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ORIGINAL RESEARCH

Relationship Between Patients' Knowledge of Beyond-Use Dates for Nonsterile Compounded Medications and Their Storage Behavior at Sewon 1 Primary Health Center

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ABSTRACT

The principal issue frequently encountered in society is confusion regarding drug stability, especially beyond use date. Many people are unfamiliar with beyond use date and expiration date. This condition often leads to improper medication storage. The aim of this study was to analyze the relationship between a patient's knowledge about beyond use date and their behavior in storing and using medication. A cross-sectional study was conducted on 80 respondents at Sewon 1 Primary Health Center, Yogyakarta, from January to February 2025. Using a validated questionnaire and purposive sampling, data was analyzed with the chi-square test. The results of the univariate analysis showed that patients' knowledge about beyond use date was mostly in the high category, which included 42 respondents (52.5%). Accordingly, patients's medication storage behavior was also mostly classified as good, accounting for 48 respondents (60.0%). Based on descriptive statistics, the mean value for the knowledge was 21.0 ± 1.701, while the mean value for the behavior variable was 41.38 ± 3.605. The conclusion of this study showed that there was a significant relationship between patients' knowledge about beyond use date of non-sterile compounded drugs and their medication storage behavior, with a significance value of 0.015 ($p<0.05$).

Keywords: Non-sterile, behavior, knowledge, BUD, cross-sectional

Introduction

Pharmaceutical services in primary healthcare facilities carry a significant responsibility in ensuring that medications are used safely, effectively, and rationally. One of the pharmaceutical services frequently performed at the primary health center level is the compounding of medications, particularly for patients with individual therapeutic needs that cannot be met by commercially manufactured products. Non-sterile compounded preparations such as powders, ointments, and oral suspensions are commonly provided to children, older adults, and patients who require dose adjustments or specific dosage forms (Cokro et al., 2022).

Unlike industrially manufactured medicines that undergo comprehensive stability testing, compounded medications have limited shelf-life data because they are not subjected to long-term stability studies. Consequently, pharmacists are required to assign a Beyond-Use Date (BUD), which defines the period during which a compounded preparation is expected to remain stable, safe, and effective, considering its ingredients, dosage form, and storage conditions (ASHP, 2021). Therefore, the BUD should not be

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equated with the expiration date found on industrial pharmaceutical products, which is established through extensive stability studies.

However, the successful implementation of BUD does not solely depend on pharmacists as healthcare professionals but also on the patient's understanding of this information. A previous study revealed that the majority of people in Jakarta have low knowledge (56.53%) and inappropriate behavior (57.45%) regarding medicine storage at home. Many patients were unaware of the correct storage conditions and often failed to understand the information provided on medicine labels, including directions and usage time limits. Improper storage, such as keeping medicines in areas exposed to heat, humidity, or sunlight can accelerate degradation and reduce drug effectiveness (Novitri et al., 2024). Similarly, a study conducted at West Sumatra, Padang Pariaman found that family knowledge, attitudes, and practices regarding drug storage and use in Indonesia remain low. The study emphasized that pharmacists and doctors are the main sources of drug information influencing proper medication handling at home. Lack of knowledge and inappropriate storage practices were shown to negatively affect drug quality and therapeutic outcomes (Rauf et al., 2021). Based on research references from Wulandari et al. (2024), age and education level play a role in shaping patient habits regarding the storage of non-sterile compounded drugs.

This study provides novelty because it examines the relationship between patients' knowledge of BUD and their medication storage behavior for non-sterile compounded preparations, an aspect that has not been previously explored within primary healthcare services in Indonesia, particularly in Primary Health Center. Previous research has mainly focused on the physicochemical stability of compounded preparations or the compounding practices of pharmacists, while the behavioral dimension at the patient level the final point of medication safety remains understudied. Therefore, this study not only provides descriptive evidence but also contributes to the development of patient-oriented pharmaceutical education, the improvement of labeling systems for compounded medications, and the enhancement of pharmacists' roles in patient-centered care. Based on this rationale, this study aims to analyze the relationship between patients' knowledge of Beyond Use Date (BUD) and their medication storage behavior for non-sterile compounded preparations at Sewon Primary Health Center, Yogyakarta.

