". In South Cotabato, with a population of 975,476, Philippines Statistics Authority data revealed that 21.1% of the population has diabetes mellitus, further emphasizing the urgent need to address this growing health concern.

The objective of this study, entitled "Assessment of the e-WAITBox Pill Organizer for Medication Adherence among Elderly Diabetic Patients of Koronadal City, South Cotabato," is to evaluate the effectiveness of the e-WAITBox pill organizer as an electronic tool for enhancing medication adherence in elderly patients. The term "e" represents electronics, which will be incorporated into the study's product. "WAIT" stands for "Ways to Adhere, Improve, and Test," emphasizing the importance of adhering to medication schedules. The connection between "WAIT" and "Schedule" signifies that medications in the pill organizer must wait for their designated time for administration. The e-WAITBox pill organizer is a versatile compliance aid consisting of 28 compartments, with four compartments used daily for morning, noon, afternoon, and night doses, effectively covering seven days. It features a daily reminder/alarm system that can be set for four groups, along with a clock and LCD screen. Its compact size allows for easy portability, making it valuable in assisting older individuals with medication management and prescription adherence (Souza & Santana, 2017). This study aims to determine the efficacy of the e-WAITBox pill organizer in promoting medication adherence among Elderly Diabetic patients, providing valuable insights for improving healthcare outcomes and addressing adherence challenges in this population.

METHODS

RESEARCH DESIGN

The study used a quasi-experimental design to assess the effectiveness of the e-WAITBox pill organizer in improving medication adherence among elderly diabetic patients. It involved a treatment group that received the intervention with the e-WAITBox pill organizer and a control group that did not receive the intervention. Baseline measurements were taken before the intervention, and post-intervention measurements were taken afterward. The e-WAITBox pill organizer featured a daily reminder system and compartments for organizing medications. Statistical analysis was performed to compare the outcomes between the treatment and control groups.

POPULATION AND SAMPLING TECHNIQUE

The study utilized purposive sampling, which involved carefully selecting participants who met specific criteria relevant to the research. This approach ensured that the chosen participants accurately represented the target population of elderly diabetic patients in Koronadal City, South Cotabato. The study included a total of thirty participants, divided equally into a controlled group and an uncontrolled group. The participants were selected based on their availability and purpose. Inclusion criteria for participant selection included being 60 years old or above, having diabetes mellitus, not using any medication adherence tool, having multiple medications, and having or not having comorbidities. Participants were also required to be capable of answering the survey questionnaire or have an assistant available to assist them. Exclusion criteria included individuals below 59 years old, those who were not considered elderly diabetic patients, individuals without multiple medications, and those who were not willing to participate in the study.

RESEARCH INSTRUMENT

The researchers utilized a validated guide questionnaire for assessing Elderly Diabetic patients. The survey questionnaire was used to assess the e-WAITBox Pill Organizer for Medication Adherence among Elderly Diabetic Patients in Koronadal City, South Cotabato.

To collect data from the participants, the researchers conducted a survey using The Malaysian Medication Adherence Scale (MALMAS). MALMAS possessed internal consistency and stable reliability. It is also a reliable and valid instrument and can be used for assessing the medication adherence of elderly diabetic patients (Chua et al, 2015).

The first item of the MALMAS has five responses: (1) All the time, (2) Often (> 15 but less than 1 month), (3) Sometimes (6–15 times), (4) Rarely (1–5 times) and (5) Never. These responses were scored according to that used by the MMAS-8. The other seven items were given a dichotomous response of "Yes" or "No". The responses in the MALMAS were scored based on the MMAS-8 where the total score ranged from 0 to 8. Both instruments categorized medication adherence based on the total scores obtained: 60-70 (Moderate/Fair); <60 (Poor); >70 (Good). For fasting blood glucose range for normal (80-100mg/dL), for impaired blood glucose (101-125 mg/dL), for diabetic (126+).

