Disposal of Expired and Unused Medications: Practices Among Undergraduate Students in Kuantan, Malaysia.

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ABSTRACT

Improper disposal of unused and expired medications is a growing global concern that contributes to environmental pollution and public health risks. Although several initiatives aim to promote safe disposal, awareness among the general public, particularly among university students, is still limited. This study aims to examine the practices of undergraduate students regarding pharmaceutical waste disposal at a tertiary institution in Malaysia, and further examine the potential influence of socio-demographic factors on disposal behaviors. A cross-sectional survey was conducted using a structured questionnaire adapted from a previous study to assess students' practices related to the disposal of unused and expired medications. Among 259 respondents, 90% reported having unused or expired medications stored at home or in their hostels. More than half (51.7%) reported not receiving information regarding proper disposal methods, although 78.8% acknowledged the potential environmental and public health risks associated with improper disposal. A total of 73.1% of students stored unused medications until they expired. Among expired medications, only 1.2% were returned to the pharmacy, indicating very low rates of appropriate disposal. Female students were significantly more likely than males to keep unused drugs until expiry. The findings reveal that only a minority of students practiced proper medication disposal, with notable gender differences in behavior. Targeted educational interventions and awareness programs are needed to promote safe and responsible disposal practices.

Keywords: Drug Storage, Environment, Health Knowledge, Attitudes, Practice

INTRODUCTION

Medications play a crucial role in disease treatment, diagnosis, and prevention. However, the widespread availability of both over-the-counter (OTC) and prescription drugs has contributed to an increase in pharmaceutical waste (Ingale et al., 2023). Many individuals store unused or expired medications due to excessive prescriptions, improved medical conditions or for potential self-medication (Gidey et al., 2020; Hong et al., 2026; Insani et al., 2020).

According to the World Health Organization (World Health Organization, 2002), nearly 50% of medications are prescribed, dispensed, or sold inappropriately, which leads to significant risks, including improper drug disposal. Pharmaceutical waste, if not managed properly, poses serious environmental and public health threats, as active drug ingredients can contaminate water sources, harm ecosystems, and contribute to antimicrobial resistance (Ingale et al., 2023).

Proper disposal of expired and unused medications is essential for minimizing health risks. Biomedical waste management guidelines categorize pharmaceutical waste as either hazardous or non-hazardous, emphasizing the need for effective disposal methods such as drug take-back programs, encapsulation, incineration, and sanitary landfills (Ingale et al., 2023). Studies have shown that a lack of awareness regarding safe disposal practices can lead to medication misuse, pediatric intoxication, illicit drug use, and ecosystem pollution (Insani et al., 2020; Manocha et al., 2020). Inappropriate disposal methods, such as flushing or discarding medications in household trash, contribute to the accumulation of pharmaceutical residues in water systems, which endangers aquatic life and public health.

In Malaysia, efforts to improve medication disposal awareness include initiatives such as the Medication Return Program (MRP), which was launched in 2010 by the Ministry of Health Malaysia (MOH) and the Disposal of Unused Medicines Program (DUMP) by a local pharmacy company in collaboration with a local university (CARiNG Pharmacy, 2022; Universiti Malaya, 2022). These programs aim to educate the public on safe disposal methods and prevent misuse. Despite these efforts, the extent of knowledge and practices regarding proper medication disposal among the public remains unclear, highlighting the need for further investigation.

According to a systematic review and meta-analysis, the prevalence of self-medication among 60,938 students is high, estimated at 70.1% (Behzadifar et al., 2020), highlighting the increased need for awareness regarding proper pharmaceutical waste disposal. In Malaysia, evidence on the disposal of unused and expired medications among university students is scarce. The most relevant study, conducted by Azad et al. (Azad et al., 2012), is now more than a decade old. Since then, most local research has examined the general public or community pharmacists (Hong et al., 2026; Low et al., 2023; Ong et al., 2020), leaving a gap in understanding the practices of the broader undergraduate population. While all students should be informed about safe disposal methods, those from science and medical backgrounds are expected to demonstrate higher awareness, given their potential future roles as healthcare professionals. Therefore, this study aims to examine the practices related to the disposal of expired and unused medications among undergraduate students from science and healthcare-related faculties.

