

**ASSESSMENT OF THE KNOWLEDGE, ATTITUDE, AND PRACTICE
TOWARDS EXPIRED DRUG DISPOSAL AMONG THE COMMUNITY
IN BEIRUT CITY, LEBANON**

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Abstract

The global increase in pharmaceutical spending has led to enhanced international awareness of the unused and expired drug issues due to improper drug disposal's harmful economic, environmental, and health effects. Consequently, the study was conducted to assess the knowledge, attitude, and practice toward expired drug disposal among the community in Beirut City, Lebanon. A cross-sectional, observational, questionnaire-based study was conducted. Data were analyzed using SPSS version 23. The fact that improper disposal of expired medicine affects the environment and health was acknowledged by 70.7% of the 450 participants. Even though 72.2% of the participants knew that the best method for drug disposal was medication disposal boxes, 50.4% did not know about the use of the drug take-back system. Expired drugs were present in 71.1% of the participants' homes, and 78.9% of the participants discarded them in household garbage. In fact, 53.6% agreed that there is a lack of adequate information on the safe disposal of expired household medicines. This study revealed a lack of proper advice on the safe disposal of expired medicines. Consequently, the government should initiate feasible expired drug programs to educate the public. Improper disposal of expired drugs has a negative impact on the environment. The current study revealed that 78.9% of the participants discards expired drugs in an improper way. Accordingly, actions should be taken to save the planet.

Keywords

Attitude, practice, knowledge, medicine disposal, unused medicines, expiry drugs

1. INTRODUCTION

The U.S. Food & Drug Administration (FDA) mandated specifying expiration dates on all medicines in the late 1970s, which are predicted using stability testing under good manufacturing practices (Saroop, 2011). The expiry date is the final date that the manufacturer guarantees the full potency and safety of a medication (Basha et al., 2015).

Unfortunately, not all purchased drugs are consumed, and many drugs are expired. Patients, in most instances, get rid of these drugs in an improper manner (Ayele and Mamu, 2018). Many reasons lead to drug accumulation in households. Patients' deaths and medical condition improvements have been found as common reasons. Moreover, lack of therapeutic effect, change of treatment, hesitation about the need for the drug, poor adherence, side effects of the drug, or concern about the side effects of the drug were also correlated with the accumulation of household drugs (Ayele and Mamu, 2018).

Improper disposal of expired drugs has a negative impact on the environment and public health. It has the potential to increase antibiotic resistance, divert licit drugs for illegal purposes [3], and cause accidental child or animal poisoning due to the drug's accessibility in the trash (Glassmeyer et al., 2009). Literature confirms the presence of low levels of pharmaceuticals in ground water and surface water that are drawn into the public water supply (Ayele and Mamu, 2018). For example, between 2006 and 2007, water sources such as rivers, streams, lakes, reservoirs (artificial lakes), and groundwater that usually lead to drinking water were analysed in 19 United States water utilities. Fifty-one compounds, such as atenolol, gemfibrozil, naproxen, phenytoin, and others, were found in drinking and tap water (Benotti et al., 2009)

Nowadays, in order to allow proper drug disposal in many developed countries, drug-take-back systems are used. One type of drug-take-back program that has been suggested by "Nebraska Medication Education for Disposal Strategies (MEDS)" is to put tamper-resistant boxes in pharmacies that will allow consumers to bring drugs back to knowledgeable pharmacists (Bashaar et al., 2017). In the absence of take-back systems, household trash is the possible means for drug disposal, as recommended by the White House Office of National Drug Control Policy (ONDCP). All personal information on the prescription labels of empty pill bottles or medicine packaging should be deleted, mixed with an undesirable substance, such as coffee grounds, placed in a sealable container (like a zipper storage bag), and then thrown in the trash. The American Pharmacists Association also recommends that unwanted drugs should be crushed or dissolved in water prior to mixing with the undesirable substance in order to prevent reutilization by scavengers (Kahsay et al., 2020). The FDA recommends that expired drugs should be mixed without crushing tablets or capsules with an undesirable substance, such as dirt or used coffee grounds, and then placed in a sealable container like a zipper storage bag, and then thrown in the trash (FDA, 2011).

