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A Cross-Sectional Study on Knowledge, Attitude and Practice towards Return and Disposal of Unused Medications among General Public in Sibu

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ABSTRACT

Introduction: Inappropriate disposal of unused medications can have negative consequences on the environment and public health. There is a concern that the general public may dispose of unused medications inappropriately due to convenience and lack of pertinent knowledge. This study aimed to determine the knowledge, attitude, and practice of the general public toward the return and disposal of unused medications.

Methods: A cross-sectional study was conducted from August to December 2019. Convenience sampling was employed and 500 respondents among the general public in Sibu were recruited. A validated questionnaire on knowledge, attitude, and practice toward the return and disposal of unused medications was used to collect responses.

Results: The majority of respondents showed positive attitudes and practices on the return and disposal of unused medications. In terms of knowledge, a mean knowledge score of 5.43 out of 10.0 was observed. A vast majority of respondents acknowledge that inappropriate disposal of unused medication may harm the environment (92.0%). However, only about one-fifth know that incineration is a recommended method (18.8%). Nevertheless, most respondents perceived that unused medications should be returned to pharmacies (81.6%). There is a statistically significant positive relationship between respondents' education level and knowledge of appropriate disposal (P=0.002).

Conclusion: Pharmacists play an integral role in creating public awareness of safe medication disposal practices, with the hope that the resultant improved knowledge translates to the desired practice. Therefore, every opportunity of patient interaction should be utilised to highlight the importance of returning unused medication and safe medication disposal methods.

Keywords: Medication return, medication disposal, unused medications, knowledge, education level

INTRODUCTION

Inappropriate or excessive drug disposal is a global issue, contributed by an increase in the usage of pharmaceuticals due to escalating prevalence of non-communicable diseases. In particular, medication non-adherence is a major factor that results in unused medications at home (1). It was found that patients stopped taking their medications at home due to concerns about the potential side effects, feeling healthy due to a lack of symptoms, hectic work schedule, and change in dose, or regimen (2,3). Therefore, it is common that most families or patients have unused or expired medications at home.

Unused or expired medications in excess pose threats to public health. Accidental ingestion of expired medications, the resultant economic and environmental impact have gained attention around the world (4). In Malaysia, nearly RM 2 million worth of medications were disposed due to being expired or spoilt in 2016 (5). However, Malaysia is not alone in this issue. For instance, in Alberta, Canada, throughout a medication disposal programme that was carried out over 8 years from 1988 to 1996, more than 204 tons of expired or unused medications have been collected (6). In England, approximately 37.6 million pounds worth of medications were discarded every year through the disposal programmes carried out by community pharmacies (7). In the United States, the potential for drug disposal or wastage is immense as there is a huge increase in pharmaceutical consumption over the years, evidenced by an increment in prescriptions sold and pharmaceutical sales (8). Furthermore, a cross-sectional study showed that people more than 65 years old in the United States contributed over 1 billion dollars in drug wastage or disposal, accounting for 2.3 % of total drug costs (9).

Apart from the economic impact, environmental impact is another worry. Unused, unwanted or expired medications are disposed through many ways, most comeither being thrown into the sink, toilet or garbage or returned to the pharmacy for proper disposal (10,11). There were many different studies conducted in the past focusing on the disposal practices of unused or unwanted medications. Most of these studies revealed that common methods for household drug disposal were by discarding as garbage (24.0% to 89.0%) or rinsing down a toilet or sink (2.0% to 55.0%), meanwhile solid dosage forms were more likely to be discarded as rubbish whereas liquid dosage forms were more likely to be poured into drainage (12,13). Apart from these, incineration is also

used to dispose unused medications (12,13). In the United States, a lot of medications have been found in minute amounts in groundwater, water surface, and drinking water (14). The existence of certain medications, such as NSAIDs, antihypertensive and antibiotics in water is dangerous as the water treatment systems in the United States could not remove most pharmaceuticals from drinking water (15,16). Although minute concentrations of medications are unlikely to bring any harm, but in the long run, toxic effects may occur (17,18). Antibiotic resistance may occur if the drinking water contains trace amounts of antibiotics, and some antibiotics present in waterways could affect the indigenous bacteria population as well (19). In one study, trace amounts of ethinyl estradiol found in waterways was found to lead to impairment in sexual development and enhancing the feminisation of fish (20).