MATERIALS AND METHODS

Study Design and Sampling Method

This quantitative, cross-sectional study was conducted to assess undergraduate students' practices regarding the disposal of unused and expired medications at International Islamic University Malaysia (IIUM) Kuantan, Pahang, Malaysia. The study was carried out over a period of three months, from March to May 2025, and included students from the Faculties of Nursing, Pharmacy, Medicine, Dentistry, and Science. A non-probability convenience sampling method was used to recruit participants across the target faculties. While convenience sampling facilitated access to respondents during the study period, this sampling approach inherently limits the generalizability of the findings beyond the surveyed cohort at IIUM Kuantan.

The total undergraduate population of the selected faculties was approximately 3840 students. The required sample size was calculated using the Raosoft sample size calculator, using a 95% confidence level, which yielded a required sample size of 350 participants. However, due to time and logistical constraints in the recruitment, a final sample of 259 participants was successfully recruited for the study. To assess whether this sample size provided sufficient statistical power, a post-hoc power analysis was conducted using G*Power 3.1. Assuming a medium effect size ($w = 0.30$) and $\alpha = 0.05$, the achieved sample size ($N = 259$) yielded a statistical power ($1 - \beta$) of 0.98, indicating that the study retained adequate power to detect key demographic associations.

Participants were eligible if they were undergraduate students enrolled in science or healthcare-related faculties at IIUM Kuantan and had provided informed consent. Students who were on study leave during the data collection period were excluded from the study. A self-administered questionnaire was distributed via Google Forms to facilitate accessibility and convenience for participants.

Research Instrument

Data were collected using a structured questionnaire adapted from a previously validated instrument by Insani et al. (2020) which demonstrated face and content validity in prior household disposal research. The instrument was maintained in English, as it is the official medium of instruction at the university, and participants possess high English language proficiency. While formal psychometric re-validation was not performed for this specific cohort, face validity was confirmed by two faculty experts in nursing and pharmacology prior to administration to ensure context suitability. Moreover, the questions were general in nature and not specific to local laws or regulations.

The questionnaire consisted of three sections: the first section collected participants' socio-demographic information, including gender, years of study and faculty. The second section assessed students' knowledge and awareness regarding unused medications, including methods of obtaining medication, and the third section evaluated students' practices and attitudes towards disposal of unused and expired medications. In this study, returning medications to hospitals or pharmacies was considered an appropriate disposal method, while discarding medications in household garbage or flushing them down the toilet or sink were considered potentially improper disposal practices.

Ethical Approval

This study was approved by the IIUM Research Ethics Committee (IREC) (Approval No: IREC 2024-164). Written informed consent was obtained from all participants before data collection.

Data Analysis

The collected data were analyzed using SPSS version 27. Descriptive statistics, including frequency and percentage, were used to summarize categorical data, and the results were presented in tables and graphs. Additionally, the chi-square test was conducted to determine associations between variables, with a p-value < 0.05 considered statistically significant. A post-hoc power analysis was conducted using G*Power to estimate the statistical power achieved with the final sample size. Based on a medium effect size ($w = 0.3$), $\alpha = 0.05$, total sample size of 259 participants, and $df = 5$ for the main comparison, the achieved statistical power was 0.98.

RESULTS

Socio-Demographic

A total of 259 undergraduate students from IIUM Kuantan participated in this study. The majority of respondents were female (n=154, 59.5%), while males accounted for 40.5% (n=105) (Table 1). Most participants were between 20 and 26 years, with the largest age group being 22-23 years (n=162, 62.5%). Participants who selected the ≥24 years category were further asked to specify their exact age, which ranged up to 26 years in this study. In terms of academic level, the highest proportion of students was in Year 4 (n=89, 34.4%), followed by Year 3 (n=73, 28.2%). Participants were recruited from the faculties described in the Study Design and Sampling Method subsection, with the Faculty of Nursing comprising the largest group (n=57, 22.0%), while the lowest representation was from the Faculty of Science, with 22 participants (8.5%).