Regarding practices of expired drug disposal, studies showed differences in several areas. For instance, in Kenya and Nigeria, it is known that expired drugs are thrown in garbage baskets or flushed down the toilet by their consumers. In Ghana and Kabul, people keep the medications at home because they do not know what to do with them, and others share the drugs with family and friends. In the UK, USA, and some regions in the Middle East, "drug back programs" have been initiated (Ayele and Mamu, 2018). In Australia and Canada, they established the "National Return and Disposal of Unwanted Medicines" Program, which is supported by the government and pharmaceutical industries in order to facilitate the safe disposal of drugs in the community (Ayele and Mamu, 2018; Daughton, 2003). In New Zealand, the DUMP campaign (Disposal of Unwanted Medication Properly) was established to encourage the public to return unwanted or expired drugs to pharmacies. Those drugs would then be disposed of safely and properly, thus reducing the chance of accidental poisonings, overdoses, inappropriate sharing of drugs, and harm to the environment (Vellinga et al., 2014). In Sweden, they introduced a system in 1971 by the Swedish pharmacy chain Apoteket AB in order to allow the return of expired and unused drugs to the pharmacies (Abahussain et al., 2012). On the other hand, other countries do not have a protocol or official guidelines for the disposal of expired and unused drugs (Bashaar et al., 2017)

Currently, in Lebanon, there is no evaluation of public awareness regarding drug disposal, although a national policy for the safe disposal of expired drugs exists. Accordingly, this study was conducted to assess the knowledge, attitude, and practices toward expired drug disposal among the community in Beirut, Lebanon.

2. METHODOLOGY

A cross-sectional study was conducted via Google form and distributed through social media using a structured questionnaire to assess the knowledge, attitude, and practices towards the disposal of expired pharmaceuticals among the community in Beirut city, Lebanon, from January to February, 2021. Accordingly, all Beirut citizens aged 18 years and above were invited to fill out the questionnaire.

The sample size was calculated using the online Raosoft sample size calculator assuming Beirut's population to account for 1,916,100 according to the population of cities in Lebanon in 2020. Accordingly, a total of 385 participants and above would provide a representative sample with a 5% margin of error and a 95% confidence interval.

The questionnaire was taken from Ayele and Mamuel et al., 2018 with some modifications to fit the studied sample and meet the purpose of the study. The questionnaire was prepared in English and then translated into Arabic, the native language. Three experts reviewed the questionnaire for content validity, and 10 samples were collected for content clarity. Modifications were made accordingly. The questionnaire included demographic information such as age, gender, and university degree, knowledge information such as the impact of improper drug disposal on the environment and health and the best method for drug disposal as well as participant's attitude and practice regarding drug disposal. Questions were formulated as multiple-choice questions using Likert scale and dichotomous questions.

The results were analyzed using the Statistical Package for social science (SPSS) version 23 software. Descriptive statistics on sample characteristics were computed as percentage and frequency, whereas continuous data were presented as mean \pm standard deviation (SD). Reliability of the knowledge, attitude, and practice questions were tested using Cronbach's alpha that revealed values of 0.644, 0.662, and 0.643, respectively. The knowledge score was computed by adding the right answers. ANOVA followed by Tukey test was used after ensuring the normality and homogeneity of the study sample. A *p-value* of less than 0.05 was considered significant.

Personal information of the participants was totally confidential (identities of participants were not recorded). After explaining the aim of the study, participants had the choice either to participate or to abide. Consequently, the institution review board exempted the study (IRB number: 2022-H-0084-P-R-0491).

3. RESULTS

Of the 450 individuals who agreed to participate in the study, 94.2% (424) were Lebanese, 38.7% (174) were between 25-34 years old, 65.5% (295) were females, and 41.6% (187) worked in the medical field. Concerning their educational level, 90.9% (409) had a college degree and above (refer to Table 1).