This study aimed to determine the knowledge, attitude and practice of the general public in Sibu, Sarawak towards the return and disposal of unused medications.

METHODS

Study Design

A cross-sectional study using a validated questionnaire was conducted from August to December 2019 among the general public in Sibu. The target population were those participating in Quality Use of Medicine-Consumer (QUMC) events, such as the World Pharmacist Day Carnival held at Sing Kwong Emporium, *Program Duta Prihatin Masyarakat* and Health Screening Campaign in Sacred Heart Hall (SK St. Rita) as well as patients attending Outpatient Clinics in Sibu Hospital. Respondents were eligible to be included if they: 1) were above 18 years old; 2) handle their medications on their own; 3) were able to read or understand Malay, English or Mandarin. Those who did not meet any of these inclusion criteria were excluded from this study. Ethical approval to conduct the study was provided by the Medical Research & Ethics Committee (MREC), Malaysia (NMRR-19-1625-48926).

Sample Size and Sampling Method

Sample size of this study was determined by using the Krejcie and Morgan Formula (21). It was calculated that a minimum of 384 respondents are required to get a 95.0% level of confidence with 5.0% margin of error, assuming an expected prevalence value of 0.5 as actual prevalence is

unknown. Accounting that 20.0% responses may have to be discarded due to incomplete answers, a sample size of 500 was needed for the study. In terms of sampling method, convenience sampling was employed.

Questionnaire

Data on the knowledge, attitude, and practice toward the return and disposal of unused medications were collected using a existing validated questionnaire (22). Permission to use the questionnaire has been obtained from the author team through email. The questionnaire consists of four parts. The first part was the respondent's demographic including gender, age, education level, and ethnicity. The second part was on the knowledge towards the return and disposal of unused medications which consists of 10 questions, with each item having 'True', 'False', and 'Do not know' as choices (Table 2); Statements 1, 6, 8, and 9 are correct. The third part was on the attitude towards the return and disposal of unused medications which consists of 10 questions with a 5-point Likert-type scales response, in which '1' represents strongly disagree and '5' represents strongly agree (Table 3). Statement 7 and 10 were reverse scored. The fourth part was on the practice towards return and disposal of unused medications which consists of 10 questions, with a 5-point Likert-type scales response (Table 4). Statement 1, 7, and 9 were reverse scored.

The orginal questionnaire was available in English. It was translated into Mandarin and Malay by a teacher. A pilot study was conducted whereby the three sets of questionnaires (respectively in English, Mandarin and Malay) were distributed to trilingual patients, in order to assess the validity of the questionnaire in our settings. Based on the results of pilot study, 48 (96.0%) out of 50 respondents submitted the same answers for the three sets of questionnaires.

Statistical Analysis

The collected data were entered into the Statistical Package for Social Sciences Program (SPSS, version 22). Descriptive and inferential analysis were conducted. In order to simplify the analysis, the categories of education level were simplified or reduced into two groups, in which 'no formal education', 'primary school', 'secondary school' were classified as 'low education level' and 'STPM/ Foundation/ Diploma/ Matriculation/A-Level', 'Bachelor degree and above' as 'high education level'. To make the descriptive analysis easier, the five point response options of the

Likert-type scale were reduced into three groups, in which 'strongly agree' or 'agree' were classified as 'agree', and 'strongly disagree' or 'disagree' as 'disagree'. For the knowledge section, the answer scheme was provided by the author of the original article. Respondents were given 1 point for each statement that were answered correctly. The mean knowledge score was then used to analyse its relationship with sociodemographic characteristics. Throughout the data analysis, several tests were used, for instance Spearman's rank-order correlation, Independent *t* test, and Kruskal-Wallis test.