Methods

Tools and Material

The research was conducted from December 2024 to February, 2025 at Sewon Primary Health Center (PHC), Yogyakarta. Data were collected through a validated questionnaire. A questionnaire which had been validated and all questions used were reliable. The questionnaires contain sociodemographic, knowledge & behaviour questions. The BUD knowledge questionnaire consists of 12 true or false questions, while the behavioral questionnaire on storing non-sterile compounded medicines contains perception statements about storing medicines with 10 statements using a likert scale. The questionnaire validation process involved two experts from relevant fields, namely, practicing pharmacists and psychologists. The validation was conducted at Kasihan 1 Health Center located in Kasihan District, Bantul Regency, Special Region of Yogyakarta, with a total of 85 respondents. A questionnaire which had been validated and all questions used were reliable.

Population and Sample

Based on the preliminary study conducted, the population in July, 2025 at Sewon 1 PHC was approximately 247 patients receiving compounded medicine. Determination of the sample size was carried out using the Slovin formula with an error tolerance limit e of 10%. So that the sample size was calculated as 80 respondents. The patients who most frequently received compounded medicine were children. Eighty respondents were selected through purposive sampling at Sewon 1 PHC, Yogyakarta. Inclusion criteria in this research were patients receiving treatment at Sewon 1 PHC Bantul who receive non-sterile compounded medicine and were willing to be respondents. There was no age limit for patients (including all age ranges). For infants, children, and early adolescents, the respondent was the companion responsible for handling/receiving the patient's non-sterile compounded medicine. The exclusion criteria of sampel were :

patients unable to read and write, patients who did not complete the questionnaire completely, patients who have never stored non-sterile compounded medications at home.

Method

This research was a descriptive observational study using a cross-sectional study. This research has been approved by the Health Research Ethics Committee of the Faculty of Medicine and Health Sciences Alma Ata University with certificate number KE/AA/X/10112067/EC/2024. The independent variable in this study was the patient's knowledge of BUD and the dependent variable was behaviour storage drug.

Data Analysis

Univariate descriptive statistical analysis was used to summarize data. Patient knowledge was categorized into two levels, high and low. Patient behavior in storing medication was divided into two categories : good and poor. Knowledge was considered high if the score was ≥ 21, and behavior was categorized as good if the questionnaire result score was ≥ 41. The correlation between knowledge and behavior was analyzed by using the chi-square test with a 95% confidence level. Based on the Kolmogorov-Smirnov test, the knowledge data was not normally distributed, whereas the behavior data is normally distributed.

Result and Discussion

Patient Characteristic

The sociodemographic characteristics of the respondents in this study was presented in Table 1. The majority of respondents in this study were female, totaling 58 people (72.5%). Based on age categories, the late adolescent group (17-25 years old) was the largest, with 22 respondents (27.5%). In terms of employment status, 44 respondents (55.0%) were unemployed. The most dominant educational level was high school graduates, with 47 respondents (58.8%). Additionally, in terms of health insurance status, the majority of respondents, 71 people (88.8%), used BPJS.

Table 1. Sociodemographic relationships with the behavior of storing non-sterile compound medicines in patients at Sewon 1 Health Center, Bantul

Sosiodemographics & Respondent Characteristics	Total (n=80)	Percentage (%)
Gender		
Male	22	27,50
Female	58	72,50
Age		
Late adolescent (17-25 yo)	22	27,50
Early adulthood (26-35 yo)	20	25,00
Late adulthood (36-45 yo)	15	18,75
Early elderly (46-55 yo)	13	16,25
Late elderly (56-65 yo)	10	12,50
Occupation		
Yes	36	45,0
No	44	55,0
Level Education		
Elementary School	4	5,00
Junior High School	10	12,50
Senior High School	47	58,75

D1/D2/D3	2	2,50
Bachelor/Master	17	21,25
Health Assurance		
BPJS	71	88,75
Non BPJS	9	11,25

*Note : BPJS = Badan Penyelenggara Jaminan Sosial.

