Handling of Unused Medications: Knowledge, Attitudes, and Practices among Outpatients at Hospital Tuanku Fauziah

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Abstract

Introduction: Unused medications refer to pharmaceuticals that are no longer being used because of discontinuation or abandonment by patients. These medications pose serious risks to both public health and environmental safety, including the potential for misuse and accidental poisoning when improperly disposed of.

Objective: The study aimed to assess knowledge, attitudes, and practices of handling unused medication among outpatients at Hospital Tuanku Fauziah (HTF) and its associated factors.

Methods: A cross-sectional study was carried out between 1 October 2022 and 28 February 2023 among patients who visited outpatient department of HTF using a validated questionnaire. Participants included individuals aged 18 years and above who were prescribed chronic medications. Associations between demographic characteristics and knowledge, attitude and practice scores were analysed using Chi-Square and Fisher's Exact tests. Spearman's correlation coefficient was employed to determine the relationship between knowledge, attitudes, and practices.

Results: A total of 384 respondents participated in this study. Most of the respondents were female (n=227, 59.1%), married (n=297, 77.3%), aged 50 years and above (n=179, 46.6%), and Malay (n=354, 92.2%). Respondents with good knowledge, attitudes and practices score were 40.1%, 18.7% and 4.2% respectively. Only 34.2% of respondents reported the correct handling of unused medications. Those who were aware of proper disposal methods or had received advice from healthcare professionals to return unused medications to the pharmacy were significantly associated with higher knowledge scores. There was a statistically significant but weak positive correlation between attitudes and practices.

Conclusion: Knowledge, attitudes, and practices regarding the proper handling of unused medications among chronic medication users remain suboptimal. Implementation of well-structured educational programs is essential to raise public awareness and promote safe medication disposal practices.

Keywords: Disposal, knowledge, attitudes, practices, unused medications

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Introduction

Unused medications is a growing concern in healthcare systems all over the world. These medications, whether expired, discontinued, or leftover due to changes in treatment, are often improperly stored or discarded (1). Studies have shown that a large proportion of the public dispose of unused medications by throwing them into household garbage, flushing them down the toilet, or pouring them into the sink (2-4). These practices contribute to environmental pollution, particularly contamination of water systems, which may lead to the development of antibiotic resistance and disruption of aquatic ecosystems (5). In addition, there are safety concerns associated with the unintentional ingestion of medications by children, the elderly, or pets, as well as the misuse or abuse of leftover controlled substances (6,7). Additionally, the environmental management of these pharmacological compounds is both difficult and costly (8).

Globally, almost one-third of adults are affected by multiple chronic conditions (MCCs) (9). In Malaysia, the National Health and Morbidity Survey (NHMS) 2015 reported a rising prevalence of chronic illnesses and a rise in the population's use of medications (10). Patients with chronic conditions often require long-term pharmacotherapy, which usually involves multiple medications to manage their illnesses, prevent both short-term and long-term complications, and ensure a good quality of life (11). Chronic medications are generally defined as those that must be taken daily for at least 30 consecutive days or used on an "as needed" basis for a total of six months or more (12).

Hospital Tuanku Fauziah (HTF), a key referral centre in the state of Perlis, caters to many patients with chronic diseases who are prescribed long-term therapies. This population is particularly susceptible to the accumulation of unused medications. However, proper disposal of unused medications among outpatients is still an unexplored area, as there is no related study done in Perlis. Therefore, it is essential to assess patients' knowledge, attitudes and practices concerning the handling of unused medications. Such an assessment will help to identify existing gaps and inform the development of targeted interventions to promote safer medication disposal practices and enhance public awareness. Therefore, this study aimed to evaluate the knowledge, attitudes, and practices of handling unused medication among patients attending the outpatient pharmacy at HTF. In addition, it seeks to identify sociodemographic and other factors associated with better knowledge, attitudes and practices of proper disposal methods. Furthermore, this study aimed to determine the relationship between knowledge, attitude and practice regarding unused medication disposal. The findings of this study are expected to assist in developing more effective educational strategies and support policy initiatives aimed at improving pharmaceutical waste management in Malaysia.