Table 1: Socio-demographic characteristics of the participants

Characteristic	Frequency (%)
Age (years)	
18-24	155 (34.4)
25-34	174 (38.7)
35 and above	121 (26.9)
Gender	
Female	295 (65.5)
Male	155 (34.4)
Occupations	
Medical field employee including retired ones (Nurse, Pharmacist, physician, Dentist, Health science)	187 (41.6)
Non-medical field employee including retired ones	131 (29.1)

Characteristic	Frequency (%)
Housewife	22 (4.9)
Student	95 (21.1)
No job	15 (3.3)
Education	
Illiterate	3 (0.7)
Primary	2 (0.4)
Secondary	36 (8)
College and above	409 (90.9)
Nationality	
Lebanese	424 (94.2)
Other	26 (5.8)

The fact that improper disposal of expired medicine affects the environment and health was acknowledged by 70.7% (318) of the participants. Sixty-six point nine percent of the participants (301) knew that drugs enter the water sewage system if withdrawn from the toilet/sink. Forty-three-point three percent (195) correctly respond that improper disposal of antibiotics leads to drug resistance. On the other hand, 50.4% (227) did not know what drug-take-back system is responsible for while most of 72.2 % (325) knew that the best method for drug disposal is the use of medication disposal boxes. Forty-one-point eight percent (188) knew that the correct way for disposing drugs in household trash is to mix the drug with something undesirable, place it in a sealed container and then throw it in the trash. Nevertheless, 29.1% (131) of the participants dispose of it as it is. Forty-four-point nine percent (202) of the participants knew that only drugs that are listed on the flush list can be flushed in the toilet (refer to table 2).

Table 2: Participants' knowledge of expired drug disposal

Characteristic	Frequency (%)
<i>Does improper disposal of expired medicines affect the environment and health?</i>	
Yes*	318 (70.7)
No	24 (5.3)
I don't know	108 (24.0)
<i>Do drugs enter the water sewage system if withdrawn in the toilet/sink?</i>	
Yes*	301 (66.9)
No	28 (6.2)
I don't know	121 (26.9)
<i>Does improper disposal of antibiotics lead to drug resistance?</i>	
Yes*	195 (43.3)
No	58 (12.9)
I don't know	197 (43.8)
<i>What is the "drug-take-back system", used in some countries, responsible for?</i>	
Drug "disposal" in some countries*	150 (33.3)
Drug "sharing or donation" in some countries	73 (16.2)
I don't know what it is responsible for	227 (50.4)
<i>What is the best method for drug disposal?</i>	

Characteristic	Frequency (%)
Throw in garbage	86 (19.1)
Flush in toilet/sink	23 (5.1)
Use the medication disposal boxes that are available in some countries to collect and dispose the unwanted or expired medications from the general public*	325 (72.2)
I don't know	16 (3.6)
<i>How should we dispose a drug, including toxic and nontoxic ones, in household trash?</i>	
As it is	131 (29.1)
Crashed before discarding	42 (9.3)
Mix the drug with something undesirable (such as used coffee grounds), then place in a sealed container (like zipper storage bag) and then throw in the trash*	188 (41.8)
I don't know	89 (19.8)
<i>What type of drugs can be flushed in the toilet?</i>	
Any type of drugs	74 (16.4)
None	89 (19.8)
Only drugs that are listed on the flush list, which is written in the label or in the patient information leaflet of the medicine (known to cause harm, include death by accidental exposure)*	202 (44.9)
I don't know	85 (18.9)

Correct answers are marked by “**”

Forty eight point seven percent of the participants (219) “Agree” that ways of disposal of expired medicines should be taught and 32.9% (148) “Strongly disagree” that doctors and healthcare professionals provide advice on the safe disposal of expired medicines. Fifty five point eight percent of the participants (251) “Agree” that expired medicines present potential risks at home, and 53.6% (241) “Agree” that there is lack of adequate information on the safe disposal of expired household medicines. Eighty two point two percent (370) agreed that the hazardous effect of expiry drugs could be minimized or controlled by providing proper guidance to the consumer, 53.6% (241) by prescribing adequate quantities and durations that ensure patient compliance, and 31.6% (142) by donating or sharing the unused drug to friends or relatives before it gets expired. The pharmacy is the best location to place a secure container as acknowledged by 89.1% (401) of the participants (refer to table 3).