DATA GATHERING PROCEDURE

In gathering data, the researchers drafted a formal letter of request to obtain permission from relevant authorities such as the City Health Office, the Local Government Unit of Koronadal City, and the respective Barangays. Additionally, the researchers seek consent from the author of the Malaysian Medication Adherence Scale (MALMAS) through a consent letter. The research team developed and validated a pre- and post-questionnaire, and after obtaining the necessary permissions, the study commenced. To ensure ethical and inclusive data collection, the researchers strictly adhered to principles of non-discrimination, employed appropriate sampling techniques, and addressed potential biases throughout the study. Once eligible participants were identified, pre-questionnaires were then distributed, and fasting blood sugar (FBS) laboratory tests were conducted in both groups. Additionally, participants in the treatment group received the e-WAITBox pill organizer intervention. The intervention phase began, and participants in the treatment group received regular updates and reminders about the e-WAITBox pill organizer to ensure compliance. FBS measurements were taken for both the treatment and control groups at the onset of the intervention and after two months. Subsequently, post-questionnaires were administered, and data was collected, compiled, analyzed, and interpreted. To further examine and compare the outcomes between the experimental and control groups, the collected data was forwarded to a statistician for further analysis. Throughout the entire research process, utmost care was taken to maintain confidentiality, ensure participant safety, and uphold the scientific rigor of the study.

DATA ANALYSIS

The study utilized descriptive and inferential statistics to analyze the data and answer the research questions. Descriptive statistics, such as the mean and standard deviation, were used to understand the average level and variability of fasting blood sugar (FBS) among elderly diabetic patients. An independent t-test and ANOVA were conducted to determine if there was a significant difference in FBS levels before and after using the e-WAITBox pill organizer. The statistical tests aimed to assess the effectiveness of the eWAITBox in managing FBS levels. The significance level of 0.05 was employed to determine statistical significance. Overall, these statistical analyses provided valuable insights into the impact of the e-WAITBox pill organizer on FBS levels among elderly diabetic patients.

RESULTS AND DISCUSSION

Level of Indicator

To determine the efficacy of e-WAITBox Pill organizer for Medication Adherence among Elderly Diabetic patients in Koronadal City, South Cotabato, the FBS and medication adherence among patients were measured before and after the intervention process. Overall results are shown in Table 1.

Test Variables		FBS		Remarks
		Mean (mg/dl)	SD	
Treatment Group	Pre-intervention	164.2	74.46	Diabetic
	Intervention	156.58	68.90	Diabetic
	Post-intervention	155.12	68.65	Diabetic
Control Group	Pre-intervention	145.80	34.20	Diabetic
	Intervention	145.39	34.33	Diabetic
	Post-intervention	146.08	34.58	Diabetic

FBS: (normal: 80-100mg/dL); 101-125 mg/dL (Impaired Glucose); 126+ (Diabetic)

Table 1: Overall FBS Mean of Elderly Diabetic Patients for Pre-Intervention, Intervention, and Post-Intervention

Table 1 shown the results among test variables for both the treatment group and the controlled for the pre-intervention (pre-test), intervention (1st month), and the post-intervention (2nd month) of the fasting blood sugar test. A fasting blood sugar test is used to assess how much glucose (sugar) is in the blood, and it is widely used to screen for pre-diabetes or diabetes (Campbell 2023).

The test outcome for the treatment group obtained the following results; for the pre-intervention the mean was 164.02 mg/dl, the intervention (1st month of FBS) is 156.58 mg/dl, and the post-intervention (final test of FBS) was 155.12 mg/dl, these values showed a decreased FBS test results from the pre-intervention (pre-test) to the post-intervention (final test). A substantial positive correspondence was discovered between pillbox use and sugar test, resulting in a greater rate of test results among patients who routinely used a pillbox compared to others, and patients were satisfied that they utilized it (Loripoor 2020).

