

Awareness and disposal practices of unused or expired medications among patients with type 2 diabetes in Ipoh, Malaysia

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ABSTRACT

Introduction: Improper disposal of unused or expired medications poses significant public health and environmental risks. Despite Malaysia's "Return Your Medicines Program," improper disposal practices persist, particularly among Type 2 diabetic patients on long-term therapies. This study aimed to determine awareness and disposal practices of unused or expired medications among Type 2 diabetic patients in Ipoh and identify factors influencing improper disposal.

Materials and Methods: A cross-sectional study was conducted at three government clinics in the Kinta District of Ipoh, Malaysia. Data were collected from 241 participants using structured questionnaires and analysed using descriptive statistics and Pearson's chi-square tests.

Results: A total of 34.4% of respondents reported having unused or expired medications, primarily due to overprescription (36.1%). Among the diabetic patients surveyed, 68% demonstrated satisfactory awareness regarding the disposal of unused prescribed medications, while 32% showed unsatisfactory awareness. In terms of disposal practices, 43.37% of participants followed proper methods, whereas 56.63% engaged in poor disposal practices. A statistically significant association was observed between the level of awareness and the disposal practices adopted by the participants ($p=0.000$). It is recommended that health authorities enhance public education campaigns and implement accessible, well-publicized medication take-back programs to promote proper disposal of unused or expired medicines.

Conclusion: The study identifies a strong association between awareness levels and proper disposal practices of unused or expired medications, emphasizing the need for targeted educational initiatives to promote safe disposal among patients.

KEYWORDS:

Type 2 diabetes; medication disposal; awareness; Malaysia; public clinic

INTRODUCTION

Healthcare systems strive to offer patients the best quality of service through maximum utilization of the available resources, while simultaneously minimizing any possible monetary losses.¹ One definition of waste is, "Any substance or object the holder discards, intends to discard, or is required to discard". Unused medications include expired, spilled, and contaminated pharmaceutical products, drugs, vaccines, and sera that are no longer required and need to be disposed of appropriately.² Overprescription, therapy changes, and patient non-adherence were contributing factors to unused medications. Socioeconomic factors, such as lower income correlating with improper disposal, highlight disparities in access to take-back programs.³

Diabetes Mellitus is among the four leading non-communicable diseases and is responsible for more than 2 million deaths globally, according to the World Health Organization.⁴ In Malaysia, the burden of diabetes mellitus has been increasing, with a prevalence of 21.1% reported in 2024, indicating that approximately 4.75 million adults were living with the condition.⁵ The Malaysian government has been subsidizing medications for diabetic type 2 patients to ensure that they have access to essential treatments. However, the issue of unused medications persists, as reflected by significant increase in the total value of medicines returned to three tertiary hospitals although the Ministry of Health in Malaysia launched the "Return Your Medicines Program" in 2010.⁶

Type 2 diabetic patients, often on long-term regimens, are particularly prone to accumulating unused drugs, exacerbating risks of improper disposal. The patients' practices toward the disposal of unused medications are influenced by several factors, including their awareness, attitudes, and accessibility to proper disposal methods. Additional barriers include unnecessary prescriptions and low medication adherence, which silently contribute to the wastage of valuable resources.⁷

Despite raising awareness, improper disposal methods are still widespread among patients and the return of medicine

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through the programs was not satisfactory. A lack of awareness, home storage of medications, and inappropriate disposal practices have been reported in Asian countries, largely due to the absence of official guidelines.⁸ A cross-sectional study in Malaysia reported that 35.1% of respondents returned unused medications, whereas 38.3% disposed of them in household trash.⁹ A study done in Kuwait had ranked throwing unused or unwanted medicines into the garbage being their most common method of disposal (76.5%) followed by flushing them down the sink or toilet (11.2%).¹⁰ Diabetes Mellitus has become a major issue in this country, with the number of cases steadily increasing and affecting a large portion of the population. A study conducted among Type 2 diabetic patients in Kelantan, Malaysia found that only 11.5% of patients disposed of sharps at a healthcare facility, while the majority (88.6%) discarded them using plastic bags.¹¹ Improper disposal of expired or unused medications by diabetic patients can harm public health, ecosystems, and contaminate water systems.¹² Several studies have investigated unused medications within the general population. However, limited research has been conducted in Malaysia on the issue of unused medications among diabetic patients. This study aimed to determine the awareness and disposal practices of unused medications among individuals with Type 2 diabetes. The findings may serve as baseline data to inform and support the development of more effective government initiatives addressing unused medication management.