RESULTS

Demographics

Table 1: Demographic data

Variable	n (%)	Median (IQR)
Age	-	35 (17.00)
Gender		
Male	194 (39.0)	-
Female	306 (61.0)	-
Ethnic		
Malay	68 (13.0)	-
Chinese	304 (61.0)	-
Iban	95 (19.0)	-
Others	33 (7.0)	-
Education		
No formal education	2 (1.0)	-
Primary school	25 (5.0)	-
Secondary school	141 (28.0)	-
STPM/ Foundation/ Diploma/ Matriculation/ A-Level	172 (34.0)	-
Bachelor degree and above	160 (32.0)	-

A total of 500 respondents were included in the study. A majority of the respondents were female (n=306, 61.0%), and the median age of respondents was 35 years old. Most of the respondents in the study were Chinese (n=304, 61.0%), followed by Iban (n=95, 19.0%), Malay (n=68, 13.0%) and other ethnicities (n=33, 7.0%). About two thirds of the respondents has high education level (n=332, 66.0%). The demographic data is illustrated in Table 1.

Knowledge on Drug Disposal

Table 2: Knowledge on drug disposal

No	Items	n (%)		
		Correct	**Incorrect**	**Do not know**
1	Improper drug disposal has harmful effects on the environment and ecosystem.	**460 (92.0)**	13 (2.6)	27 (5.4)
2	Wastewater treatment removes most of the medicines from the environment and ecosystem.	187 (37.4)	**189 (37.8)**	124 (24.8)
3	It is acceptable to dispose solid medicines (such as tablets, capsules, and patches) in the garbage.	237 (47.4)	**224 (44.8)**	39 (7.8)
4	It is acceptable to dispose liquid medicines by throwing down the sink.	141 (28.2)	**318 (63.6)**	41 (8.2)
5	It is acceptable to dispose medicines by flushing down the toilet.	79 (15.8)	**371 (74.2)**	50 (10.0)
6	Incineration is the environmentally sound way of disposing unwanted medicines.	**94 (18.8)**	351 (70.2)	55 (11.0)
7	It is acceptable to dispose needles and syringes in the garbage.	115 (23.0)	**371 (74.2)**	14 (2.8)
8	It is acceptable to return or dispose unused medicines to a local pharmacy or health care facility.	**408 (81.6)**	44 (8.8)	48 (9.6)
9	It is acceptable to dispose pressurized aerosol metered-dose inhalers (like the Ventolin inhaler) in the garbage.	**131 (26.2)**	240 (48.0)	129 (25.8)
10	It is acceptable to dispose creams and ointments in the garbage.	303 (60.6)	**147 (29.4)**	50 (10.0)

**Correct answers are bolded*

Knowledge score was centrally distributed with a mean score of 5.43 out of 10.0 (SD 1.73). The majority of respondents knew that improper drug disposal has harmful effects on the environment and ecosystem (92.0%). Most of the respondents also agreed that "It is acceptable to return or dispose unused medicines to a local pharmacy or health care facility" (81.6%). However, almost three-fourth did not know that "Incineration is the environmentally sound way of disposing unwanted medicines" (70.2%). It was also noticed that quite a number of respondents answered "do not know" for statement 2 (24.8%) and 9 (25.8%). This correlates with the high difficulty level ascribed to the 2 items by authors who developed the questionnaire.