The test outcome for the control group, on the other hand, are the following; for the pre-test mean is 145.80mg/dl, the 1st month of FBS mean is 145.39 mg/dl, and the final test of FBS mean was 146.08 mg/dl, these values shown steady difference despite of minor alterations; however, the results did not reach the significant level to establish that there were significant modifications. In general, pillbox use can en-

hance medication adherence in older persons, hence it is suggested for enhancing medication adherence and mitigating the effects of non-compliance (Heidari, 2020). In addition, this table shown participants were all categorized as diabetic based on their FBS results from pre-intervention (pre-test) until post-intervention (final-test). This agreed with the study indicated that diabetes or termed as “diabetic” was identified when fasting blood glucose levels reach 126 mg/dL (7 mmol/L) or above on two separate measures (WHO 2023).

Overall results revealed that the level of FBS in the treatment group had substantially decreased post-intervention. The FBS value was found to decrease at 155.12 post-intervention as compared to 164.2 (pre-intervention) prior to the e-WAITBox Pill organizer intervention for the treatment group. Meanwhile, the FBS level for the control group remains almost the same before, during, and after the study. This conformed with the study of Eshete (2023), that patients who received the intervention significantly reduced mean fasting blood glucose after an intervention. Furthermore, patients who received a pillbox intervention had significantly lower FBS levels than patients who received their medications in the usual way. The pillbox intervention helped patients to take their medications more consistently, which led to improved FBS levels in the treatment group (Vries, et. al, 2017).

Analysis Before and After e-WAITBox Pill Organizer Intervention

ITEMS	Expected ideal response	Before			After		
		YES	NO	Remarks	YES	NO	Remarks
Do you ever feel hassled about sticking to your treatment plan?	No	0%	100%	Good	0%	100%	Good
When you travel or leave home, do you sometimes forget to bring along your medicine?	No	26.7%	73.3%	Good	6.7%	93.3%	Good
Do you sometimes forget to take your medicine?	No	53.3%	46.7%	Poor	6.7%	93.3%	Good
People sometimes miss taking their medicines for reasons other than forgetting. Thinking over the past 2 weeks, were there any days when you did not take your medicine?	No	86.7%	13.3%	Poor	6.7%	93.3%	Good
Do you have difficulty remembering to take all your medicine?	No	53.3%	46.7%	Poor	20%	80%	Good
When you feel like your symptoms are under control, do you sometimes stop taking your medicines?	No	46.7%	53.3%	Poor	26.7%	73.3%	Good
Did you to take all your medicines yesterday?	Yes	100%	0%	Good	100%	0%	Good
Have you ever cut back or stopped taking your medicine without telling your doctor because you felt worse when you took it?	No	40.0%	60%	Moderate	33.3%	66.7%	Moderate
Overall mean		50.84%	49.16%	Poor	25.01%	74.98%	Good

Ratings for Medication Adherence: <60 (Poor); 60-70 (Moderate / Fair); >70 (Good)

Table 2.1: Treatment group Mean for Medication Adherence of Patients Before and After e-WAITBox Pill Organizer Intervention

The study found that 100% of participants did not experience hassle about sticking to their treatment plan, both before and after the study. This indicated high medication adherence, which is important for managing chronic conditions and achieving optimal health outcomes. It is important to note that high adherence to medication means that individuals consistently follow their prescribed treatment plan, taking the right dose of medication at the right time, in the right way, and with the recommended frequency (FDA, 2016). Adhering to medication as directed by a healthcare professional can contribute to maintaining good health and effectively managing medical conditions (Olsson, 2021).

The study found that 26.7% of participants forgot to bring their medicine when they traveled or left home. However, this number decreased to 6.7% after the study. Furthermore, 73.3% were able to bring their medicine when they traveled or left home before study. However, this number increased after the study to 93.3%. The study's findings highlighted the importance of being prepared and organized when traveling or going on vacation, layout the medications patients need in their original containers so subjects less likely to forget the medication, and being prepared and organized can save the patient from an anxiety of forgetting or losing the medication (Hemphill 2022).