MATERIALS AND METHODS

Study area and duration

A cross-sectional study was carried out among Type 2 diabetic patients registered in the government health clinics (Klinik Kesihatan) in Kinta district of Malaysia. The duration of the study was from 3/2/2025 to 16/5/2025. The selected clinics were Klinik Kesihatan Greentown, Klinik Kesihatan Gunung Rapat, and Klinik Kesihatan Chemor.

Sample size and sampling method

Three health clinics located within the Kinta district were selected using simple random sampling by using Research Randomizer and participants were recruited to ensure the inclusion of individuals with specific experiences and knowledge related to diabetic medication use. Participants were identified using purposive sampling from three clinics, with approximately equal proportions obtained from each clinic.

The sample size was calculated using OpenEpi with a 5% margin of error and a 95% confidence interval. The population size was based on registered active diabetic individuals, as reported by the Kinta District Health Office in 2023.¹³ The prevalence of proper disposal practice of unused medication was 15% according to the previous study in Malaysia.¹⁴ Based on these parameters, the sample size required for this study was 191 participants. Allowing a 20% attrition rate, the study recruited 241 participants.

Inclusion and exclusion criteria

This study included individuals aged 18 and above with Type 2 Diabetes Mellitus (T2DM) who were registered in the Kinta district and consented to participate. Patients with conditions other than T2DM or those registered at clinics outside the Kinta district were excluded from the study.

Data Collection

Data collection was conducted through face-to-face interviews using both printed questionnaires and a Google Form. A QR code linking to the Google Form was provided to enhance accessibility and convenience for participants.

To minimise interviewer bias, all interviewers used a structured questionnaire with consistent wording and sequence of questions. Interviewers were instructed to remain neutral and avoid leading participants' responses. Participants were assured of the confidentiality of their responses to encourage honest reporting.

Materials

The questionnaire was divided into three sections: Section A gathered sociodemographic information, Section B assessed awareness regarding the disposal of unused or expired prescribed medications, and Section C focused on the disposal practices of unused medications.

Both English and Malay versions of the questionnaire were used. Content validity was established through expert review by a panel comprising specialists in Public Health, Internal Medicine, and Pharmacy. The panel evaluated the questionnaire for relevance, clarity, comprehensiveness, and appropriateness of the items. Based on their feedback, revisions were made to ensure that the questionnaire adequately covered all relevant domains related to diabetic medication use and disposal practices. A pre-test was subsequently conducted, and the questionnaire demonstrated acceptable internal consistency, with a Cronbach's alpha value of 0.76. For language adaptation, the questionnaire was translated from English into Malay by a bilingual expert. A separate independent bilingual translator then performed back-translation into the original language to ensure conceptual equivalence. Any discrepancies identified during the translation process were reviewed and resolved by the research team prior to data collection.

Statistical analysis

Data were analysed using IBM SPSS version 25. Binary logistic regression was employed to assess associations between variables, with a p-value of less than 0.05 considered statistically significant.

Ethical considerations

Ethical approval was sought from the National Medical Research and Ethics Committee (MREC) and the Ethics Committee of UniKL Royal College of Medicine Perak (UniKLRCMP/MREC/2024-2025/SRP-091) before commencing the study. Informed consent was obtained from all participants, and the study was conducted in accordance with the principles of the Declaration of Helsinki.