Table 1. Socio-demographic characteristics of respondents

Descriptive Characteristics of Respondents	n	(%)
Sex		
Female	154	59.5%

Male	105	40.5%
Age		
20-21	37	14.3%
22-23	162	62.5%
≥24	60	23.2%
Years of study		
Year 1	31	12.0%
Year 2	49	18.9%
Year 3	73	28.2%
Year 4	89	34.4%
Year 5	17	6.6%
Faculty		
Nursing	57	22.0%
Pharmacy	36	13.9%
Medicine	53	20.5%
Allied Health Science	40	15.4%
Dentistry	51	19.7%
Science	22	8.5%

Knowledge and Awareness of Unused Medication

The majority of students (90%) reported having unused medication at home or in their hostel, with more than half (62.5%) indicating they had between one and five unused medications (Table 2). The most common reasons for unused medications were improved medical conditions (68%), followed by drug expiration (58.7%), and changes in therapy (52.9%). Non-adherence was reported by 26.6% of respondents, while no participants cited adverse drug reactions as a reason. Regarding the types of unused drugs, non-steroidal anti-inflammatory drugs (NSAIDs) were the most common (67.6%), followed by vitamins and nutritional supplements (57.5%) and cough medications (52.9%). Notably, 48.6% of respondents also kept unused antibiotics. Other categories included herbal drugs, antiallergics, antidiabetics, and antiulcer drugs. In terms of procurement, most students obtained medications through prescriptions (82%) or purchased over-the-counter (65.3%), while 46.3% received medicines from family and friends. Regarding awareness, 86.5% of students checked the expiration date of medicines before use. Less than half (48.3%) of respondents claimed they had received information about proper medication disposal, and 78.8% were aware that improper disposal could harm the environment.

Table 2. Knowledge and Awareness of Unused Medication

Item	**Yes, n (%)**	**No, n (%)**
Did you have unused medicine at home/hostel?	233 (90%)	26 (10%)
The number of unused medications at home/hostel?		
0	24 (9.3%)	235 (90.7%)

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1-5	162 (62.5%)	97 (37.5%)
6-10	62 (23.9%)	197 (76.1%)
>10	11 (4.2%)	248 (89%)
The reason for unused medicine at home.		
Improved medical condition	176 (68%)	83 (32%)
The drug had expired	152 (58.7%)	107 (41.3%)
Changes in therapy	137 (52.9%)	122 (47.1%)
Non-adherence to medication	69 (26.6%)	190 (73.4%)
Adverse drug reaction	0 (0%)	259 (100%)
Did not know/ sure about the purpose of medication	5 (1.9%)	254 (98.1%)
Instruction for use was unclear	44 (17%)	215 (83%)
Kept for reoccurring condition	118 (45.6%)	141 (54.4%)
The patient was pregnant /The patient has passed away	24 (9.3%)	235 (90.7%)
What class of drugs that you have?		
NSAIDs	175 (67.6%)	84 (32.4%)
Vitamins and nutritional supplements	149 (57.5%)	110(42.5%)
Antibiotics	126 (48.6%)	133 (51.4%)
Herbal drugs	76 (29.3%)	183 (70.7%)
Antihypertensive drugs	39 (15.1%)	220 (84.9%)
Cough medication	137 (52.9%)	122 (47.1%)
Anti-allergy drugs	91 (35.1%)	168 (64.9%)
Antidiabetic drugs	26 (10%)	233 (90%)
Antiulcer drugs	24 (9.3%)	235 (90.7%)
What is the method of procuring the medication?		
Prescription drugs	177 (68.3%)	82 (31.7%)
Over-the-counter drugs	169 (65.3%)	90 (34.7%)
Received from relatives/friends	120 (46.3%)	139 (53.7%)
Purchased based on recommendations from relatives/friends	91 (35.1%)	168 (64.9%)
Did you check the expiration date of the medicine before procuring it?	224 (86.5%)	35 (13.5%)
Did you ever receive information about proper medication disposal practices?	125 (48.3%)	134 (51.7%)
Did you know that improper medication disposal could harm the environment and population health?	204 (78.8%)	55 (21.2%)

A chi-square test of independence showed a significant association between gender and reasons for keeping unused drugs. Female students were more likely than males to retain unused drugs due to improved medical conditions (X^2 (1, N=259) = 8.34, p = 0.04), to keep them until expiration (X^2 (1, N=259) = 11.82, p < 0.001), and to hold onto them due to changes in medical therapy (X^2 (1, N=259) = 17.41, p < 0.001). Although no other significant associations were found (all p > 0.05), some notable trends emerged.