The sociodemographic profile of respondents in this study showed a predominance of female participants and a concentration in late-adolescent to early-adulthood age ranges. This aligns with national Indonesian data showing that females and those aged 26-35 or 36-45 years had higher odds of low awareness of chronic disease medication (Khoiry et al., 2023). The majority of respondents possessed senior high school education, consistent with findings that educational attainment significantly influences knowledge and attitudes related to medication use and storage (Adhayanti et al., 2024). Furthermore, the high coverage of health insurance among our sample mirrors literature indicating that insurance status is a determinant of access to health education and medication practices (Khoiry et al., 2023). Lastly, studies on household antibiotic storage highlight that knowledge level, recent usage, and presence of a healthcare professional in the family significantly affect storage behaviour (Karuniawati et al., 2025). Together, these findings suggest that the sociodemographic variables assessed in our sample are supported by empirical literature as relevant moderators of patients' understanding of beyond-use dates and medication-storage behaviour, thereby reinforcing the analytical approach of this study.

The Distribution of Patients' Knowledge Concerning Beyond Used Date

Table 2. The distribution of patients' knowledge concerning BUD at Sewon 1 PHC Center, Bantul

No.	Indicator	Questions	True f, (%)	False f, (%)
1	Understanding Basic Concepts (Definition)	The expiration date is the date by which a medicine should be used before its primary packaging is opened.	71 (88,75)	9 (11,25)
2	Understanding Basic Concepts (Definition)	Beyond Use Date (BUD) is a term used to refer to the period of time during which a medicine can be used after. its packaging has been opened.	77 (96,25)	3 (3,75)
3	Understanding Basic Concepts (Definition)+	The term Beyond Use Date (BUD) or usage period is the same as the term Expired Date (ED).*	32 (40)	48 (60)
4	Differences in stability between compounded and non-compounded drugs.	Medicine that have passed their Beyond Use Date (BUD) or usage period cannot be used even if they have not passed their expiration date.	60 (75)	20 (25)
5	Specific Knowledge about BUD of antibiotic syrup/ suspension/ emulsion	The Beyond Use Date (BUD) or usage period for dry antibiotic syrup after preparation is 7 days.	60 (75)	20 (25)

6	Understanding Basic Concepts (Definition)	Compounded medicine means medicine that is made in a different dosage form or mixed with other medicines.	72 (90)	8 (10)
7	Specific Knowledge about BUD of antibiotic syrup/ suspension/ emulsion	The Beyond Use Date (BUD) or usage period for dry syrup preparations dissolved in water is the same as the Beyond Use Date (BUD) for liquid syrup/suspension/emulsion preparations.*	48 (60)	32 (40)
8	Differences in stability between compounded and non-compounded drugs.	Compounded medicine can be used as long as it has not exceeded the Expiration Date (ED).*	44 (55)	36 (45)
9	Identify drugs that are no longer suitable for use.	Medicines in powder form can be used before the Beyond Use Date (BUD) or usage period is over.	16 (20)	64 (80)
10	Identify drugs that are no longer suitable for use.	Powder preparations that have changed form (including wet or damp powder, discoloration, or clumping) but have not passed their Beyond Use Date (BUD) or usage period can still be used.*	59 (73,75)	21 (26,25)
11	Differences in stability between compounded and non-compounded drugs.+	Compounded medicine lasts longer than non-compounded medicine.*	61 (76,25)	19 (23,75)
12	Identify drugs that are no longer suitable for use.	The first step that can be taken to find out the Beyond Use Date (BUD) or the usage period of a medicine is to look at the information on the packaging/brochure.*	69 (86,25)	11 (13,75)