Table I: Awareness of disposal of unused or expired prescribed medications among diabetic patients

Awareness questions	No	Yes
Improper disposal of medicines has adverse effects on the environment?	13.7%	86.3%
Is it acceptable to dispose of solid medicines such as tablets and capsules into the garbage?	77.2%	22.8%
Is it acceptable to dispose of needles and syringes into the garbage?	81.7%	18.3%
Is it acceptable to dispose of liquid medicines into the sink or toilet?	73.0%	27.0%
Do you think the medicines disposed of in the sink or toilet can reach and contaminate the groundwater?	27.4%	72.6%
Is it appropriate to return unused or expired medicines to the local pharmacy or hospital?	6.6%	93.4%
Do you know about the "Return Your Medicines Program"?	44.8%	55.2%

Table II: Nature of unused medication disposal among the respondents

Variable		Frequency	Percentage
Do you have any unused or expired medicines at home? (N = 241)	Yes	83	34.4
	No	158	65.6
Why do you have unused or expired prescribed medicines at home? (N=83)	Prescribed more than needed	30	36.1
	Doctor changed treatment	5	6
	Self-discontinuation after the condition	22	26.5
	Passed expiry date	11	13.3
	Adverse effects of prescribed drug	4	4.8
	Non-compliance	11	13.3
	Inhaler	1	1.2
What is the form of the unused or expired prescribed medicines at home? (N=83)	Capsules	2	2.4
	Injection	1	1.2
	Syrup	1	1.2
	Tablets	78	94
How do you dispose of unused or expired prescribed medicines? (N=83)	Continue to use since not yet expire	3	3.6
	Return to pharmacy/clinic	36	43.4
	Thrown away in the trash/garbage	32	38.6
	Rinsing down a toilet/sink	3	3.6
	Given away to friends/charity	3	3.6
	Stored/never disposed	6	7.2
Practice of unused medicine disposal(N=83)	Poor	47	56.63
	Good	36	43.37

N=number of individuals

Table III: Association between socio-demographic factors and awareness of unused medicine disposal

Predictor	B	SE	Wald	p-value	OR	95% CI for OR	
Older than 60	Ref.						
30-60 yrs	-0.396	0.31	1.629	0.202	0.673	0.367	1.236
Younger than 30	-0.227	1.261	0.033	0.857	0.797	0.067	9.434
Female	Ref.						
Male	0.15	0.281	0.286	0.593	1.162	0.67	2.017
Tertiary education	Ref.						
Secondary education	0.174	0.331	0.278	0.598	1.191	0.622	2.277
Primary education	0.083	0.427	0.038	0.845	1.087	0.471	2.51
>11000 RM	Ref.						
4500-11000 RM	-0.642	0.659	0.95	0.33	0.526	0.145	1.914
<4500 RM	-0.264	0.612	0.187	0.666	0.768	0.231	2.547
Model summary							
Hosmer and Lemeshow X2	3.177						
df	8						
p	0.923						

B=Unstandardized coefficient, SE=Standard Error, OR=Odds Ratio, CI=Confidence Interval

Table IV: Association between socio-demographic factors, respondents' awareness and disposal practice of unused medicine

Predictor	B	SE	Wald	p-value	OR	95% CI for OR	
Older than 60	Ref						
30-60 yrs	-0.84	0.524	2.572	0.109	0.432	0.155	1.205
Younger than 30	-21.249	40192.97	0	1	0	0	
Female	Ref						
Male	0.392	0.573	0.468	0.494	1.481	0.481	4.555
Tertiary edu	Ref						
Secondary edu	0.208	0.677	0.094	0.759	1.231	0.327	4.641
Primary edu	0.408	0.934	0.19	0.663	1.503	0.241	9.377
>11000 RM	Ref						
4500-11000 RM	-1.416	1.719	0.679	0.41	0.243	0.008	7.052
<4500 RM	-2.148	1.604	1.793	0.181	0.117	0.005	2.708
Unsatisfactory attitude	Ref						
Satisfactory attitude	3.058	0.726	17.751	0.000*	21.282	5.131	88.267
Model summary							
Hosmer and Lemeshow χ^2	3.454						
df	7						
p	0.84						