For example, a large proportion (54.1%) of the respondents aged 22-23, primarily Year 3 and Year 4 students from clinical faculties, reported regularly checking expiration dates before procuring medication. Exposure to drug disposal education also varied across faculties, with 24% of nursing students reporting being informed compared to 20.8% from medicine or 16.8% from pharmacy. Additionally, female students (68.8%) were more likely than male students to report having received education on proper medication disposal. Most respondents (78.8%) acknowledged that improper drug disposal harms the environment and public health, with stronger agreement observed among senior students and those from healthcare-related faculties.

Medication Disposal Practices

The results from Table 3 show that the majority of respondents (73.4%) reported keeping unused medications at home until they expired, while 61.0% disposed of them in household garbage. 17.4% reported donating unused medications to hospitals. Regarding expired medications, most students (77.2%) discarded them in household garbage, while 35.1% flushed them down the sink or toilet. Notably, only 1.2% returned expired medications to pharmacies, indicating a general lack of awareness regarding drug take-back programs. When asked about the necessity of education on proper medication disposal, an overwhelming majority (98.1%) agreed that such education is needed.

Table 3. Practices and Attitudes towards Disposal of Unused and Expired Medication

Questions	**Yes, n (%)**	**No, n (%)**
Practice		
What did you do with the unused medication?		
Kept in the home until expired	190 (73.4%)	69 (26.6%)
Threw away in household garbage	158 (61.0%)	101 (39.0%)
Gave to friends/relatives	104 (40.2%)	155 (59.8%)
Flushed down to the toilet or sink	77 (29.7%)	182 (70.3%)
Donated to the hospital	45 (17.4%)	214 (82.6%)
What did you do with the expired medicine?		
Threw away in household garbage	200 (77.2%)	59 (22.8%)
Flushed down to the toilet or sink	91 (35.1%)	168 (64.9%)
Burned the medicine	25 (9.7%)	234 (90.3%)
Gave to friends/relatives	50 (19.3%)	209 (80.7%)
Returned it to the pharmacy	3 (1.2%)	256 (98.8%)
Attitude		
Did you think education on proper medication disposal methods was necessary?	254 (98.1%)	5 (1.9%)

A statistical analysis was conducted to examine differences in medication disposal practices based on gender, age, year of study and faculty. Regarding the disposal of unused and expired medication in household garbage, more than half of the respondents followed this practice, with women comprising 56.0% of those who did so. While there was a trend suggesting this behavior was more common among women, the difference was not statistically significant ($p > 0.05$). Notably, students from the Faculty of Nursing were significantly more aware of this proper disposal method ($X^2(5, N = 259) = 25.88$, $p < 0.001$).

DISCUSSION

In this study, a significant proportion of respondents reported having at least one to five unused medications at home or in hostels due to various reasons, such as improvement in medical conditions, changes in therapy, or recurring illnesses. This finding is similar to a previous study conducted among female university students in Malaysia, whereby more than 90% of the students stated that they stored medicine in their rooms, with analgesics and antipyretics being the most common medications reported (Ali et al., 2010). A study by Bashatah & Wajid (Bashatah & Wajid, 2020) among pharmacy and nursing students in Saudi Arabia also reported painkillers as the most common medication they possessed. Keeping a small stock of routinely used medications, such as antipyretics, is a common practice for many individuals (Akkawi et al., 2023). Additionally, some students may retain medications to avoid wasting resources. However, the fact that antibiotics were among the unused medications is concerning, as they are meant to be completed as prescribed. This issue warrants further investigation into students' awareness and attitudes toward antibiotic use.

Regarding medication acquisition, the study found that most students obtained their medications through doctors' prescriptions, followed by over-the-counter (OTC) purchases and receiving from friends or relatives. This pattern suggests that both professional and informal sources contribute to students' medication use. Previous studies also reported that a significant proportion of students obtained their medications over the counter (Ali et al., 2010), and overprescription and excessive OTC purchases may contribute to the accumulation of unused medications (Insani et al., 2020). Moreover, improper storage and disposal of these medications, in turn, pose significant health and environmental risks (Ingale et al., 2023).