Method

A cross-sectional study was conducted to evaluate the knowledge, attitudes, and practices of handling unused medication among patients with chronic illnesses at the outpatient pharmacy of HTF. The study was conducted from 1 October 2022 to 28 February 2023. Eligible participants were patients aged 18 years and above who were currently taking or had previously taken chronic medications for a minimum duration of one month. Patients who were not on follow-up at HTF, caregivers collecting medications on behalf of others, and individuals who were unable to read or understand the Malay language were excluded from participation.

A convenience sampling method was employed to recruit participants at the outpatient pharmacy. The study was explained to the patients, and they were invited to participate. A Malay version of the questionnaire was distributed to the respondents after written informed consent was obtained. The investigator-assisted questionnaire administration took approximately 20 minutes to complete, and respondents returned it to the pharmacy upon completion. Based on an estimated 70,119 outpatient prescriptions dispensed between August and December 2021, the required sample size was calculated as 383 using the Raosoft sample size calculator, with parameters set at a 5% margin of error, 95% confidence level, and a 50% response distribution.

Data were collected using a validated questionnaire adopted from a previous study (13). The questionnaire consisted of five sections. Section A collected demographic information, including gender, age, ethnicity, marital status, employment status, and educational level. Ten items in section B were designed to assess respondents' knowledge of proper medication disposal. There were three choices of responses included: "True," "False," and "Do Not Know," with each correct response assigned one point and incorrect or "Do Not Know" responses assigned zero points. The values were then presented as percentages. The maximum scores in this section were 10 points or 100%. According to Bloom's cut-off, respondents scoring above or equal to 60% indicated good knowledge, and scores below 60% indicated poor knowledge (14). Sections C and D each consisted of 10 questions assessing attitudes and practices using a five-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree", One to five points were assigned to the answers accordingly, with "Strongly Disagree" being assigned 1 point, 5 points for "Strongly Agree". Higher scores represented more appropriate attitudes or practices towards medication disposal. Negatively worded items were reversely scored. The expected maximum total score per section was fifty (14). The scores were presented as percentages. Good attitude or

practice was considered as having a score of at least 80%, while poor attitude or practice was defined as obtaining a score of less than 80% (14,15). In Section E, the actual practices of whether respondents dispose of the unused medication correctly according to the recommended guideline by returning it to the pharmacy and the reported reasons were evaluated (16). This section is a multiple-choice question where respondents are allowed to report more than one type of medication disposal methods based on their practice.

Data were entered into Microsoft Excel and categorised according to the domains of knowledge, attitudes, and practices. The statistical analysis was conducted using IBM® SPSS version 21.0. The demographic information was compiled using descriptive statistics, including frequencies (n) and percentages. Chi-Square and Fisher's Exact tests were applied to assess the factors associated with knowledge, attitudes and practices scores, with significance set at $p<0.05$. Spearman's correlation coefficient was used to determine correlations between knowledge, attitudes, and practice.

The study (NMRR-22-02285-ZKW) was approved by the Medical Research and Ethics Committee of the Ministry of Health Malaysia. The respondents were informed of their voluntary participation and right to withdraw at any time. All responses were kept anonymous and confidential.

Results

Demographic data

Out of 450 outpatients invited to participate, 384 completed the questionnaire, yielding a response rate of 85.3%. The majority of the respondents were over 50 years (46.6%) and identified as Malay (92.2%). Female respondents comprised a larger proportion of the sample (59.1%), and most respondents were married (77.3%). Regarding educational background, 220 respondents (57.3%) had received formal education up to secondary school, while 213 respondents (55.5%) were still employed.

Less than half of the respondents demonstrated good knowledge (40.1%), attitude (18.7%) and practice (4.2%) regarding the correct handling of unused medications. More than half of the respondents (62.0%) reported that they were aware of proper medication disposal methods and had been advised by healthcare providers to return unused medications to a pharmacy (59.9%). Over 90% of respondents reported checking the expiry date before purchasing or consuming medication, whereas 40.4% indicated that they still kept unwanted medications at home. A summary of the sociodemographic characteristics and respondents' feedback on their handling of unused medications is presented in Table 1.