B=Unstandardized coefficient, SE=Standard Error, OR=Odds Ratio, CI=Confidence Interval

* Significant

RESULTS

A total of 241 diabetic patients participated in the study, with the majority being female (55.6%), over the age of 60 (63.9%), having a secondary level of education (46.5%), and earning a monthly income below RM4500 (70.5%).

Table I presents the findings on awareness regarding the disposal of unused or expired prescribed medications among the diabetic patients. Although most respondents were aware of proper disposal methods, approximately one-fourth were not aware of appropriate practices for disposing of unused medicines. Some believed it was acceptable to discard medications in the trash or down the sink, unaware of the potential health risks. Notably, 93.4% of diabetic patients knew that unused or expired medications should be returned to a pharmacy or hospital. However, nearly half (44.8%) were unfamiliar with the 'Return Your Medicine Program.'

The awareness questionnaire consisted of 7 binary items, with each correct response scored as 1 and each incorrect response scored as 0, resulting in a total score range of 0–7. Since the awareness score was derived from summed binary items and represented an ordinal/discrete distribution, participants were categorized based on the median total score. A score above the median value of 5 was considered satisfactory awareness, while scores at or below the median were categorized as unsatisfactory awareness. In this study, 68% of diabetic patients demonstrated satisfactory awareness regarding the disposal of unused prescribed medications, whereas 32% showed unsatisfactory awareness.

Approximately one-third (34.4%) of respondents had unused prescribed medications at home. Among these individuals, 36% cited overprescription as the main reason. The vast majority (94%) of unused medications were in tablet form. The most common disposal method was returning unused medications to a pharmacy or clinic (43.3%). However, a considerable proportion of respondents disposed of medications in household trash (38.6%), while a smaller percentage discarded them via the toilet or sink (3.6%). Disposal methods were categorized as either good or poor. Returning unused medications was considered a good

practice, while all other methods were classified as poor practices. As mentioned in Table II, 56.63% of diabetic patients demonstrated poor disposal practices, whereas 43.37% were found to follow good disposal practices.

A binary logistic regression was performed to find out the impact of socio-demographic factors on the likelihood of awareness of unused medicine disposal. Based on Table III, socio-demographic factors did not have any effect on the awareness of disposal practices. Hosmer and Lemeshow χ^2 showed non-significant p-value, suggesting a good model fit. A binary logistic regression was carried out in Table IV to find out the impact of socio-demographic factors and participant's awareness on the likelihood of disposal practice of unused medicine. A non-significant Hosmer and Lemeshow χ^2 suggests the model fits the data adequately. Nagelkerke R Square indicates 43.8% variance is explained by the model. Respondent's awareness is a significant predictor of disposal practices for unused medicines among diabetic patients (B=3.058, SE=0.726, $p<0.001$, OR=21.282, 95%CI [5.13,88.26]). Lower awareness was significantly associated with improper disposal practices.

DISCUSSION

Malaysia has made strong progress in health, with good coverage and risk protection. However, the country still faces health problems caused by social and environmental issues. Government clinics (Klinik Kesihatan) make up 28% of primary healthcare but handle 64% of outpatient visits. Still, only 2.2% of the country's GDP is spent on the current health expenditure (CHE), showing that health is underfunded. One major reason for rising health costs is the growing demand for medicines and medical supplies.¹⁵

In 2010, Ministry of Health Malaysia introduced "The Return Your Medicine Program" to encourage safe disposal of unused or excessed medicine among patients. This program helps patients safely dispose of unused medicines in an environmentally friendly way, following proper guidelines, through a joint effort between government and private pharmacies.¹⁶⁻¹⁷