Attitude on Drug Disposal

Table 3: Attitude on drug disposal

No	Statement	n (%)				
		Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1	It is my responsibility to protect the environment even if others are unconcerned or irresponsible.	4 (0.8)	9 (1.8)	13 (2.6)	241 (48.2)	233 (46.6)
2	It is my responsibility to ensure the safety of other living species on earth.	6 (1.2)	0 (0.0)	39 (7.8)	237(47.4)	218 (43.6)
3	It is my responsibility to protect my household members from unintended harmful exposure to unused medicines.	6 (1.2)	0 (0.0)	22 (4.4)	184 (36.8)	288 (57.6)
4	If medicines are free or heavily subsidized by the government, I will not collect all the prescribed medicines as I have sufficient medicines at home.	8 (1.6)	34 (6.8)	118 (23.6)	212 (42.4)	128 (25.6)
5	Media reports and campaigns can influence my willingness to return unused medicines.	16 (3.2)	42 (8.4)	138 (27.6)	222 (44.4)	82 (16.4)
6	I believe discarding unused medicines that are still in good condition is a waste of resources.	17 (3.4)	29 (5.8)	68 (13.6)	213 (42.6)	173 (34.6)
7	I am willing to donate my unused medicines before expiry to reduce wastage.	40 (8.0)	59 (11.8)	51 (10.2)	193 (38.6)	157 (31.4)

Table 3: *Continued*

No	Statement	n (%)				
		Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
8	If there is monetary incentive for me to return unused medicines, I am more likely to do so.	53 (10.6)	51 (10.2)	138 (27.6)	147 (29.4)	111 (22.2)
9	If I have paid for my prescribed medicines, I expect a refund when I return my unused medicines.	55 (11.0)	132 (26.4)	157 (31.4)	105 (21.0)	51 (10.2)
10	If I have excess medicines, I will share my medicines with others.	71 (14.2)	125 (25.0)	60 (12.0)	176 (35.2)	68 (13.6)

** Items 7 and 10 were reversed scored*

The majority of respondents acknowledged that it was their responsibility to protect the environment and to protect their household members from unintended harmful exposure to unused medications (94.8%) (Table 3, items 1, 2, 3, and 4). More than half agreed that media reports and campaigns would influence their willingness to return unused medications (60.8%). (Table 3, item 5). Discarding unused medications was deemed wasteful by 77.2% of respondents (Table 3, item 6). Although 70.0% of respondents were willing to donate their non-expired, unused medications to reduce waste (Table 3, item 7), 51.6% agreed that their willingness to return unused medications was influenced by whether there was any monetary incentive for doing so (Table 3, item 8). Additionally, if they paid for their medications, 31.2% expected a refund when returning medications, while 31.4% were neutral (Table 3, item 9). Almost half of the respondents thought that sharing their unused medications was fine (48.8%) (Table 3, item 10).

Practice on Drug Disposal

More than half of the respondents had unused medications because they stopped taking them when they felt better (60.4%) (Table 4, item 1). Meanwhile around half experienced side effects (43.6%) (Table 4, item 3), had medications that were no longer needed (38.8%) (Table 4, item 5), did not

take the medications as instructed/prescribed (44.2%) (Table 4, item 9), or having them in stock just in case they are needed in the future (67.2%) (Table 4, item 10). Additionally, most respondents admitted that they threw away their expired medications (81.8%) (Table 4, item 2) when they experienced unwanted side effects (59.4%) (Table 4, item 4), when medications smelt bad, tasted bad, or looked bad (81.0%) (Table 4, item 6), or when medications were not stored correctly (83.4%) (Table 4, item 8).

Table 4: Practice on drug disposal

No	Statement	n (%)				
		Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
1	I have unused medicines because I stop taking the medicines when I feel better.	32 (6.4)	80 (16.0)	86 (17.2)	196 (39.2)	106 (21.2)
2	I dispose my medicines when the medicines have expired.	10 (2.0)	23 (4.6)	58 (11.6)	311 (62.2)	98 (19.6)
3	I have unused medicines because I experience unwanted side effects.	13 (2.6)	78 (15.6)	191(38.2)	174 (34.8)	44 (8.8)
4	I dispose my medicines when I experience unwanted side effects.	38 (7.6)	66 (13.2)	99 (19.8)	235 (47.0)	62 (12.4)
5	I have unused medicines because my doctor has changed my treatment.	42 (8.4)	94 (18.8)	170 (34.0)	156 (31.2)	38 (7.6)
6	I dispose my medicines when they smell bad, taste bad, or look bad.	17 (3.4)	37 (7.4)	41 (8.2)	287 (57.4)	118 (23.6)
7	I have unused medicines because I do not feel better as I have expected.	16 (3.2)	74 (14.8)	154 (30.8)	212 (42.4)	44 (8.8)
8	I dispose my medicines when I have not stored them correctly and my medicines turned bad.	12 (2.4)	15 (3.0)	56 (11.2)	282 (56.4)	135 (27.0)