Table 1: Sociodemographic characteristics of the respondents and responses on their handling of unused medications (n=384)

Variables	Frequency, n (%)
Age, mean (SD)	47.4 (15.1)
18 to 29	63 (16.4)
30 to 49	142 (37.0)
≥50	179 (46.6)
Gender	
Male	157 (40.9)
Female	227 (59.1)
Ethnicity	
Malay	354 (92.2)
Chinese	14 (3.6)
Indian	11 (2.9)
Others	5 (1.3)
Marital status	
Single	63 (16.4)
Married	297 (77.3)
Widowed	20 (5.2)
Divorce	4 (1.0)

Level of education	
No formal education	4 (1.0)
Primary education	11 (2.9)
Secondary education	220 (57.3)
College/Pre-university/Diploma	80 (20.8)
Degree	52 (13.5)
Master	17 (4.4)
Working status	
Working	213 (55.5)
Not working	171 (44.5)
Knowledge score, mean (SD)	49.5 (17.4)
Poor (<60)	230 (59.9)
Good (⩾60)	154 (40.1)
Attitude score, mean (SD)	35.8 (4.1)
Poor (<80)	312 (81.3)
Good (⩾80)	72 (18.7)
Practice score, mean (SD)	32.9 (4.0)
Poor (<80)	368 (95.8)
Good (⩾80)	16 (4.2)
Aware of the proper disposal of medications	
Yes	238 (62.0)
No	145 (37.8)
Have unused medications at home	
Yes	155 (40.4)
No	229 (59.6)
Check the expiry date before purchasing or consuming the medications	
Yes	350 (91.1)
No	34 (8.9)

Abbreviation: SD = standard deviation

Knowledge on correct handling of unused medications

A significant number of respondents (84.9%) responded that inappropriate disposal of medications can harm the environment and ecosystem. Most respondents were aware that solid medications (56.3%) and needles, including syringes (70.3%), should not be disposed of in the garbage. Regarding liquid medications, 164 respondents (42.7%) believed that disposing of them in the sink was unacceptable, while 255 respondents (66.4%) rejected flushing them down the toilet. A large majority (83.9%) reported that returning or disposing of unused medications at a local pharmacy or healthcare facility is an acceptable practice. However, respondents were largely unaware of the proper disposal of medications through incineration (14.3%), the disposal of metered-dose inhalers (15.9%), as well as creams and ointments (45.1%). The respondents' correct responses to the knowledge statements are summarised in Table 2.

Table 2: Correct responses for knowledge statements among the respondents

No.	Questions	Correct answer	No. of correct responses, n (%)
1.	Improper drug disposal has harmful effects on the environment and ecosystem.	TRUE	326 (84.9)
2.	Wastewater treatment removes most of the medications from the environment and ecosystem.	FALSE	71 (18.5)
3.	It is acceptable to dispose solid medications (such as tablets, capsules, and patches) in the garbage.	FALSE	216 (56.3)

4.	It is acceptable to dispose liquid medications by throwing down the sink.	FALSE	164 (42.7)
5.	It is acceptable to dispose medications by flushing down the toilet.	FALSE	255 (66.4)
6.	Incineration is the environmentally sound way of disposing unwanted medications.	TRUE	55 (14.3)
7.	It is acceptable to dispose needles and syringes in the garbage.	FALSE	270 (70.3)
8.	It is acceptable to return or dispose unused medications to a local pharmacy or healthcare facility.	TRUE	322 (83.9)
9.	It is acceptable to dispose pressurised aerosol metered-dose inhalers (like the Ventolin inhaler) in the garbage.	TRUE	61 (15.9)
10.	It is acceptable to dispose creams and ointments in the garbage.	FALSE	173 (45.1)