This study aimed to assess how aware patients with Type 2 Diabetes (T2DM) are about disposing of unused medications and how they actually dispose of them. Most of the participants were from low-income groups and had a secondary education level. Klinik Kesihatan play a key role in Malaysia's healthcare system by offering affordable and accessible services. They charge low consultation fees and are especially important for low- and middle-income families.¹⁸ Although most respondents knew that unused or expired medicines should be returned to a hospital or pharmacy, about 13% to 27% were not properly aware of how to dispose of them in the current study. Almost half were still unaware that the Medication Return Programme is available at all government hospitals and clinics. A study in Terengganu, Malaysia also found low awareness of the program, with 60% to 70% of people throwing unused or expired medicines in the trash.¹⁹ Ling et al. (2024) also reported that 71.5% of respondents disposed of unused medications in rubbish bins, making it the most common method among Malaysians. The study also found that awareness of how pharmaceuticals can harm the environment was strongly linked to proper disposal practices.²⁰

Although Malaysia has been promoting awareness programs for rational drug use for over a decade, Lim (2016) reported that fewer than 50% of respondents demonstrated satisfactory awareness. Findings from the current study support previous research, revealing that only 32% of diabetic patients are aware of proper disposal methods for unused medications. This highlights the ongoing need to raise public awareness about the safe disposal of medications.²¹

In this study, 43.3% of participants returned unused medications to a pharmacy or clinic, indicating awareness of the "Return Your Medicines Program" and appropriate medication disposal practices. Compared with a study conducted in Saudi Arabia, participants in the present study demonstrated greater awareness regarding the proper disposal of unused medications (43.3% versus 14.9%).²² The Saudi study targeted the general public, whereas the current study focused on patients with Diabetes Mellitus. These patients may have better awareness of medication disposal practices due to more frequent exposure to healthcare providers.²³

Findings reported that one-third of the respondents reported disposing of unused or expired medications in the trash, while 3.6% admitted to discarding them in sinks or toilets. These findings indicate that poor disposal practices are prevalent among more than half of the patients with Type 2 Diabetes Mellitus (T2DM). Improper disposal methods, such as discarding medications in the trash or flushing them, can lead to environmental pollution, accidental poisoning, and potential drug misuse. These practices may contaminate water sources, posing risks not only to human health but also to wildlife. Furthermore, pathogens and toxic substances from pharmaceutical waste can contribute to climate impact through environmental degradation.²⁴

Awareness and disposal patterns of unused medications were not significantly associated with sociodemographic factors in

the current study. Our findings are consistent with a study conducted in the United Arab Emirates (UAE), which also found no significant relationship between age, gender, or education level and knowledge or practices related to the disposal of unused medications.²⁵ However, in a survey conducted among the general public in Saudi Arabia, gender and educational level were found to be significantly associated with unused medication disposal patterns. That study included a larger sample size and a higher proportion of respondents with tertiary education compared to the current study.²⁶

A cross-sectional survey conducted among the Malaysian public in 2023 revealed that individuals with greater awareness of health and environmental hazards were more likely to practice safe disposal of unused medications.²⁰ Similar findings were observed in the current study, where participants with better knowledge regarding medication disposal reported safer disposal practices.

To improve public awareness, targeted health education campaigns can be implemented at local health clinics, reaching not only patients with chronic conditions such as Type 2 Diabetes Mellitus, but also their family members. Additionally, pharmacists can play a vital role by providing brief, personalized guidance on proper disposal methods at the point of prescription. Educational materials such as pamphlets or handy flyers can further reinforce this information. Moreover, incorporating animated sticker labels on medication packaging that demonstrate correct disposal methods can serve as a cost-effective and visually engaging reminder for patients.

LIMITATION

This study has several limitations that should be acknowledged. The use of nonprobability sampling limits the generalizability of the findings, as participants were selected based on their availability and willingness rather than random selection, which may not fully represent the broader population of Type 2 diabetic patients in the Kinta district. Additionally, reliance on self-reported responses introduces the possibility of recall bias and social desirability bias, potentially affecting the accuracy of reported disposal practices.