The fact that none of the students listed adverse drug reactions (ADR) as a reason for having unused medication is intriguing. Most of the drugs students possessed were OTC medications, which are typically considered safe with minimal side effects. It is possible that any side effects experienced were either mild enough not to interfere with students' daily lives, or were unrecognized, which may explain why no participants attributed discontinuation of the medication to an ADR. Alternatively, students may not have perceived mild reactions as serious enough to consider them a reason for not finishing their medication. On the other hand, non-adherence to medication, although reported by less than half of the respondents, presents a concerning issue. Non-adherence is known to cause a range of complications, such as treatment failure, increased morbidity and mortality, as well as an increased financial burden on healthcare systems (Stewart et al., 2023). The causes for non-adherence can vary, as discussed by Aljofan et al. (11), but patient-related factors may be particularly relevant in this young adult population, particularly a lack of understanding about their condition and the importance of completing prescribed treatment. This may lead to premature cessation of medication use and leave students with leftover drugs that may be discarded improperly.

The assessment of medication disposal practices revealed a generally poor level of awareness regarding proper pharmaceutical waste management. Even students with medical or health science backgrounds demonstrated gaps in knowledge regarding proper medication disposal, consistent with findings by a previous study among pharmacy and nursing students (Bashatah & Wajid, 2020). This can be directly related to the lack of exposure to the correct method of disposal, as more than half of the respondents had never received information on proper medication disposal methods. This finding on the lack of proper medication disposal knowledge is also consistent with previous studies conducted among the public in Indonesia and Malaysia (Insani et al., 2020; Ong et al., 2020). This lack of awareness may contribute to improper disposal practices, highlighting the need for higher education institutions to incorporate education on medication

disposal into their curricula, either as part of pharmacology-related subjects or within broader topics such as environmental health.

Moreover, only 17.4% of respondents reported having donated unused medications back to hospitals. In the context of this study, this response may reflect participants' interpretation of returning medications to healthcare facilities through available medicine take-back initiatives, where unused or expired medications are returned for appropriate handling and disposal rather than reuse. There are similarities between the current findings and a study conducted at IIUM more than a decade ago (Azad et al., 2012). In their study, they reported that 93% of the students did not know about the drug-take-back system. Although their respondents included non-science students, this highlights the urgent need for continuous targeted education on safe pharmaceutical disposal among all students, regardless of their field of study. Drug take-back programs and designated disposal sites at hospitals and pharmacies offer safer alternatives, as they ensure environmentally responsible handling of pharmaceutical waste (Ingale et al., 2023). Expanding the availability and visibility of such drug-take-back programs, particularly in educational settings, could promote better disposal practices.

A significant proportion of respondents reported discarding unused medications in household garbage, which was also observed in previous studies (Azad et al., 2012; Bashatah & Wajid, 2020). This practice poses environmental risks, as pharmaceutical compounds can leach into soil and water systems, potentially affecting ecosystems and human health (Ingale et al., 2023). There are also immediate safety concerns, as improperly discarded medications may be accidentally ingested by children or pets. Although certain medications may be disposed of in household trash if mixed with inedible substances such as coffee grounds or cat litter and sealed in a secure container, this method is only appropriate under specific guidelines (Ingale et al., 2023). Another concerning finding was the practice of flushing medications down the toilet or sink among the students, which is also reported by the previous studies (Azad et al., 2012; Bashatah & Wajid, 2020). This can result in pharmaceutical contamination of water sources, posing risks to aquatic life and potentially entering human water supplies (Kumari et al., 2022).

On a positive note, most students in the current and previous study (Bashatah & Wajid, 2020) acknowledged that improper drug disposal poses risks to both the environment and public health. Increasing awareness among young individuals is crucial, as they represent a generation that will play a critical role in future environmental sustainability efforts. Notably, a large proportion of respondents reported checking the expiration date before consuming medication, a practice that helps prevent potential health risks associated with degraded or toxic pharmaceutical byproducts (Sarla, 2019; Zilker et al., 2019). This preventive measure also reduces the likelihood of unused medications expiring and subsequently contributing to pharmaceutical waste.