Table 4: *Continued*

No	Statement	n (%)				
		Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
9	I have unused medicines because I have not taken the medicines as instructed/prescribed.	41 (8.2)	120 (24.0)	118 (23.6)	176 (35.2)	45 (9.0)
10	I keep medicines that I no longer require just in case I need them in the future.	35 (7.0)	53 (10.6)	76 (15.2)	191 (38.2)	145 (29.0)

** Items 1, 7 and 9 were reversed scored*

Association between Demographic Data and Knowledge Score

Table 5: Association between demographic data and knowledge score

Variable	n	Mean (SD)/ Median (IQR)	Mean diff. (95% Cl)	*t*-statistics (*df*)[a]	*P* value [a]
Gender					
Male	194	5.58 (1.57)	0.2	1.62 (498)	0.107
Female	306	5.33 (1.81)	(-0.1, 0.6)		
Education level					
Low Education	168	5.08 (1.60)	-0.5	-3.19 (498)	0.002
High Education	332	5.60 (1.76)	(-0.8, -0.2)		
Ethnic					
Malay	68	6 (1)	-	5.18 (3)[b]	0.159[b]
Chinese	303	5 (3)			
Iban	96	6 (1)			
Others	33	7 (2.5)			

[a] Independent *t* test

[b] Kruskal-Wallis test

There was no statistically significant association between respondents' age (r = 0.031, P = 0.48; Spearman's rank-order correlation), gender nor ethnincity with the knowledge score (Table 5). However, significant association was observed between education level and knowledge score. Respondents with higher education level (STPM / Foundation / Matriculation / Diploma / A-level

/ Bachelor degree and above) were found to have better knowledge score compared to their peers with lower education level (No formal education / Primary school / Seconday school).

DISCUSSION

The study seems to indicate that the general public in Sibu is aware that inappropiate disposal of medicines can harm the environment. This is consistent with the findings of other studies, which showed that between 42.0% to 98.0% respondents felt that improper disposal of unused medications could affect the environment (23-26). Despite this, most are unaware of the appropriate way to dispose of such medications.

The majority of respondents are aware that it is not acceptable to dispose of medicines down the sink nor toilet, but remained unsure whether wastewater treatment removes most of the medicines from the environment and ecosystem. The major aim of wastewater treatment is to remove suspended solids and convert it into an effluent, which are then discharged back to the environment (27). Therefore, it is not equipped to remove chemicals from the sewage; eventually the pharmaceutical wastes will still be released into marine ecosystem and undergo the same cycle (28). It must be acknowledge that attempts to isolate hazardous pharmaceutical components significantly increase overall wastewater treatment cost (29).

A study in the United Kingdom that assessed the knowledge of asthmatic patients on metered dose inhalers disposal revealed that a vast majority them have very high knowledge on the matter (92.3%) (30). In comparison, this study assessed the knowledge among the general public on the knowledge on the disposal of medications generally. This may explain the disparities in the findings between both studies. Although there are no guidelines regarding the disposal of used pressurised metered-dose inhalers, all manufacturers stated that canisters should not be burnt or punctured, even when empty. This shows that public education campaigns may be needed for general public in Sibu, Sarawak or even nationwide to further improve public knowledge on safe methods of disposal for unused medications, and not just on used metered-dose inhalers which could modify their behavior with regards to the proper disposal methods.