In addition, the study found that there was a significant improvement in medication adherence after the study. Before the study, 53.3% of participants reported sometimes forgetting to take their medicine. However, after the study, only 6.7% reported forgetting to take their medicine, indicating a substantial decrease in forgetfulness and a higher level of adherence. Furthermore, before 46.7% of participants reported not forgetting to take their medicine and there was a significant increase after the study to 93.3%, demonstrating a strong improvement in adherence levels. Forgetting to consider doing something was unavoidable, but not taking care of administering medications at the appropriate time might have serious consequences (Cossart 2022).

The study found that the participants' medication adherence improved significantly after the study. Before the study, 86.7% of participants reported missing taking their medication on some days for the past two weeks. However, it significantly decreased to 6.7% post-intervention. Furthermore, only 13.3% reported not missing to take their medication pre-intervention and after the study there was an increase to 93.3%, indicating high adherence. Additionally, it was important to note that forgetting or skipping your medications can cause serious consequences. For example, if a patient taking medication for a chronic condition such as diabetes or hypertension, missing doses can increase the risk of complications, such as heart attack or stroke (Nazario, 2018).

In terms of the difficulty in remembering to take the medicine, before the study, 53.3% of participants reported having difficulty remembering to take their medication. However, after the study, only 20% reported experiencing difficulty in remembering, indicating a decrease in this issue and a higher level of adherence. Additionally, before the study, 20% of participants reported not having difficulty in remembering to take their medication while there was an increase to the adherence (80%) post-intervention, indicating an improvement in adherence levels. The study's findings highlighted the importance of interventions that can help to improve medication adherence. By providing education, counseling, reminders, and support, healthcare providers can help patients take their medication as prescribed and improve their health outcomes. (Castel, 2018).

The study revealed a positive shift in medication adherence among participants. Prior to the study, 46.7% of participants reported occasionally discontinuing their medication when their symptoms were under control, indicating a poor level of adherence. However, following the study, this behavior decreased to 26.7%, signifying an improvement in adherence. Furthermore, before the study, 53.3% of the participants consistently adhering to their medication even when their symptoms were under control and 73.3% of participants reported post-intervention, demonstrating a higher level of adherence. This improvement in adherence is crucial as non-adherence to prescribed medications can have serious consequences, including increased mortality and hospitalization rates. People die because they do not take their prescriptions exactly as advised by their doctors. Using medications appropriately at the right time and in the right method can usually prevent health issues from worsening while also lowering the risk of dying or being hospitalized (Healthcare Associates, 2018).

The study found that none of the participants reported forgetting to take their medications yesterday, both before and after the study. This indicated a high level of medication adherence among the participants, which was important for maximizing therapeutic benefits and improving treatment outcomes. It is indeed important to adhere to medication schedules and take medications as prescribed by healthcare professionals. Adhering to medication regimens ensures that the body maintains an effective level of the drug consistently, maximizing its therapeutic benefits and improving treatment outcomes (HealthyMePa, 2018).

In terms of cutting back or stopping taking medicine without telling the doctors, 40% of participants admitted to cutting back or discontinuing their medication without informing their doctor due to feeling worse when taking it, indicating a poor level of adherence. However, following the study, there was a positive shift in these numbers, with only 33.3% of participants reporting such behavior. Furthermore, there were 60% participants before the study responded that they did not engage in cutting back or stopping their medication without consulting their doctor while there was an increase to 66.7% participants reported post-intervention. It is important to note that patients often discontinue medication for various reasons, including forgetfulness, perceived improvement in symptoms, and skepticism regarding the effectiveness of the medication. These factors contribute to non-adherence and can have detrimental effects on health outcomes (Golin, 2017). Thus, the observed improvement in adherence was significant as it signified a positive change in patient behavior towards better medication management and communication with healthcare providers.

Overall results demonstrated that the level of medication adherence in the treatment group had substantially increased post-intervention with the e-WAITBox Pill organizer. Medication adherence was found to increase at 74.98% to manage their diabetes as compared to 49.16% prior to the e-WAITBox Pill organizer intervention. This finding indicated the importance of the e-WAITBox Pill organizer as a tool to enhance the level of medication adherence among respondents. The positive effects of pillbox used on medication adherence were attributable to its reminder effects. Considering that forgetfulness was a significant factor behind poor medication adherence (Mehdinia, A. et. Al 2020).