Note : Unfavourable question (*)

The analysis of patients' knowledge regarding Beyond-Use Date (BUD) showed that the majority of respondents demonstrated a strong understanding of the basic concepts of BUD. As presented in Table 2, most respondents correctly identified the definition of the expiration date (88.75%) and recognized the meaning of BUD as the period of time in which a medicine remains suitable for use after its packaging has been opened (96.25%). However, misconceptions were still found in several areas. A notable proportion of respondents (40%) incorrectly believed that BUD and expiration date refer to the same concept, indicating persistent confusion between these two terms.

Regarding knowledge of differences in stability between compounded and non-compounded drugs, 75% of respondents correctly acknowledged that medicines exceeding their BUD should not be used, even if the expiration date has not passed. In addition, knowledge concerning BUD for antibiotic suspensions was relatively high, with 75% correctly identifying the BUD for reconstituted dry syrups. Respondents also exhibited good knowledge of compounded medications in general, with 90% able to correctly define compounded preparations.

Despite this, several misconceptions were apparent. For example, 60% of respondents incorrectly believed that the BUD for reconstituted dry syrup is equal to the BUD for liquid preparations, and 55% incorrectly assumed that compounded medicines remain usable as long as the expiration date has not passed. Knowledge related to identifying medications that are no longer suitable for use also revealed gaps, where

20% believed that powder medicines may be used regardless of BUD and 73.75% incorrectly believed that powders with changes in physical characteristics could still be used if they had not passed their BUD. Overall, the distribution of responses indicates that while most patients possess good foundational knowledge of BUD, specific misconceptions remain particularly regarding distinctions between BUD and expiration date, stability issues in compounded medications, and criteria for determining whether a medicine remains suitable for use.

The findings from Table 2 demonstrate that although respondents generally exhibited strong knowledge regarding BUD concepts, significant misconceptions persist in areas critical to medication safety. High levels of correct responses on basic definitions of expiration date and BUD align with prior studies showing that patient awareness of medication labeling tends to be relatively good but not sufficiently comprehensive (Isnaeni et al, 2024). Misunderstanding between BUD and expiration date remains a recurring issue, as evidenced by 40% of respondents who believed that both terms refer to the same concept. Similar confusion has been reported in other studies, highlighting the need for clearer patient-centered pharmaceutical counseling to prevent medication misuse (Wulandari et al., 2024).

Knowledge regarding the stability of compounded preparations is especially crucial because compounded medications do not undergo long-term stability testing, and their integrity is highly dependent on correct storage practices (USP, 2021). In this study, Question 4, although 75% correctly recognized that medications exceeding their BUD should not be used, a considerable proportion still held incorrect assumptions, such as believing that compounded medicines remain safe as long as the expiration date has not passed. This misconception reflects findings by Ebtavanny et al. (2023), who noted that limited knowledge about drug stability among medication handlers leads to inappropriate retention and use of expired or unstable preparations.

Questions 10, 11, and 12 are unfavourable questions. Furthermore, answers to Question 10 showed that a misunderstanding of signs of physical deterioration, such as changes in color, odor, or powder clumping, suggests that patients may be unaware of early indicators of medication instability. This finding is consistent with studies showing that patients often fail to evaluate the physical condition of medications before use (Mutmainah et al., 2022). Such knowledge gaps are clinically significant because compounded medications, particularly powders and suspensions, are highly susceptible to environmental factors, including moisture, temperature, and microbial contamination.