Table 3: Participant’s attitude toward expired pharmaceuticals disposal

Characteristic	Frequency (%)
<i>Ways of disposal of expired medicines should be taught</i>	
Strongly disagree	13 (2.9)
Disagree	5 (1.1)
Neutral	22 (4.9)
Agree	219 (48.7)
Strongly agree	191 (42.4)
<i>Doctors and healthcare professionals provide advice on the safe disposal of expired medicines</i>	
Strongly disagree	148 (32.9)
Disagree	117 (26)
Neutral	66 (14.7)
Agree	87 (19.3)

Characteristic	Frequency (%)
Strongly agree	32 (7.1)
<i>Expired medicines present potential risks at home</i>	
Strongly disagree	15 (3.3)
Disagree	24 (5.3)
Neutral	41 (9.1)
Agree	251 (55.8)
Strongly agree	119 (26.4)
<i>There is lack of adequate information on the safe disposal of expired household medicines</i>	
Strongly disagree	20 (4.4)
Disagree	8 (1.8)
Neutral	21 (4.7)
Agree	241 (53.6)
Strongly agree	160 (35.6)
<i>How could hazardous effects of expired medicines be minimized or controlled?</i>	
Provide proper guidance to the consumer	370 (82.2)
Prescribe the adequate quantities and durations that ensure patient compliance	241 (53.6)
Reduce the number of prescribed medicines by doctor	72 (16)
Donate or share the unused drug to friends or relatives before it gets expired	142 (31.6)
Keep the expired drugs in a safe place	117 (26)
Dispose them in the toilet	22 (4.9)
Burn them	5 (1.1)
<i>Where is the best location for placing a secure container to collect the expired drugs?</i>	
Pharmacy	401 (89.1)
Hospital	170 (37.8)
Supermarket	66 (14.7)
I don't need this program	13 (2.9)

Seventy one percent of the participants (320) had expired medicines at home. The majority (72%) did not ever read medicines disposal instructions. Twenty eight percent (126) of the participants get their information about proper drug disposal from pharmacists, 11.6% (52) from physicians, 32.4% (146) from electronic media, and 44% (198) from nowhere. Furthermore, 78.9% (355) of them throw away expired drug in household garbage and 16.7% (75) flush expired medications in the toilet/sink. The reasons for having unused medications at home were 70.0% (315) due to disease or condition resolved 48.7% (219) due to forgetting, and 48.2% (217) due to a change in medication regimen. The most common types of pharmaceuticals kept in households are analgesics followed by antibiotics (with percentages of 93.6% and 48.4%, respectively (refer to table 4).

Table 4: Participants practice of expired drug disposal

Characteristics	Frequency (%)
<i>From where do you get your information about the proper disposal of expired medicines?</i>	
Pharmacists	126 (28)
Physicians	52 (11.6)
Electronic media	146 (32.4)
Newspaper	7 (1.6)
Schools and universities	65 (14.4)
Others	39 (8.7)
From nowhere	198 (44)
<i>Do you ever read medicines disposal instructions?</i>	
Yes	126 (28)
No	324 (72)
<i>Did any quantity of purchased medicines remain expired at your home?</i>	
Yes	320 (71.1)
No	130 (28.9)
<i>What do you do with the expired medicines?</i>	
Throw away in household garbage	355 (78.9)
Flush expired medications in toilet/sink	75 (16.7)
Return back to the pharmacy	47 (10.4)
I don't know what to do with the expired drugs	24 (5.3)
Others (land fill, burn, keep at home)	38 (8.4)
<i>What is in general, the main reason for the presence of some unused medicines at home?</i>	
Disease or condition resolved	315 (70.0)
Forgetting	219 (48.7)
Experiencing side effect(s)	97 (21.6)
Change of medication	217 (48.2)
Others	53 (11.8)
<i>The most common types of pharmaceuticals kept in households</i>	
Analgesic (painkillers)	421 (93.6)
Antibiotic	218 (48.4)
Antihypertensive (drugs for blood pressure)	104 (23.1)
Anti-diabetic	65 (14.4)
Drug for heart failure	48 (10.7)
Others	105 (23.3)

Overall, the participants scored 3.72 ± 2.18 over the seven on the knowledge questions with a minimum of 0 and maximum of 7. More specifically, participants aged 35 and above scored significantly lower than younger participants. Females had a knowledge score of 4.10 ± 1.96 while males had a score of 2.99 ± 2.37 ($p < 0.05$). As for the occupation, participants working in the medical field scored significantly higher than others did (refer to table 5).