Furthermore, the study was conducted only in three health clinics, which may not fully reflect the practices of patients in other clinics or healthcare settings. To address these limitations, future research should consider using probability sampling methods to improve representativeness and reduce selection bias, while expanding the study to include more clinics across different districts or states to obtain a broader understanding of disposal practices among diabetic patients in Malaysia.

CONCLUSIONS

This study reveals that one-third of Type 2 diabetes patients registered at government clinics in Ipoh possess unused or expired prescribed medications, primarily due to overprescription and self-discontinuation of treatment. These

findings provide important insight into the initial steps needed to address improper medication waste disposal among patients.

The study identifies a statistically significant association between awareness levels and proper disposal practices of unused or expired medications, emphasizing the need for targeted educational initiatives to promote safe disposal among patients. Enhancing public knowledge, increasing accessibility to medication take-back programs, and strengthening communication between healthcare providers and patients regarding medication management are critical steps in reducing pharmaceutical waste and its associated environmental and health risks. Lower awareness was significantly associated with improper disposal practices, underscoring the importance of sustained awareness efforts.

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REFERENCES

1. Mbau R, Musiega A, Nyawira L, Tsofa B, Mulwa A, Molyneux S, et al. Analysing the efficiency of health systems: a systematic review of the literature. *Appl Health Econ Health Policy*. 2023; 21(2): 205-24.
2. Environment Agency. Check if your material is waste [Internet]. London: GOV.UK; 2021 Aug 31 [updated 2024 Jul 11; cited 2026 Jun 25]. Available from: <https://www.gov.uk/government/publications/legal-definition-of-waste-guidance/definition-of-waste-2018-waste-framework-directive-amendments>
3. Calise TV, Martin SL, Wingerter C. Safely disposing unused and unwanted prescription and over-the-counter medications: a public health, housing, and safety partnership in Framingham, MA. *Journal of Pharmaceutical Policy and Practice* 2022; 15(1): 1-8.
4. Noncommunicable diseases [Homepage on the Internet]. [cited 2026 Apr 8]; Available from: <https://www.who.int/news-room/fact-sheets/detail/noncommunicable-diseases>
5. Malaysia - International Diabetes Federation [Homepage on the Internet]. [cited 2026 Apr 8]; Available from: <https://idf.org/our-network/regions-and-members/western-pacific/members/malaysia/>
6. Returning Unwanted Medicine To Pharmacies – Monash University Malaysia - CodeBlue [Homepage on the Internet]. [cited 2025 Jun 6]; Available from: <https://codeblue.galencentre.org/2022/05/returning-unwanted-medicine-to-pharmacies-monash-university-malaysia/>
7. Alharbi H. Drug Consumers Behaviors toward the Disposal of Unused and Expired Medicines in Qassim Province/Saudi Arabia. *J Pharm Biomed Sci* 2018; 8(1): 8-13.
8. Borhan Uddin M, Al Samir R, Golam Meheboob Pantho GM. Practice of Expired and Unused Drug Disposal in South Asian and Southeast Asian Countries. *Waste Management for a Sustainable Future - Technologies, Strategies and Global Perspectives*. 2024 Sep 26;
9. Wang LS, Aziz Z, Chik Z. Disposal practice and factors associated with unused medicines in Malaysia: a cross-sectional study. *BMC Public Health* 2021;21:1695.