ITEMS	Expected ideal re- sponse	Before			After		
		YES	NO	Remarks	YES	NO	Remarks
Do you ever feel hassled about sticking to your treatment plan?	No	0.0%	100.0%	Good	0.00%	100.0%	Good
When you travel or leave home, do you sometimes forget to bring along your medicine?	No	40%	60%	Moderate	20%	80%	Good
Do you sometimes forget to take your medicine?	No	40%	60%	Moderate	33.3%	66.7%	Moderate
People sometimes miss taking their medicines for reasons other than forgetting. Thinking over the past 2 weeks, were there any days when you did not take your medicine?	No	73.33%	26.67%	Poor	66.7%	33.3%	Poor
Do you have difficulty remembering to take all your medicine?	No	66.7%	33.3%	Poor	66.7%	33.3%	Poor
When you feel like your symptoms are under control, do you sometimes stop taking your medicines?	No	93.3%	6.7%	Poor	73.3%	26.67	Poor
Did you to take all your medicines yesterday?	Yes	93.3%	6.7%	Poor	80%	20%	Poor
Have you ever cut back or stopped taking your medicine without telling your doctor because you felt worse when you took it?	No	93.3%	6.7%	Poor	93.3%	6.7%	Poor
Overall mean		Overall mean	62.50%	37.51%	Poor	52.49%	47.51%

Rating for Medication Adherence: <60 (Poor); 60-70 (Moderate / Fair); >70 (Good)

Table 2.2: Control group Mean for Medication Adherence of Patients Before and After the Study

A study was conducted to assess medication adherence among participants. Before and after the study there were none of the participants reported feeling hassled about sticking to their treatment plan. This indicated that all participants reported not feeling hassled about adhering to their treatment plan. Missing or delaying medication can have unexpected impacts. This is particularly applicable if you skip many doses (Nazario, 2018).

Another question that was asked was whether participants sometimes forgot to bring their medication when traveling or leaving home. Before the study, 40% of participants reported forgetting to bring their medication, while 60% reported not forgetting. This suggested a moderate adherence rate. However, after the study, only 20% of participants reported forgetting to bring their medication, while 80% reported not forgetting. This suggested that the interventions that were implemented during the study were effective in increasing medication adherence among participants. When traveling, it was important to carry medications in carry-on luggage. An individual should pack your medications in their original, labeled containers and bring enough medication for the entire trip, plus an extra day or two in case of delays. An individual should also store your medications in a cool, dry place at home and when traveling. Keep medications out of direct sunlight and do not store them in the bathroom. An individual should also keep medications out of reach of children and pets. If a person has any questions about storing or traveling with medications, be sure to talk to the doctor. (Resident Care Pharmacy, 2021).

In addition, before the study, 40% of participants reported stopping their medication when their symptoms were under control, while 60% reported not stopping. This suggested that a majority of participants reported not stopping their medication when their symptoms were under control, indicating a moderate adherence rate. However, after the study, only 33.3% of participants reported stopping their medication, while 66.7% reported not stopping. This suggested a shift towards high adherence among the participants after the study. Skipping a dose or several can have a significant influence on your health depending on the medicine, as many medications will not be effective if you do not take them when and how they are intended to be taken, particularly when you missed numerous doses (Hinck, 2020).

Another question that was asked was whether participants had difficulty remembering to take all their medicine. Before the study, 73.3% of participants reported difficulty in remembering to take their medication, while 26.67% reported no difficulty. This indicated a lower adherence rate. However, after the study, the proportion of participants reporting difficulty in remembering to take their medication remained high, with 73.3% reporting difficulty and 26.67% reporting no difficulty. This suggested that there was no significant change in a

herence rates for this question after the study. Forgetting to do something is unavoidable, but failing to take medications on time can have significant repercussions (Cossart 2022).