In general, governments and healthcare providers should take an active role in promoting proper medication use, storage, and disposal through coordinated public health initiatives. Expanding awareness through broader channels such as television campaigns, social media platforms, and integration into academic curricula, especially for healthcare students, could effectively influence public behavior and foster long-term environmental responsibility.

This study has several limitations that should be considered when interpreting the findings. First, the use of convenience sampling and recruitment from a single university campus limits the representativeness of the sample, and caution should be exercised when generalizing these findings to the broader Malaysian undergraduate population or other regional institutions. Second, although the final sample size fell short of the initial target due to recruitment constraints, post-hoc power analysis demonstrated high statistical power, suggesting adequate precision for the observed categorical associations.

Nevertheless, a larger, multi-center sample would improve population-level precision. Third, while the research instrument was adapted from a validated framework and reviewed for face validity by domain experts, construct re-validation and internal consistency testing were not performed on this sample, which may limit the psychometric evaluation of response patterns. Finally, the survey relied on self-reported

practices, which may be subject to social desirability or recall bias regarding past medication disposal behaviors. Future studies should employ randomized, multi-institutional sampling and formal instrument validation to further investigate pharmaceutical waste management across higher education settings.

CONCLUSION

This study highlights that the majority of undergraduate science students did not practice proper medication disposal, with household trash and flushing being the most common disposal methods reported. Such practices pose risks to environmental and public health. Female students were more likely than males to retain unused medicines until they expired, suggesting gender-based differences in disposal behavior. Targeted educational initiatives, including the integration of safe disposal education into healthcare curricula, are needed to foster more responsible practices. Future research should assess the effectiveness of these interventions to guide policy and strengthen efforts to reduce pharmaceutical waste.

Conflict of Interest

The authors have no conflicts of interest to report.

REFERENCES

1. Akkawi, M. E., Elnaem, M. H., & Nahas, A. R. F. (2023). Self-medication practices among Malaysian older adults during the COVID-19 pandemic. Asian Journal of Gerontology and Geriatrics, 18(1), 15–20. https://doi.org/10.12809/ajgg-2022-580-oa
2. Ali, S. E., Ibrahim, M. I. M., & Palaian, S. (2010). Medication storage and self-medication behaviour amongst female students in Malaysia. Pharmacy Practice, 8(4), 226–232. https://doi.org/10.4321/s1886-36552010000400004
3. Aljofan, M., Oshibayeva, A., Moldaliyev, I., Saruarov, Y., Maulenkul, T., & Gaipov, A. (2023). The rate of medication nonadherence and influencing factors: A systematic Review. Electronic Journal of General Medicine, 20(3), em471. https://doi.org/10.29333/ejgm/12946
4. Azad, Md. A. K., Akhter, R. H. A. M. A., Uddin, S. M. A.-M. M., & Rahman, M. M. (2012). Disposal Practice for Unused Medications amongthe Students of the International Islamic University Malaysia. Journal of Applied Pharmaceutical Science, 02(07), 101–106. https://doi.org/10.7324/JAPS.2012.2712
5. Bashatah, A., & Wajid, S. (2020). Knowledge and Disposal Practice of Leftover and Expired Medicine: A Cross-Sectional Study from Nursing and Pharmacy Students' Perspectives. International Journal of Environmental Research and Public Health, 17(6), 2068. https://doi.org/10.3390/ijerph17062068
6. Behzadifar, M., Behzadifar, M., Aryankhesal, A., Ravaghi, H., Baradaran, H. R., Sajadi, H. S., Khaksarian, M., & Bragazzi, N. L. (2020). Prevalence of self-medication in university students: Systematic review and meta-analysis. Eastern Mediterranean Health Journal = La Revue De Sante De La Mediterranee Orientale = Al-Majallah Al-Sihhiyah Li-Sharq Al-Mutawassit, 26(7), 846–857. https://doi.org/10.26719/emhj.20.052
7. CARiNG Pharmacy. (2022). The Proper Practice of Medicine Disposal. CARiNG Pharmacy. https://www.caring2u.com/health-center/health-info/the-proper-practice-of-medicine-disposal/
8. Gidey, M. T., Birhanu, A. H., Tsadik, A. G., Welie, A. G., & Assefa, B. T. (2020). Knowledge, Attitude, and Practice of Unused and Expired Medication Disposal among Patients Visiting Ayder Comprehensive Specialized Hospital. BioMed Research International, 2020, 9538127. https://doi.org/10.1155/2020/9538127
9. Hong, T. C., Sivanandy, P., & Ingle, P. V. (2026). Effectiveness of a Pharmacist-Led Educational Intervention on Safe Disposal of Unused and Expired Medications in Klang Valley, Malaysia: A Pre-Post Interventional Study. Pharmacy Practice, 24(1), 1–9. https://doi.org/10.18549/PharmPract.2026.1
10. Ingale, M. H., Tayade, M. C., Patil, Y. P., & Salunkhe, R. (2023). Pharmaceutical Waste Disposal Current Practices and Regulations: Review. INTERNATIONAL JOURNAL OF PHARMACEUTICAL QUALITY ASSURANCE, 14(03), 821–824. https://doi.org/10.25258/ijpqa.14.3.59