Incineration is the best way to dispose of medicines, as outlined by guidelines prepared by the

United States Food and Drug Administration (FDA) and the World Health Organisation (WHO) (31,32). However, only a minority of respondents were aware of this (18.8%). Therefore, it is important to educate the public on proper drug disposal so that they know where and how they can dispose of their unused medications. Healthcare providers particularly pharmacists are literally better equipped to educate the public and create adequate awareness for proper storage and safe disposal of unwanted or unused and expired medicine (33). Safe disposal instructions should be provided by all healthcare providers in routine patient education. Public education regarding unused medication disposal is needed and healthcare workers should give advice to patients on how to dispose of unwanted medications and the impact of improper disposal (34). Pharmaceutical manufacturers may enclose a patient information leaflet with the details on disposal instructions. The same should be strictly followed by the patients or health consumers. Pharmacists are then obligated to counsel patients before they leave the pharmacy counters, on not only the use of medicines but also the proper disposal methods.

In 2010, the Pharmaceutical Services Division, Ministry of Health Malaysia implemented the "Return Your Medicines Program," where patients can return their unused or excess medicines to the pharmacy for safe disposal (35). In our study, the majority of the respondents felt that it was acceptable to return unused medications to pharmacies (81.6%). This indicates that a formal return policy can help to increase awareness and practice of safe methods of disposal of unused medications. Unfortunately, a significant proportion of them also felt that it was acceptable to dispose of solid medications in the garbage (47.4%). A study conducted in Nigeria suggested that basic education on appropriate disposal methods of medication is needed, as unused medications are not returned to the pharmacies for appropriate disposal as in developed countries (36). Education to inculcate awareness will play a pivotal role, as another study found that less than 20.0% of patients had been given advice regarding medication disposal by a healthcare providers, suggesting that there is a lack of patient education on proper medication disposal (2).

It was interesting to note that around half of the respondents were more likely to return medications if there were monetary incentives (51.6%). A study has shown that incentive-based medication adherence interventions can effectively promote medication adherence, increasing adherence by at least 20 percentage points (37). Thus, public campaigns which highlight the monetary cost of

unused medications, and the possibility of a small refund or discount on their next prescription if unused medications were returned, may work to encourage the return of unused medications. Unfortunately, public healthcare facilities are not in a position to provide monetary incentives for patients.

Our study found a positive association between education level and knowledge of correct drug disposal management. This is consistent with the findings of another study (38). Hence, there may be a need to make drug disposal education easier to be understood by the masses. Information on hazardous household materials and medication disposal shall then be disseminated to the public through national awareness campaigns to promote appropriate disposal behaviour among the general public. Positive attitudes towards correct disposal of medical wastes can be capitalised by making it easier to properly dispose of unused medication, for example by setting up more unused medication collection centres. Patients with enhanced knowledge on proper drug disposal and easy access to means of drug disposal, will more likely have positive practice and attitude towards proper disposal of medicines.

There were several limitations in the study. Despite having a validated questionnaire, there was a need for translation in view of language literacy in Sibu community. However, all translated versions were not back-translated to ensure the validity of translated questionnaires. In retrospect, the term “unused medication” was not defined properly in the questionnaire; the intention was to investigate disposal of medicines for chronic illnesses, but may be misunderstood as referring to medicines for acute symptomatic relief.

As respondents were not guided when they were answering the questionniare, misconception on the actual meaning of the items in the questions may occur. Some respondents might not read through the questionnaire properly before answering, as they may be distracted by the surrounding environment. The ethinicity profile in this study reflects the actual composition of Sibu population, where Chinese comprised the largest percentage (52.1%) (39). However, it may not be generalisable to the other populations in Malaysia or other countries.

Pharmacists can provide necessary advice and education to the general public on the handling of excess or unused medications during the dispensing sessions. Education pamphlets regarding proper excess or unused medications disposal can be given during Quality Use of Medicine Campaign (QUMC) events organised by the Pharmaceutical Services Division. Home medication reviews also provide opportunities to assist patients on the management of their medications, especially on the storage and disposal.

CONCLUSION

Our research revealed that knowledge level is important in order to project an appropriate attitude and practice toward drug disposal. Even though most of our respondents were aware of the bad effects of inappropriate disposal of unused medications, they did not know which disposal methods are considered appropriate. Therefore, healthcare providers particularly pharmacists should proactively educate the public on medication returns and create adequate awareness for proper storage and safe disposal of unwanted or unused and expired medications.