10. Abahussain EA, Ball DE, Matowe WC. Practice and Opinion towards Disposal of Unused Medication in Kuwait. *Medical Principles and Practice* 2006; 15(5): 352-7.
11. Hasan UA, Hairon SM, Yaacob NM, Daud A, Hamid AA, Hassan N, et al. Factors contributing to sharp waste disposal at health care facility among diabetic patients in North-East Peninsular Malaysia. *Int J Environ Res Public Health* 2019; 16(13): 2251.
12. Tong AYC, Peake BM, Braund R. Disposal practices for unused medications around the world. *Environment International* 2011; 37(1): 292-8.
13. Pejabat Kesihatan Daerah [Homepage on the Internet]. [cited 2025 Jun 6]; Available from: <https://jknperak.moh.gov.my/jkn/v2/index.php/perkhidmatan/pejabat-kesihatan-daerah-pkd>
14. Hassali MA, Shakeel S. Unused and Expired Medications Disposal Practices among the General Public in Selangor, Malaysia. *Pharmacy: Journal of Pharmacy Education and Practice* [homepage on the Internet] 2020 [cited 2026 Apr 8];8(4):196.
15. Ministry of Health Malaysia. Health White Paper for Malaysia. Putrajaya: Ministry of Health Malaysia; 2023. [cited 2026 Jun 25]. Available from: https://www.moh.gov.my/images/04-penerbitan/kertas-putih/Kertas_Putih_Kesihatan_ENG_compressed.pdf
16. The Proper Practice of Medicine Disposal | CARiNG Pharmacy [Homepage on the Internet]. [cited 2025 Jun 7]; Available from: <https://www.caring2u.com/health-center/health-info/the-proper-practice-of-medicine-disposal/>
17. Keowmani T, Liew JE, Tan SL. Knowledge, attitude and practice related to unused medicines among doctors, pharmacists and nurses: developing and validating a tool. *Pharm Res Rep* 2024; 7(1): 18-32.
18. Understanding Malaysia's Healthcare System [Homepage on the Internet]. [cited 2025 Jun 7]; Available from: https://www.internationalinsurance.com/health/systems/malaysia.php?srsltid=AfmBOoqyUHvd5XLrHWZgHvECu_geCewbT9XhuCMI8LSRAY5ytMJ15zx
19. Saharuddin NA, Noordin ZM, Hospital TA, et al. Original Research Article Assessing Public Awareness and Practices in Medicine Disposal : A Cross-Sectional Study on the Utilisation of the ' Return Your Medicines ' Program in. 2024; 7: 34-47.
20. Ling JY, Ng PY, Shamsuddin AS, Zulkifli A, Lee KE. Medication Disposal Patterns and Practices with Awareness of Environmental Contamination Caused by Pharmaceuticals among the General Public in Malaysia. *Asian Pacific Journal of Cancer Prevention* 2024; 25(8): 2723-34.
21. Lim MT. Disposal Practices of Unused and Unwanted Medications among Patients in a Tertiary Hospital. *Education in Medicine Journal* 2016; 8(3): 49-59.
22. Bani Hani S, Al Omar S, Abu Zaid A, et al. Preoperative predictors of complications in pediatric laparoscopic appendectomy: a retrospective cohort study. *J Pediatr Surg* 2022; 57(6): 1171-7.
23. Aljeezan MK, Altaher YY, Boushal TA, Alsultan AM, Khan AS. Patients' Awareness of Their Rights and Responsibilities: A Cross-Sectional Study From Al-Ahsa. *Cureus* 2022; 14(12).
24. World Health Organization. Health care waste [Internet]. Geneva: World Health Organization; 2024 Oct 24 [cited 2026 Jun 25]. Available from: <https://www.who.int/news-room/fact-sheets/detail/health-care-waste>
25. Dweik R Al, Ajaj R, Hafez W. Public awareness of medication disposal and its impact on environmental and public health: A cross-sectional study in the United Arab Emirates. *Informatics in Medicine Unlocked* 2024; 50: 101580.
26. Khan NA, Easwaran V, Orayj K, Venkatesan K, Alavudeen SSA, Alhadeer SA, et al. A cross-sectional study on perceptions towards safe disposal of unused/expired medicines and its associated factors among the public in Saudi Arabia—a threat to the environment and health. *PeerJ* 2025; 13: e19258.