Attitudes towards handling unused medications

The respondents' attitudes toward the handling of unused medications are presented in Table 3. The majority of respondents recognised that it was their responsibility to protect the environment (91.5%), as well as all living species on earth (89.9%), and their household members (91.4%) from the detrimental impact of unused and expired medications. When asked whether they would continue to collect prescribed medicines from pharmacies if they were free or heavily subsidised, even when they had sufficient medications at home, more than half of the respondents (66.6%) indicated they would not. Approximately three-quarters (74.5%) agreed that disposing of unused medications that are still in good condition constitutes a waste of resources. Of those who responded, 50.8% of respondents agreed or strongly agreed that unused medications should be donated to prevent waste, while 36.8% disagreed or strongly disagreed. Additionally, 286 respondents (74.5%) claimed that they were more willing to return unused medications to the pharmacy as a result of media campaigns and reports. Furthermore, 156 respondents (40.6%) indicated they would be more likely to return unused medications if a monetary incentive was offered, while 154 respondents (40.1%) expected a refund if they had paid for the prescribed medications.

Practices on handling of unused medications

Table 3 summarises the respondents' practices regarding the handling of unused medications. The most common reason for having unused medications was stopping medications when feeling better (45.3%). Other reasons included experiencing unwanted side effects (33.4%), the doctor changing the treatment regimen (41.7%), not feeling better after taking the medications (34.2%) and not taking the medications as directed (33.6%). The majority of respondents reported that they dispose of unused medications when the medications have expired (75.0%), when they experience unwanted side effects (34.6%), when they smell, taste, or look bad (73.1%) or when they are improperly stored or have turned bad (67.8%).

Table 3: Responses for the attitudes and practices section regarding the handling of unused medications (n=384)

Section	Frequency, n (%)				
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Attitudes					
1. It is my responsibility to protect the environment even if others are unconcerned or irresponsible.	6 (1.6%)	10 (2.6%)	17 (4.4%)	221 (57.6%)	130 (33.9%)
2. It is my responsibility to ensure the safety of other living species on earth.	6 (1.6%)	7 (1.8%)	26 (6.8%)	220 (57.3%)	125 (32.6%)
3. It is my responsibility to protect my household members from unintended harmful exposure to unused medications.	3 (0.8%)	9 (2.3%)	21 (5.5%)	195 (50.8%)	156 (40.6%)
4. If medications are free or heavily subsidised by the government, I will collect all the prescribed medications even if I have sufficient medications at home.	52 (13.5%)	204 (53.1%)	35 (9.1%)	78 (20.3%)	15 (3.9%)
5. Media reports and campaigns can influence my willingness to return unused medications.	5 (1.3%)	60 (15.6%)	33 (8.6%)	200 (52.1%)	86 (22.4%)
6. I believe discarding unused medications that are still in good condition is a waste of resources.	12 (3.1%)	48 (12.5%)	38 (9.9%)	212 (55.2%)	74 (19.3%)
7. I am willing to donate my unused medications before expiry to reduce wastage.	21 (5.5%)	120 (31.3%)	48 (12.5%)	142 (37.0%)	53 (13.8%)
8. If there is monetary incentive for me to return unused medications, I am more likely to do so.	26 (6.8%)	113 (29.4%)	89 (23.2%)	126 (32.8%)	30 (7.8%)
9. If I have paid for my prescribed medications, I expect a refund when I return my unused medications.	28 (7.3%)	113 (29.4%)	89 (23.2%)	122 (31.8%)	32 (8.3%)
10. If I have excess medications, I will share my medications with others.	49 (12.8%)	180 (46.9%)	56 (14.6%)	79 (20.6%)	20 (5.2%)
Practices					
1. I have unused medications because I stop taking the medications when I feel better.	23 (6.0%)	114 (29.7%)	73 (19.0%)	155 (40.4%)	19 (4.9%)
2. I dispose my medications when the medications have expired.	10 (2.6%)	38 (9.9%)	48 (12.5%)	238 (62.0%)	50 (13.0%)
3. I have unused medications because I experience unwanted side effects.	25 (6.5%)	143 (37.2%)	88 (22.9%)	117 (30.5%)	11 (2.9%)