11. Insani, W. N., Qonita, N. A., Jannah, S. S., Nuraliyah, N. M., Supadmi, W., Gatera, V. A., Alfian, S. D., & Abdulah, R. (2020). Improper disposal practice of unused and expired pharmaceutical products in Indonesian households. Heliyon, 6(7), e04551. https://doi.org/10.1016/j.heliyon.2020.e04551
12. Kumari, A., Alam, M. S., Kujur, M., & Kumar, S. (2022). The Pattern of Disposal Practices of Unused and Expired Medications Among Healthcare Professionals: A Cross-Sectional Survey in Rajendra Institute of Medical Sciences, Ranchi, Jharkhand. Cureus, 14(8), e27555. https://doi.org/10.7759/cureus.27555
13. Low, B. Y., Ting, K. N., & Lee, M. K. (2023). Knowledge, attitude and practice of community pharmacists towards household pharmaceutical waste disposal. International Journal of Pharmacy Practice, 31(2), 261–265. https://doi.org/10.1093/ijpp/riac101
14. Manocha, S., Suranagi, U. D., Sah, R. K., Chandane, R. D., Kulhare, S., Goyal, N., & Tanwar, K. (2020). Current Disposal Practices of Unused and Expired Medicines Among General Public in Delhi and National Capital Region, India. Current Drug Safety, 15(1), 13–19. https://doi.org/10.2174/1574886314666191008095344
15. Ong, S. C., Ooi, G. S., Shafie, A. A., & Hassali, M. A. (2020). Knowledge, attitude and disposing practice of unused and expired medicines among the general public in Malaysia. Journal of Pharmaceutical Health Services Research, 11(2), 141–148. https://doi.org/10.1111/jphs.12333
16. Sarla, G. S. (2019). Efficacy and disposal of drugs after the expiry date. The Egyptian Journal of Internal Medicine, 31(4), Article 4. https://doi.org/10.4103/ejim.ejim_110_19
17. Stewart, S.-J. F., Moon, Z., & Horne, R. (2023). Medication nonadherence: Health impact, prevalence, correlates and interventions. Psychology & Health, 38(6), 726–765. https://doi.org/10.1080/08870446.2022.2144923
18. Universiti Malaya. (2022). UM, CARiNG PHARMACY AND MULTIPLE STRATEGIC PARTNERS COLLABORATE TO SAFELY DISPOSE OF UNWANTED MEDICINES. SAFELY DISPOSE OF UNWANTED MEDICINES. https://um.edu.my/news/um-caring-pharmacy-and-multiple-strategic-partners-collaborate-to-safely-dispose-of-unwanted-medicines
19. World Health Organization. (2002). WHO Policy Perspectives on Medicines—Promoting rational use of medicines: Core components. World Health Organization. https://iris.who.int/bitstream/handle/10665/67438/WHO_EDM_2002.3.pdf
20. Zilker, M., Sörgel, F., & Holzgrabe, U. (2019). A systematic review of the stability of finished pharmaceutical products and drug substances beyond their labeled expiry dates. Journal of Pharmaceutical and Biomedical Analysis, 166, 222–235. https://doi.org/10.1016/j.jpba.2019.01.016