In terms of the forgetfulness to take the participants medication, before the study, 66.7% of participants reported sometimes forgetting to take their medication, while 33.3% reported not forgetting. This suggested a moderate adherence rate. However, after the study, the proportion of participants reporting forgetting to take their medication increased to 66.7%, while the proportion reporting not forgetting decreased to 33.3%. This suggested that there was a shift towards lower adherence rates after the study. Missed dosages could be regarded from a perspective of patient noncompliance. If a patient missed one or more doses, consume the next dose at the usual time and in the usual amount. Take not more than what the physician has prescribed (Gilbert, 2018).

Another question that was asked was whether participants had missed taking their medication for reasons other than forgetting. Before the study, 93.3% of participants reported missing their medication, while 6.7% reported not missing. However, after the study, the proportion of participants reporting missing their medication increased to 53.3%, while the proportion reporting not missing decreased to 46.7%. This suggested that there was a shift towards moderate adherence rates after the study. When a person takes a prescription on a regular basis, the body achieved a "steady state" in which the quantity of drug entering the body equals the amount of drug leaving your body (Anderson PharmD, 2022).

In terms of cutting back or stopping taking the medicine, before and after the study, the data shows that there were 93.3% of participants reported cutting back or stopping their medication without informing their doctor because they felt worse when they took it, while 6.7% reported not doing so. This suggested a poor adherence rate. This suggested that there was a consistent lower adherence rate. Even if a person starts to feel better, refrain from discontinuing the prescription medication unless the doctor suggested it is safe (NIH, 2022).

Overall statistical mean of medication adherence in the control group, obtained no significant changes on their medication adherence, hence, insignificant results occurred. The findings of this study were consistent with the findings of other studies. For instance, a study by Heidari (2020) found that there was no significant change in medication adherence in the control group. Similarly, a study by Dehghan, et al. (2020) found that medication adherence did not change drastically in the control group. Furthermore, non-adherence to diabetes medication can cause serious consequences. Furthermore, a study by Alrahbeni (2019) found that noncompliance with diabetes medication was associated with poor glycemic control, suboptimal benefits from prescribed medicines, increased medical expenses, and increased mortality.

Test variables			Mean (mg/dL)	SD	T/F value	P value	Remarks*
FBS	Treatment group	Pre-intervention	164.2	74.5	0.071	0.932	Not significant
		Intervention	156.6	68.9			
		Post-intervention	155.1	68.7			
	Control group	Pre-intervention	145.8	34.2	0.001	0.999	Not significant
		Intervention	145.3	34.3			
		Post-intervention	146.1	34.6			

*Calculation was performed at 0.05 level of significance using ANOVA

Table 3.1: Testing the Significant Difference of FBS of Elderly Diabetic Patients Before and After using the e-WAITBox Pill Organizer

Based on the statistical test, treatment group and control group results revealed that there was no significant difference ($p > 0.05$) among the level of FBS before, during, and after the e-WAITBox pill organizer intervention among elderly diabetic patients. This means that the level of blood sugar did not significantly decrease post-treatment. The intervention favorable impact on FBS, although there was not a significant distinction between the intervention and the control group (Kumar, et. Al 2018).

The mean on fasting blood sugar level for the treatment group was 164.2 mg/dL at baseline, 156.6 mg/dL during the intervention, and 155.1 mg/dL at follow-up. The mean on fasting blood sugar level for the control group was 145.8 mg/dL at baseline, 145.3 mg/dL during the intervention, and 146.2 mg/dL at follow-up. The study's findings suggested that the e-WAITBox pill organizer did not have a significant impact on fasting blood sugar levels in elderly diabetic patients. However, the study found that the e-WAITBox pill organizer was well-received by participants and that it helped them to improve their medication adherence.