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REFERENCES

1. World Health Organization. The world medicines situation. Geneva: World Health Organization; 2004
2. Seehusen DA, Edwards J. Patient practices and beliefs concerning disposal of medications. J Am Board Fam Med. 2006 Nov;19(6):542-7.
3. Ruhoy IS, Daughton CG. Beyond the medicine cabinet: An analysis of where and why medications accumulate. Environment International. 2008 Nov 1;34(8):1157-69.
4. Ananth AP, Prashanthini V, Visvanathan C. Healthcare waste management in Asia. Waste Management. 2010 Jan;30(1):154-61.
5. Ministry destroys RM2mil worth of expired meds – Nation. The Star Online. Thestar.com.my [Internet] 2016 [cited 10 April 2019]. Available from: https://www.thestar.com.my/news/nation/2016/12/27/ministry-destroys-rm2mil-worth-

of-expired-meds/#PjB0iYOfilET1fyM.99

6. Cameron S. Study by Alberta pharmacists indicates drug wastage a "mammoth" problem. CMAJ: Canadian Medical Association journal. 1996;155(11):1596.
7. Huge waste of medicines claimed (editorial). Pharmaceut J. 2000; 264:238.
8. U.S. Census Bureau. economic census. [Internet] 2007 [cited October 9 2009]. Available from: www.census.gov/ econ/census07
9. Morgan TM. The economic impact of wasted prescription medication in an outpatient population of older adults. Journal of Family Practice. 2001;50(9):779-81.
10. Kuspis DA, Krenzelok EP. What happens to expired medications? A survey of community medication disposal. Veterinary and human toxicology. 1996;38(1):48-9.
11. Boehringer SK. What's the best way to dispose of medications. Pharmacist's Letter. 2004;20(200415).
12. Gupta D, Gupta A, Ansari NA, Ahmed QS. Patient's opinion and practice toward unused medication disposal: A qualitative study. J Pharm Sci Innov. 2013;2:47-50.
13. Arkaravichien W, Ruchipiyarak T, Thawinwan W, Benjawilaikul S. A Threat to the Environment from Practice of Drug Disposal in Thailand. Environment Asia. 2014;7(1).
14. Smith CA. Managing pharmaceutical waste. Journal of the Pharmacy Society of Wisconsin. 2002;5:17-22.
15. Stackelberg PE, Furlong ET, Meyer MT, Zaugg SD, Henderson AK, Reissman DB. Persistence of pharmaceutical compounds and other organic wastewater contaminants in a conventional drinking-water-treatment plant. Science of the total environment. 2004;329(1-3):99-113.
16. Borgmann U, Bennie DT, Ball AL, Palabrica V. Effect of a mixture of seven pharmaceuticals on Hyalella azteca over multiple generations. Chemosphere. 2007;66(7):1278-83.
17. Heberer T. Occurrence, fate, and removal of pharmaceutical residues in the aquatic environment: a review of recent research data. Toxicology letters. 2002;131(1-2):5-17.
18. Woodhouse B. Pharmaceuticals and other wastewater products in our waters: a new can of worms. Southwest Hydrology. 2003;30:12-3.
19. Costanzo SD, Murby J, Bates J. Ecosystem response to antibiotics entering the aquatic environment. Marine pollution bulletin. 2005;51(1-4):218-23.