Table 5: Participants' knowledge according to demographic data

Socio-demographic characteristics		Mean \pm SD
Age (year)		
	18-24	3.83 \pm 2.18*
	25-34	4.05 \pm 2.06*
	35 and above	3.11 \pm 2.22
Gender		
	Female	4.10 \pm 1.96
	Male	2.99 \pm 2.37*
Occupations		
	Medical field employee including retired ones (Nurse, Pharmacist, physician, Dentist, Health science)	4.81 \pm 1.53
	Non-medical field employee including retired ones	2.56 \pm 2.21*
	Housewife	2.59 \pm 2.44*
	Student	3.45 \pm 2.07*
	No job	3.60 \pm 2.50*

ANOVA test was done followed by Tukey test

*: $p < 0.05$

4. DISCUSSION

The active pharmaceutical ingredients in drugs may be unsafe to the environment, and consequently, contamination may arise due to improper disposal of these pharmaceuticals. The aquatic life is also affected by the existence of drugs even in low quantities (Bashaar et al., 2017; Gidey et al., 2020). In this study, 70.7 % of the participants correctly understood the negative impacts of inappropriately disposing of expired medicines on the environment and health while in other studies done in Adigrat City study, Afghanistan, Karachi city, and Harar city higher percentages were noticed (Ayele and Mamu, 2018; Kahsay et al., 2020; FDA, 2011; Daughton, 2003). The difference might be due to the lack of awareness programs about the negative impacts of the improper disposal of unused and expired medicines on the environment and health. Moreover, in the current study, 26.9% of the participants were not aware that drugs enter the water sewage system if withdrawn from the toilet/sink. Furthermore, 16.4% acknowledge that any type of drug can be flushed on the toilet even though the FDA specified only 26 drugs to be flushed in the toilet (Daughton, 2003). This may negatively affect the environment since drugs disposed of in the sink/toilet get to the waterways affecting the marine life and get to the water table by the mud component of the sewage treatment process thereby affecting human and animal life as well (Abahussain et al., 2012). Improper disposal of antibiotics may lead to drug resistance. In the current study, only 43.3% of the participants knew this fact.

The solution for drug disposal, as followed by most countries, is the medication disposal boxes. In the current study, 72.2% acknowledged that it is the best method although 66.6% did not know about it previously. Although a large percentage of participants knew the best method for drug disposal, disposal boxes are not available in Lebanon. Moreover, less than half of the participants (41.8%) have the correct knowledge about how to dispose of drugs in household trash. However, 29.1% discard it as it is. This approach contradicts the recommended ways of discarding expired medicines, because the FDA recommends the deletion of all personal information from the medicine packaging which is followed by mixing the drug with something undesirable, then placing it in a sealed container, and lastly throwing it in the trash (FDA, 2011). This approach is very important since it can prevent drug re-utilization by scavengers (Ayele and Mamu, 2018).

In this study, 91.1% of the participants agreed that the ways of the disposal of expired medicines should be taught. They also strongly disagree (32.9%) that doctors and healthcare

professionals provide them with advice on the safe disposal of expired medicines. Moreover, 53.6% “agreed” that there is a lack of adequate information on the safe pharmaceutical disposal practice. This indicates that the participants are aware of the importance of the safe disposal of drugs and that they need education on this topic which is not provided effectively. This can be done by implying a policy by the government on the methods for safe drug disposal, in addition to awareness campaigns by healthcare providers.

It is important to be aware that there are several potential harms that may occur from the presence of expired drugs at home, one of them is the accidental taking of expired drugs by patients with serious and life-threatening diseases. In addition, an expired drug may have degraded, and if a drug has degraded, it might not provide the patient with the intended benefit because it will have lower strength than intended. Also, when a drug degrades it may yield toxic compounds that could cause consumers to experience unintended side effects (FDA, 2011). The current study revealed that only 26.4% “Strongly agree” that expired medicines present potential risk at home.

In order to control the hazardous effects of expired drugs and to minimize the entry of drugs into the environment, 82.2% of the participants suggested providing proper guidance to the consumer, 53.6% proposed prescribing adequate quantities and durations that ensure patient compliance, and 31.6% recommended to donate or share the unused drug to friends or relatives before it gets expired. It is likely that better advice and guidance from healthcare professionals may contribute to a better practice of proper disposal. Furthermore, donation or sharing of medication is associated with several problems like self-treatment in chronic co-morbidity and polypharmacy.