Blood glucose monitoring aided in identifying shifts in the fluctuation of blood glucose (sugar) levels that took place in relation to diet, exercise, medicines, and medical conditions connected to blood glucose changes, such as diabetes mellitus (Zubair, 2023). The fasting blood sugar resulted for the treatment group from the pre-intervention (pre-test) until the post-intervention (final test) had small amounts of changes regarding the outcomes. However, the changes obtained did not meet the level standard to conclude that there was a significant level during the intervention. The primary thing that an individual can do to control diabetes is to keep track of the blood sugar levels on a regular basis. Inevitably be able to observe what causes the level to rise or fall, such as consuming different foods, taking medication, or exercising (Centers for Disease Control and Prevention 2022).

In the course of the control group, the fasting blood sugar test after the study from pre-test until the post-test had no significant changes. Furthermore, as we can observe, the value decreased by a small amount; however, it was still not an indication to achieve the level of significance. It is well established that more frequent blood glucose monitoring leads to improved control and general health maintenance and monitoring and managing blood glucose levels is an absolute must for maintaining diabetic control (PCORI, 2023).

Test variables			Mean (%)	SD	T/F value	P value	Remarks*
Medication adherence	Treatment group	Before	49.16	31.66	2.68	0.0314	Significant
		After	74.99	32.41			
	Control Group	Before	37.51	33.59	1.98	0.0876	Not significant
		After	47.51	32.16			

*Calculation was performed at 0.05 level of significance using a t-test

Table 3.2: Testing the Significant Difference of Medication Adherence of Elderly Diabetic Patients Before and After using the e-WAITBox Pill Organizer

Based on a statistical test, the treatment group's "p" value was less than 0.05 compared to the control group. Therefore, there was a significant difference ($p < 0.05$) in the level of medication adherence in the treatment group before and after the e-WAITBox pill organizer intervention – indicating its efficacy in enhancing the level of medication adherence among patients, meanwhile, control group results were not significant to medication adherence before and after the conduct of the study. According to a study of Dehghan, et. al (2020), medication adherence was significantly higher after the intervention, in the intervention group compared to the control group.

The mean for medication adherence for the treatment group was 49.16% before the study and 74.99% after the study. The mean medication adherence for the control group was 37.51 before the study and 47.51 after the study. The study's findings suggested that the e-WAITBox pill organizer have a significance for the treatment group. Wherein, the use of straightforward medication reminders, like pillboxes, was seen potentially beneficial and economically strategic for overcoming older individuals' forgetfulness and encouraging the proper taking of medicines. (Heidari, et. Al 2020). The study's findings revealed that the treatment group's medication adherence was noticeably higher than that of the control group. They indicated that the treatment group may have seen this change because of receiving greater assistance and information regarding their medicine (Zhang, M. et. Al 2022).

Analysis With and Without e-WAITBox Pill Organizer Intervention

Test variables		Mean (mg/dL)	SD	T/F value	P value	Remarks*
FBS	With	155.12	68.65	0.207	0.652	Not significant
	Without	146.08	34.58			

*Calculation was performed at 0.05 level of significance using a t-test

Table 4.1: Testing the Significant Difference of FBS of Elderly Diabetic Patients With and Without using the-WAITBox Pill Organizer

Based on the statistical test, results revealed that there was no significant difference ($p > 0.05$) on the level of FBS among patients who underwent the e-WAITBox pill organizer intervention and those who did not. This means that the level of blood sugar did not significantly decrease in both groups. Based on the journal from *Diabetes Care in 2015*, it took time for some treatments to affect FBS. If the study was not long enough, it may not have been able to detect the difference in FBS between treatment and control groups. According to Smith, M. et. al (2022), their study stated, the control group did not get a pillbox, while the pillbox group received instructions on how to use one to ensure proper medicine administration. The outcomes demonstrated that there was no significant difference in the levels of FBS between the two groups. In the pillbox group, the mean FBS level was 120 mg/dL, while it was 122 mg/dL for the control group. The pillbox proved ineffective in reducing FBS levels in persons with type 2 diabetes, according to the study's authors. They suggested that the lack of signifi-

cance might be due to the small sample size or the fact that the participants were not well-matched. Therefore, users and non-users of e-WAITBox pill organizers are shown to not be significant in terms of using the FBS as a parameter.