4.	I dispose my medications when I experience unwanted side effects.	25 (6.5%)	148 (38.5%)	78 (20.3%)	114 (29.7%)	19 (4.9%)
5.	I have unused medications because my doctor has changed my treatment.	24 (6.3%)	109 (28.4%)	91 (23.7%)	150 (39.1%)	10 (2.6%)
6.	I dispose my medications when they smell bad, taste bad, or look bad.	12 (3.1%)	40 (10.4%)	51 (13.3%)	229 (59.6%)	52 (13.5%)
7.	I have unused medications because I do not feel better as I have expected.	24 (6.3%)	127 (33.1%)	102 (26.6%)	125 (32.6%)	6 (1.6%)
8.	I dispose my medications when I have not stored them correctly and my medications turned bad.	8 (2.1%)	57 (14.8%)	59 (15.4%)	226 (58.9%)	34 (8.9%)
9.	I have unused medications because I have not taken the medications as instructed/prescribed.	31 (8.1%)	148 (38.5%)	76 (19.8%)	122 (31.8%)	7 (1.8%)
10.	I keep medications that I no longer require just in case I need them in the future.	57 (14.8%)	164 (42.7%)	53 (13.8%)	102 (26.6%)	8 (2.1%)

Correlation between knowledge, attitudes, and practices

As shown in Table 4, a weak but statistically significant positive correlation was observed between attitude-practice (rs=0.278). There was no correlation found between knowledge and attitudes (rs=-0.310), as well as knowledge and practice (rs = -0.910).

Table 4: Correlation between knowledge, attitude and practice

Variable	Correlation Coefficient (rs)	p-value
Knowledge-Attitude	-0.310	0.543
Knowledge-Practice	-0.910	0.075*
Attitude-Practice	0.278	<0.001#

*Correlation is significant at the 0.05 level (2-tailed).
#Correlation is significant at the 0.01 level (2-tailed).
Abbreviation: rs = Spearman's rank correlation coefficient

Actual disposal practices and reason of disposing unused medications

Only 34.2% of respondents reported the correct disposal methods of unused medications. Improper disposal of oral medications showed the highest rate of 41.5%, consisting of 79.8% of liquid medications and 60.2% tablets/capsules, respectively. However, 11.8% of respondents indicated the proper disposal method for inhalers and insulin compared to improper disposal methods (8.4%). This may be explained by the exchange basis policy ensuring continuity of medication supply. Among the 43.8% of respondents who responded to the reason for disposal of unused medications, the five common reasons were medications getting expired (44.6%), health improvements (44.0%), change in medication regimen (30.4%), and experiencing unpleasant adverse effects (22.6%), followed by oversupply of medications (20.8%). Table 5 summarises the actual disposal methods and reasons for disposal reported by respondents.

Table 5: Actual medicines disposal methods and reason for disposal of medicines

Disposal methods	Frequency, n (%)					
	Liquid medications	Tablets/ capsules	Ointments/ creams	Inhaler	Insulin	Total
Pouring it into the sink	128 (30.0)	7 (1.6)	3 (1.0)	0 (0.0)	5 (3.3)	143
Flushing it into the toilet	67 (15.7)	18 (4.2)	4 (1.4)	1 (0.7)	4 (2.7)	94
Throw into rubbish bin	114 (26.8)	177 (41.0)	168 (56.8)	40 (28.2)	33 (22.0)	532
Give away or donate to friends/relatives/others	18 (4.2)	31 (7.2)	33 (11.1)	8 (5.6)	9 (6.9)	99
By burning	13 (3.1)	27 (6.3)	22 (7.4)	11 (7.7)	11 (7.3)	84
Improper disposal	**340 (79.8)**	**260 (60.2)**	**230 (77.7)**	**60 (42.3)**	**62 (41.3)**	**952 (65.8)**
Return to the pharmacy	64 (15.0)	149 (34.5)	46 (15.5)	51 (35.9)	46 (30.7)	356
Dispose into biomedical waste bin	22 (5.2)	23 (5.3)	20 (6.8)	31 (21.8)	42 (28.0)	138
Proper disposal	**86 (20.2)**	**172 (39.8)**	**66 (22.3)**	**82 (57.7)**	**88 (58.7)**	**494 (34.2)**
Total Responses	426 (100)	432 (100)	296 (100)	142 (100)	150 (100)	1446 (100)