In the present study, 89.1% of the participants suggested that the pharmacy is the best location for placing a secure container to collect the expired drugs from the community followed by hospital (37.8%), and only 2.9% suggested that they do not need this program. This indicates the important role of pharmacist in spreading awareness on safe drug disposal and the willingness of the community to have a system that encourages safe drug disposal.

In our current study, about two third (71.1%) of the participants had expired medications at home which is higher than that in the study conducted in all other countries: Adigrat city (52.4%), India (68%), Harar city (66.2%) Serbian households (44.4%) (Ayele and Mamu, 2018; Kaysay et al., 2020; Paut et al., 2016). This difference might be due to the difference in systems and educational programs available in different countries. The increased storage of unused or expired drug in homes should be given importance as it can lead to irrational drug use since most people keep unused drugs at home for future use or to donate and share with friends and family members.

The frequently stated reason for having leftover or unwanted medications at home was disease or condition resolved (70%). This excess of medications in homes leads to the issue of inappropriate drug disposal. Because of this, physicians should prescribe drugs in adequate quantities and durations that ensure patient compliance. This will decrease leftover drugs in homes after diseases or conditions are resolved, which will decrease quantities of drug disposal.

In addition, in this study, the common types of medications kept in households were analgesics (93.6 %) and antibiotics (48.4%) This may be due to the high prevalence of self-medication practice in Beirut city, Lebanon. The increased presence of antibiotics at home should get serious attention and consideration since it may lead to the problem of antimicrobial resistance. An excess of those drugs at home may be due to the idea of ready prevention of infectious diseases without referral to the physician, and pain that is associated with many diseases that patients may consider treatable with analgesics.

In practice, even though some knew the best way of discarding expired/unused, 78.9% of the participants throw drugs in the household garbage and very few consider returning them to the pharmacies or health care providers. This is higher than in the study conducted in Harar (53.2%) and in Adigrat city (75.2%) and consistent with a study conducted in Afghanistan (78%) (Ayele and Mamu, 2018; Kahsay et al., 2020). This wrong practice might be due to the lack of a system that encourages proper disposal of unused medicine as opposed to other countries such as Sweden, Canada, and Korea where a drug return or Drug Take-back system of unused drugs exists (Kahsay et al., 2020).

Socio-demographic characteristics play an important role in drug disposal practices. In the current study, a correlation was identified between the Socio-demographic characteristics and the proper disposal of the expiry drug results. According to the comparison of the mean values between different genders, we can say that females paid more attention to the expiry drug disposal compared to males, which may be due to the fact that in Lebanon females stay at home and are highly involved in giving their child medicines much more than males. Age also is an important factor in expiry drug disposal behavior. We found that the attention to expiry drug disposal decreases with age. The fact that young people are more knowledgeable regarding this topic may be due to their active and up-to-date education. This makes them more aware and careful regarding the expiry drug disposal best practices. Moreover, from the current study, a significant difference among the different occupations regarding the attention of expiry drug disposal is noticed. It is clear that the medical field employees have significantly higher scores compared to other jobs. This emphasizes the important role that healthcare providers may offer in educating the patients on the expiry drug disposal best practices.

5. CONCLUSION AND LIMITATIONS

It is essential for the drug regulating bodies and government authorities to implement educational programs and to create awareness campaigns through an appropriate medium of communication about the appropriate drug waste disposal methods and the impact of inappropriate disposal practices in order to protect the public and the ecosystem. Therefore, the government of Lebanon should be committed to encouraging feasible expired drug programs. Additionally, stronger campaigns and significant involvement of the community, healthcare providers, and the government are required, in order to avoid any possible barriers such as the lack of information on techniques for the proper disposal of expired drugs.

This study carries some limitations. Most importantly, the cross-sectional nature of the study design prevents us from drawing causal inferences about the relationship between the chosen covariates and outcome variables over a period. Since the study is done in Beirut area, it could be a challenge to conclude the present results about the status of knowledge, attitudes, and practices towards the disposal of unused and expired drugs among community in other areas of Lebanon. Moreover, the questionnaire was distributed through Google form to decrease exposure during Covid-19 pandemic which may carries some bias.

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