Question 11 stated that compounded medicines last longer than non-compounded medicines, and 76.25% of respondents answered correctly, although the question was actually misunderstood. In question 11, 76.25% of respondents realised that compounded medicines do not last longer than manufactured (non-compounded) medicines. From a pharmaceutical perspective, compounded medicines such as powders (pulveres) have physical and chemical stability that is more vulnerable compared to intact preparations in the manufacturer's primary packaging (blister/strip). The grinding process increases the drug's surface area, thereby increasing the risk of hydrolysis and oxidation due to exposure to air and moisture. This is in line with research by Rohmanna & Sukmawati (2021), which states that the stability of powdered compounded preparations is greatly influenced by temperature and humidity, where compounded preparations generally have a much shorter shelf life compared to the expiration date (ED) of the original drug. The high level of knowledge is based on a misconception that compounded drugs are more durable. These drugs pose safety risks, as they have degraded and are not therapeutically effective.

Based on question 12, as many as 86.25% of respondents understood that looking at information on packaging/brochures is not the correct step to determine the Beyond-Use Date (BUD) after a drug has been opened or compounded. This is indicated by the high percentage of respondents who were able to identify incorrect (unfavorable) statements in the questionnaire. Not all BUDs are listed on packaging/brochures (Deniyati, 2024). Information on the packaging only applies if the drug is still completely sealed, whereas the BUD is calculated from the time the drug is first opened or compounded. Although the knowledge level is relatively high, the role of pharmacists in providing education remains crucial. Misunderstandings regarding expiration dates (ED) and BUDs often occur in the community, where many patients still rely on the date on the packaging even though the drug (such as syrup or eye drops) has been opened months earlier. The research results indicate that the majority of respondents in the work area of Sewon 1 Health Center already have a good understanding of the basic concept of compounded drug stability, but the determination

of the Beyond Use Date (BUD) of compounded drugs is still not well understood. As found in the study by Veronica, Arrang, and Notario (2023), the public's knowledge level regarding BUD is greatly influenced by exposure to educational media; respondents who did not receive specific information tend to equate the expiration date (ED) with BUD. In addition, research by Pertiwi, Aini, & Hajrin (2021) also emphasizes that an incorrect understanding of BUD has the potential to reduce the effectiveness of therapy and patient safety. Therefore, even though 86.25% of respondents answered correctly, ongoing education on how to calculate BUD independently (such as noting the package opening date) should still be conducted to prevent the use of drugs that are no longer suitable for use. Overall, the high percentage of correct answers on these two unfavorable items indicates that respondents at the research site have fairly good literacy in distinguishing the stability characteristics of compounded and non-compounded drugs, as well as understanding the limitations of expiration information on drug packaging.

Errors in understanding the BUD of reconstituted antibiotic syrups highlight another area of concern. Adequate knowledge is necessary because antibiotic suspensions are among the most frequently compounded preparations in primary healthcare settings. Previous research has also emphasized that incorrect storage time for reconstituted antibiotics contributes to reduced potency and therapeutic failure (Novitri et al., 2024). Thus, the persistence of incorrect assumptions among respondents indicates the need for standardized verbal and written instructions during dispensing.

Overall, the distribution of knowledge in this study underscores the critical role of pharmacists in reinforcing patient education about BUD. Although general understanding was adequate, misconceptions in key areas, especially stability differences, reconstituted antibiotics, and identification of unsuitable medications, may predispose patients to inappropriate medication use. These findings support strengthening pharmaceutical counseling, improving labeling clarity, and implementing targeted educational interventions to enhance medication safety, especially in primary health-care settings where compounded preparations are frequently dispensed.

The Distribution of Storage Drug Behaviour

Table 3. The distribution of storage drug behaviour at Sewon 1 PHC Center, Bantul

No.	Indicator	Statement	Strongly Agree f, (%)	Agree f, (%)	Some what agree f, (%)	Disagree f, (%)	Strongly disagree f, (%)
1	Compliance with Storage Rules	I always store medicines according to the instructions on the packaging or as explained by the pharmacist.	52 (65)	26 (32,5)	2 (2,5)	0 (0)	0 (0)
2	Management of Expiration Dates and Physical Condition of Drugs	I keep compounded medicines that have passed their expiration date, even though they have deteriorated or expired.*	32 (40)	39 (48,75)	5 (6,25)	2 (2,5)	2 (2,5)
3	Safety and Storage Environment Conditions	I keep compounded medicines out of the reach of children.	42 (52,5)	33 (41,25)	5 (6,25)	0 (0)	0 (0)