Reasons	Frequency, n (%)
Change to other drug regimens	51 (30.4)
No clear instructions on the label	23 (13.7)
The health condition is getting better	74 (44.0)
Unknown reason the medications are being prescribed	11 (6.5)
Oversupply of medications	35 (20.8)
Medications expired	75 (44.6)
Difficulty in following the instructions	17 (10.1)
Unpleasant adverse effect	38 (22.6)
Other	1 (0.6)

Factors associated with knowledge, attitudes, and practice of medication disposal

Table 6 indicated that there was no significant difference between the sociodemographic characteristics (gender, age, ethnicity, marital status, employment status, and educational level) and the respondents' knowledge scores. However, this study showed a statistically significant association between age and disposal practices ($p=0.0189$). In addition, respondents who were aware of proper medication disposal methods ($p<0.001$) or had been advised by a healthcare professional to return unused medications to the pharmacy ($p=0.002$) demonstrated significantly higher knowledge scores. On the other hand, there was no statistically significant association between respondents who were checking the expiry date of a medication before buying or using it with the knowledge score.

Table 6: The association between total sociodemographic characteristics and respondents with knowledge, attitudes, and practice of handling unused medication

Variables	Knowledge		p-value	Attitude		p-value	Practice		p-value
	Poor	Good		Poor	Good		Poor	Good	
Age (years)			0.09[9]			0.659[a]			**0.0189[a]**
18 to 29	40 (63.5)	23 (36.5)		52 (83.9)	10 (16.1)		61 (98.4)	1 (1.6)	
30 to 49	93 (65.5)	49 (34.5)		113 (79.0)	30 (21.0)		141 (98.6)	2 (1.4)	
⩾50	97 (54.2)	82 (45.8)		147 (82.1)	32 (17.9)		166 (92.7)	13 (7.3)	
Gender			0.826[a]			0.361[a]			0.812[a]
Male	93 (59.2)	64 (40.8)		131 (83.4)	26 (16.6)		150 (95.5)	7 45.0)	
Female	137 (60.4)	90 (39.6)		181 (79.7)	46 (20.3)		218 (96.0)	9 (4.0)	
Marital status			0.143[a]			0.505[a]			0.799[a]
Single	58 (66.7)	29 (33.3)		72 (83.7)	14 16.3)		82 (95.3)	4 (4.7)	
Married	172 (57.9)	125 (42.1)		240 (80.5)	58 (19.5)		286 (96.0)	12 (4.0)	
Ethnicity			0.431[a]			0.761[a]			0.812[a]
Malay	210 (59.3)	144 (40.7)		287 (81.1)	67 (18.9)		339 (95.8)	15 (4.2)	
Non-Malay	20 (66.7)	10 (33.3)		25 (83.3)	5 (16.7)		29 (96.7)	1 (3.3)	
Working status			0.589[a]			0.122[a]			0.324[a]
Working	125 (58.7)	88 (41.3)		168 (78.5)	46 (21.5)		207 (96.7)	7 (3.3)	
Not working	105 (61.4)	66 (38.6)		144 (84.7)	26 (15.3)		161 (94.7)	9 (5.3)	
Level of education			0.054[b]			0.661[b]			0.197[b]
No	3 (75.0)	1 (25.0)		3 (75.0)	1 (25.0)		3 (75.0)	1 (25.0)	
Primary	8 (81.8)	2 (18.2)		10 (90.9)	1 (9.1)		11 (100.0)	0 (0.0)	
Secondary	140 (63.6)	80 (36.4)		180 (82.2)	39 (17.8)		212 (96.8)	7 (3.2)	
Tertiary	78 (52.3)	71 (47.7)		119 (79.3)	31 (20.7)		142 (94.7)	8 (5.3)	
Aware of the proper disposal of medications			**<0.001[a]**			**0.047[a]**			0.630[a]
Yes	124 (52.1)	114 (47.9)		186 (78.2)	52 (21.8)		229 (96.2)	9 (3.8)	
No	106 (72.6)	40 (27.4)		126 (86.3)	20 (13.7)		139 (95.2)	7 (4.8)	