20. Jobling S, Williams R, Johnson A, Taylor A, Gross-Sorokin M, Nolan M, et al. Predicted exposures to steroid estrogens in UK rivers correlate with widespread sexual disruption in wild fish populations. Environmental health perspectives. 2005;114(Suppl 1):32-9.
21. Krejcie RV, Morgan DW. Determining sample size for research activities. Educational and Psychological Measurement. 1970;30:607-610.
22. Sim SM, Lai PSM, Tan KM, Lee HG, Sulaiman CZ. Development and Validation of the Return and Disposal of Unused Medications Questionnaire (ReDiUM) in Malaysia. Asia Pacific Journal of Public Health. 2018;30(8):737-749
23. Bashaar, M., Thawani, V., Hassali, M. A., & Saleem, F. Disposal practices of unused and expired pharmaceuticals among general public in Kabul. BMC public health. 2017;17(1):45.
24. Abahussain EA, Waheedi M, Koshy S. Practice, awareness and opinion of pharmacists toward disposal of unwanted medications in Kuwait. Saudi Pharm J. 2012;20:195-201.
25. Aditya S, Rattan A. Minimizing pharmaceutical waste: the role of the pharmacist. J Young Pharm. 2014;6:14-19.
26. Persson M, Sabelstrom E, Gunnarsson B, Handling of unused prescription drugs knowledge, behaviour and attitude among Swedish people. Environ Int. 2009;35:771-774.
27. Wastewater Treatment Water Use [Internet]. Usgs.gov. [cited 1 June 2020]. Available from: https://www.usgs.gov/special-topic/water-science-school/science/wastewater-treatment-water-use?qt-science_center_objects=0#qt-science_center_objects
28. Keeping Drugs Out of Our Waterways: Safe Drug Disposal Program [Internet]. Clean Water Action. [cited 14 June 2020]. Available from: https://www.cleanwateraction.org/features/keeping-drugs-out-our-waterways-safe-drug-disposal-program
29. Pal P. Treatment and disposal of pharmaceutical wastewater: toward the sustainable strategy. Separation & Purification Reviews. 2018;47(3):179-98.
30. Hassan WU, Henderson AF, Keaney NP. Disposal of used metered dose inhalers. BMJ. 1992;305:479.
31. World Health Organization. International Pharmaceutical Association. International Solid Waste Association. UNICEF. Guidelines for Safe Disposal of Unwanted Pharmaceuticals in and after Emergencies. World Health Organization; Geneva, Switzerland: 1999.

32. Food Drug and Administration Where and How to Dispose of Unused Medicines. [Internet] 2017 [cited 8 January 2019] Available from: https://www.fda.gov/drugs/safe-disposal-medicines/disposal-unused-medicines-what-you-should-know#Medicines_recommended.
33. Sivasankaran P, Elmutaz BM, Ganesan N, Durai R. Storage and Safe Disposal of Unwanted/Unused and Expired Medicines: A Descriptive Cross-Sectional Survey among Indian Rural Population. Journal of Young Pharmacists. 2019;11(1):97.
34. AlAzmi A, AlHamdan H, Abualezz R, Bahadig F, Abonofal N, Osman M. Patients' knowledge and attitude toward the disposal of medications. Journal of pharmaceutics. 2017;2017.
35. Office Portal of Pharmaceutical Services Programme, Ministry of Health Malaysia. Return your medicines program. [Internet] 2013 [cited October 9 2009] Available from: https://www.pharmacy.gov.my/v2/en/content/return-yourmedicines-program.html.
36. Auta A., Omale S., Shalkur D., Abiodun A.H. Unused medicines in Nigerian households: Types and disposal practices. J. Pharmacol. Pharmacother. 2011;2:195–196.
37. Sorensen JL, Haug NA, Delucchi KL, Gruber V, Kletter E, Batki SL, et al. Voucher reinforcement improves medication adherence in HIV-positive methadone patients: a randomized trial. Drug Alcohol Depend. 2007;88:54–63.
38. Ayed A, Sayed S, Harazneh L, Fashafsheh I, Eqtait F. Knowledge and Attitude of Staff Nurses Regarding Palliative Care. International Journal of Science and Research (IJSR). 2015;4(11):1790-1794.
39. Population Distribution by Local Authority Areas and Mukims [Internet] 2010 [cited 10 November 2021]. Available from: https://web.archive.org/web/20150205090002/http://www.statistics.gov.my/portal/download_Population/files/population/03ringkasan_kawasan_PBT_Jadual1.pdf