4	Storage Temperature Management	I keep compounded powder or capsule medications in the refrigerator.*	9 (11,25)	48 (60)	4 (5)	15 (18,75)	4 (5)
5	Storage Temperature Management	I keep compounded medicine at room temperature.	26 (32,5)	47 (58,75)	3 (3,75)	4 (5)	0 (0)
6	Storage Temperature Management	I keep compounded medicines such as dry syrup that have been compounded in the freezer so that they last longer.*	21 (26,25)	43 (53,75)	6 (7,5)	6 (7,5)	4 (5)
7	Management of Expiration Dates and Physical Condition of Drugs	I still keep the medicine even though it smells and tastes bad or is not as expected.*	41 (51,25)	34 (42,5)	2 (2,5)	3 (3,75)	0 (0)
8	Safety and Storage Environment Conditions	I keep compounded medicines in a place away from direct sunlight.	43 (53,75)	28 (35)	3 (3,75)	5 (6,25)	1 (1,25)
9	Management of Expiration Dates and Physical Condition of Drugs	I still have more than 7 days' worth of dry syrup mixture left.*	19 (23,75)	41 (51,25)	12 (15)	7 (8,75)	1 (1,25)
10	Safety and Storage Environment Conditions	I often keep medicines in easily accessible places such as on the table without protection from dust or heat.*	15 (18,75)	51 (63,75)	3 (3,75)	8 (10)	3 (3,75)

Note : Unfavourable question (*)

Based on Table 3, it was shown that out of 10 questions regarding the behaviour of storing compounded medications, 4 questions require further review. These questions were numbers 6, 7, 9, and 10. Based on the respondents' answers, question 6, which is about storing compounded medications such as dry syrup that has been prepared in the freezer to preserve its longevity, had 26.25% of respondents strongly agree and 53.75% agree. Meanwhile, question 9, which states, "I still store compounded dry syrup preparations for more than 7 days," had 51.25% of respondents agree and 23.75% strongly agree. These research results indicate a fundamental misunderstanding among respondents regarding the physical stability and Beyond Use Date (BUD) of compounded medications, particularly dry syrup preparations.

The high percentage of respondents who agreed to store prepared dry syrup in the freezer (80%) and keep it for more than 7 days (75%) indicates a lack of knowledge among respondents that freezing temperatures can damage suspension stability and the potential for bacterial growth after exceeding the 7-

day BUD at room temperature. Low public health literacy often results in improper storage practices of antibiotic syrups contrary to pharmacist instructions, where the perception that "cold (frozen) means long-lasting" still dominates patients' mindsets, compared to understanding the chemical stability of the active ingredient. According to the USP, controlled cold temperature is defined as refrigerator temperature (2-8°C), not freezing temperature (freezer).

Storing suspension preparations (dry syrup) in the freezer can damage the physical system of the preparation. Freezing can cause the growth of crystals ('caking') that cannot be redispersed or break the emulsion/suspension, making the consumed dose no longer homogeneous and accurate. This respondent behaviour violates USP physical stability principles because it alters the properties of the preparation (USP, 2021). It is essential to educate patients to align home drug storage habits with USP standards to ensure therapy effectiveness and patient safety. One of the sociodemographic factors that most often poses a risk to low knowledge of BUD and drug storage is education. Parental education plays an important role in knowledge of dry syrup BUD (Atmi, 2024; Abd Sukri, 2024).