Advised by a healthcare professional to return unused medications to the pharmacy			**0.002[a]**			0.060[a]			0.448[a]
Yes	123 (53.5)	107 (46.5)		179 (78.2)	50 (21.8)		218 (95.2)	11 (4.8)	
No	107 (69.5)	47 (30.5)		133 (85.8)	22 (14.2)		150 (96.8)	5 (3.2)	
Check the expiry date before purchasing or consuming the medications			0.549[a]			0.527[a]			0.428[a]
Yes	208 (59.4)	142 (40.6)		283 (80.9)	67 (19.1)		336 (96.0)	14 (4.0)	
No	22 (64.7)	12 (35.3)		29 (85.3)	5 (14.7)		32 (94.1)	2 (5.9)	

[a]Chi-Square test
[b]Fisher's Exact test
p<0.05 indicates a significant difference.

Discussion

Medication is essential for disease prevention, illness treatment, and symptom relief. However, how the medication is handled is equally crucial because improper disposal can have harmful impacts on the environment and human health. In our study, outpatients had an overall low knowledge about how to properly dispose of unused medication. Jha et al. (2018) reported similar results, where 65.2% of households in Nepal lacked awareness of proper handling of their medications. This points out the need for improved education and awareness regarding the proper handling of unused medications (17).

In this study, the majority of respondents were aware that improper handling of unused medication could harm the environment. Nevertheless, a large number of respondents believed that pouring medications down the sink or flushing them down the toilet was acceptable and more than half of the respondents reported disposing of liquid medications through these methods. In contrast to what many respondents may have believed, wastewater treatment does not eliminate drugs from the environment. Pharmaceuticals are rarely eliminated from the wastewater systems even with advanced treatment technology, (18). As these medications get into the water systems and eventually contaminate groundwater, rivers, and lakes, they pose serious environmental risks. Human health and aquatic life might be impacted greatly as a result of such contamination.

In our findings, there was a statistically significant but weak correlation between attitude and practice. This suggested that respondents with positive attitudes tend to demonstrate better practices in handling unused medications. Respondents who were aware of the harmful effects of improper disposal of unused medications on the environment, as well as the risk of accidental ingestion by young children, were more likely to comply with the proper disposal method, such as returning unused medications to the pharmacy. However, there was no significant relationship between knowledge and attitudes or practices regarding the correct disposal of medications, indicating that good knowledge among respondents does not necessarily show a more positive attitude or proper disposal practice.

Discarding medications in the trash was the most common disposal method for tablets, capsules, and ointments. Similar findings were observed in other studies conducted in Malaysia (19-21). The popularity of this method may be due to its convenience, but it remains an improper disposal method. Undoubtedly, medication waste disposal contributes to the increasing volume of solid waste in landfills, which is the way most waste is managed in Malaysia. In addition to potential health risks such as drug abuse, toxicity, and even death, this practice may pollute the environment (22). Thus, specialised incineration is the recommended disposal method of solid and liquid medication (16).

Only a minority of respondents returned unused medications to pharmacies or healthcare facilities, even though most of them were aware of this option. The finding is consistent with a study

carried out in a tertiary care hospital, where only 6% of respondents returned unused medications to the pharmacy (23). Intending to reduce medication waste, the Malaysian Ministry of Health (MOH) launched the Medicine Return Programme (MRP) in 2010 and the Patient's Own Medicines campaign in 2016. A recent study carried out in Sabah found that only half of the respondents were aware of the MRP, suggesting that awareness and utilisation rates remain low despite these initiatives (19).