Test variables		Mean (%)	SD	T/F value	P value	Remarks*
Medication adherence	With	77.99	32.407	2.4944	0.0413	Significant
	Without	47.51	32.154			

*Calculation was performed at 0.05 level of significance using a t-test

Table 4.2: Testing the Significant Difference of Medication adherence of Elderly Diabetic Patients for With and Without using the e-WAITBox Pill Organizer

For medication adherence, there was a significant difference in the level of medication adherence among patients using the e-WAITBox pill organizer intervention compared to the patient without using the e-WAITBox – indicating its efficacy to enhance the level of medication adherence among patients, since the $p < 0.05$. According to Schwartz, J. (2016), pillboxes were useful tools to improve medication adherence. Most participants used pillboxes as a management tool for their medications. Users of pillbox generally had better adherence to medications than non-users. Another study written by Chan, et. al (2018), using moderator analyses, the study discovered that interventions were most successful when they were delivered in blister packs or pill boxes. Compared to the control group without receiving the intervention, which was less effective.

According to the study of Ellis, R. et. al (2018), it was evident that pillboxes helped users to stick to their prescription regimens. Another study also reported that patients utilizing the pillbox had higher T2DM adherence levels (7.36%) and lower blood sugar levels (61.161 mg/dL) than those who did not. With a value of 0.011 ($p < 0.05$), there was a statistically significant difference in the adherence levels between patients utilizing pillboxes and those who did not (Sar, J. 2022).

Level of Effectiveness of e-WAITBox Pill Organizer Intervention

Test variables		Mean	Remarks
FBS	With	155.12	Non-effective
	Without	146.08	Non-effective
Medication adherence	With	74.99	Effective
	Without	47.51	Non-effective

*FBS: (normal: 80-100mg/dL); 101-125 mg/dL (Impaired Glucose); 126+ (Diabetic)

* Medication Adherence: 60-70 (Moderate / Fair); <60 (Poor); >70 (Good)

Table 5: Level of Effectiveness of e-WAITBox Pill Organizer to Enhance Patient’s Medication Adherence and Management

Based on the findings, it was deduced that the e-WAITBox pill organizer intervention was not effective in terms of decreasing the FBS level among patients. In terms of FBS as a parameter for the e-WAITBox pill organizer, both the treatment and control groups have ineffective results. If FBS was not significant to both treatment and control groups, it does not necessarily mean that the treatment was ineffective. According to the journal *Diabetes Care in 2015*, other factors can affect FBS levels, such as stress, exercise, and diet. If these factors were not controlled for in a study, they can also lead to a lack of significance in the results.

In terms of the level of medication adherence among patients in the treatment group, results proved that it was able to enhance the level of medication adherence among patients, compared to the control group which was shown to be ineffective. A study published in the journal "JMIR Diabetes" in 2019 found that the pillbox was effective in improving medication adherence among patients with type 2 diabetes. Another study reported that patients who used the pillbox had a significantly higher medication adherence rate than patients who did not use the pillbox. In individuals with chronic illnesses, medication compliance patients who received compartmentalized medication boxes and particular multicomponent recommendations showed improvement (Maddock, C. 2017). The proposed pillbox supports remote dosage modification and enhances medicine adherence, even with complicated regimens (Karagiannis, D. et. al 2022).

Conclusion

According to the study's findings, both groups are not significant for FBS (fasting blood glucose) outcomes, hence, other methods/parameters, such as HbA1C, are suggested for further intervention. On the other hand, for medication adherence, the control group are not significant with the product while the treatment group shows significance with the e-WAITBox pill organizer. Therefore, pill organizer effectively supports elderly patients in adhering to their prescribed medication regimens. By implementing the e-WAITBox pill organizer as part of a comprehensive care plan, healthcare providers can empower their elderly patients to better manage their diabetes, improve medication adherence, and ultimately achieve better health outcomes.

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