Incorrect behaviour regarding drug storage is exacerbated by respondents' answers to Question 7, which states, “I still keep medicines even though the smell and taste are no longer pleasant or as expected.” Respondents who strongly agreed amounted to 51.25%, and those who agreed were 42.50%. A total of 93.75% of respondents still kept medicines even after experiencing organoleptic changes (smell and taste), which clinically pose a risk of intoxication or failure to achieve therapeutic effects. According to the USP, the BUD limit for oral formulations containing water stored under controlled cold temperature is 14 days (USP, 2021). The practice of storing compounded liquid medicines for more than 7–14 days without strict temperature control (refrigeration) is a direct violation of safe drug use guidelines.

In addition to internal stability factors, the aspect of drug protection from environmental factors is also still neglected. Question 10, which is “I often store medicines in easily accessible places such as on the table without protection from dust or heat”, was answered by the majority of respondents as “agree” with a response rate of 63.75% and “strongly agree” at 18.75%. A total of 82.5% of respondents store medicines in open, easily accessible places without protection from dust or heat, such as on tables. Direct exposure to light and fluctuations in room temperature can accelerate the degradation of compounded medications, which generally do not have primary packaging as strong as manufactured drugs (USP) (books, prescription science). This finding is relevant to Novitri's (2024) research, which highlights that the failure to implement the DAGUSIBU (Get, Use, Store, Dispose) principle in households is often due to the habit of placing medicines based on ease of access rather than safety. This condition emphasises the need for more intensive educational interventions from pharmacists at Sewon 1 Health Center, considering that improper storage can alter the pharmacokinetic profile of medicines and significantly reduce treatment effectiveness. Efforts needed to increase awareness of proper drug storage include strengthening health education for rural communities regarding the use of antibiotics and drug disposal methods, improving effective communication between doctors and patients, and enhancing the supervision of drug sales in pharmacies to improve the public’s understanding and knowledge of antibiotics (Yu, M., *et al*. (2019).

The Relationship Between Knowledge and Behaviour

Tabel 4. Relationship between patients’ knowledge regarding non-sterile compounded drugs and medication storage behavior at Sewon 1 PHC, Bantul

Knowledge of BUD	Behaviour				Total		P-value
	Poor		Good				
	F	Percetage (%)	F	Percetage (%)	F	Percetage (%)	
Low	21	26,3	17	21,3	38	47,5	

High	12	15	30	37,5	42	52,5	0,015*
Total	33	41,3	47	58,8	80	100	

Note: * data were analyzed by Chi-square test, CI = 95%

Based on descriptive statistics, the mean value for the knowledge variable was 21.0 ± 1.701, while the mean value for the behavior variable was 41.38 ± 3.605. The level of patient knowledge regarding BUD influences patient behavior in storing drugs (p value = 0,015). Age and education level play a role in influencing respondents' medication storage habits (p value = 0,003 and 0,000). In line with other research, the level of knowledge influences attitudes and behavior (Mutmainah, 2022; Wulandari A.S., 2024). Knowledge is an important foundation that can influence a person's attitude and behavior. Education delivered by pharmacists through booklets has been proven to significantly improve patient knowledge and behavior (Wulandari, 2020). Knowing BUD helps decrease the risks that may be posed to patients. In other words, the BUD serves to alert healthcare workers to the time/ day after which a compounded sterile preparation or compounded non-sterile preparation must not be used. (USP, 2021). Patient knowledge has a significant contribution to the rationality of treatment where knowledge encourages more rational therapeutic decision-making, especially when self-medication (Niva, 2023).

The limitation was that the questionnaire did not include options for the names of drugs and non-sterile compounded preparations. As a result, the researchers did not obtain information on the names of the drugs or the forms of non-sterile compounded preparations stored by patients during their treatment.

Conclusion

Based on the results of the study, it can be concluded that the patient's knowledge about BUD was mostly in the high category, which included 42 respondents (52,5%). Accordingly, patients's medication storage behavior was also mostly classified as good, accounting for 48 respondents (60,0%). There was a significant relationship between patients' knowledge about BUD of non-sterile compounded drugs and their medication storage behavior, with a significance value of 0.015 ($p<0.05$).

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