Globally, with successful examples in developed nations like the USA, UK, and Australia, community-oriented “take-back” programs, which allow patients to return unused medications to pharmacies, are considered the safest and most environmentally friendly disposal method (24). In Sweden, 85% of the population supports a formal program that has been in place since 1971 regarding the return of unused medications to pharmacies for safe disposal and incineration (25). Nonetheless, not all patients can easily access or take part in these programs. In Malaysia, raising awareness among the public as well as making take-back programs easily accessible are strategies to improve medication disposal practice. Since there is a lack of clear instructions for individuals on how to safely handling of unwanted medications at home, thus, national and international standards governing the safe handling of medical waste are primarily applicable at the organisational level (26-28). Some organisations recommend using alternative disposal methods, such as mixing medications with coffee grounds or cat litter before throwing them in the trash, to prevent misuse. Nevertheless, these approaches may not fully address the broader environmental concern related to medication disposal (16).

From our study, older age was associated with better medicines disposal practice. A more frequent visit to health facility due to chronic disease increased the exposure to healthcare information and also experience (11). Besides, more than half of the respondents stated that they had been given information about the return of unused medications to the pharmacy and were more inclined to participate in the medication return activities due to the campaign disseminated through the mass media and reports. Thus, healthcare professionals play an important role in raising awareness, especially through initiatives such as the "Know Your Medicines" campaign, encouraging patients to return unused medications for proper disposal. This information can be disseminated through the ‘‘Know Your Medicine’’ programme at school and university levels as an early exposure to the community. Besides that, a standard medication disposal guideline should be developed by the relevant authorities (29) and medication disposal infographics should be disseminated to the public.

During the medication dispensing and counselling process, pharmacists can play a vital role in educating patients about appropriate medicines disposal methods. A brief education on stock management, such as First Expired, First Out (FEFO) should be provided as the majority of the respondents reported checking the expiration date before consuming and disposing when the medications have expired. In addition, more designated bins for the safe disposal of medications should be made available. Collaboration between government and the private sector needs to be strengthened where efforts to promote awareness should be enhanced. These efforts are key to reducing environmental pollution as well as the related expenses of healthcare and environmental management depend on these initiatives.

Apart from that, an integrated computerised system throughout the health facility is recommended as a patient confidentiality-protected system with only authorised personnel who can access the medication profile while patients visit different health facilities to seek medical advice. This is where the risk of duplicated prescriptions could be reduced which may lead to an oversupply of medications and thus reduce the cost of unused medication disposal.

There are several limitations in this study. First, self-reports were the method for data collection, which might lead to inaccurate and biased recall. In addition, the time frame for respondents’ disposal practice was not specified, which may lead to different interpretations. Apart from that, certain disposal methods practiced by respondents, such as burying tablets in the soil, were not included in the limited choice of responses, which may not capture the actual disposal practice among respondents. Additionally, eye drops and ear drops were not included in this study. A proper handling of eye and ear drops was crucial since the shelf life of these topical medications only lasts for 28 days after opening, regardless of their expiry date, which will lead to the need for proper disposal. Therefore, it is crucial that studies related to how to properly dispose of eye and ear medications can be conducted in the

future. Despite those limitations, this study provides valuable information regarding knowledge and medication handling practices among outpatients at Perlis Hospital. To ensure the safe and environmentally responsible management of unused medications, this study points out the importance of increasing public awareness regarding the proper handling of unused medications.

Conclusion

This study found that the knowledge, attitudes, and practices on handling unused medications among outpatients were suboptimal. To address these gaps, continuous public education initiatives such as mass media campaigns and targeted pharmacy counselling are essential. Furthermore, implementing integrated computerised prescription management systems could potentially minimise medication over-dispensing and waste at the source, ultimately protecting the environment. Future research should evaluate medication handling practices among caregivers of paediatric patients, particularly concerning liquid dosage forms, which pose distinct risks of environmental contamination, accidental ingestion, and toxicity.

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Conflict of Interest

The authors declare that they have no conflicts of interest and they did not receive any financial support or funding that is relevant to this study.

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