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ORIGNAL ARTICLE

Concept, Beleifs and Practices of Drug Disposal Among Undergraduate University Students of Basic Health Sciences

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1 Conception & Study design, Drafting of Manuscript, Critical Review.
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ABSTRACT

Background: Environmental and water contamination due to the presence of pharmaceuticals has become a hot issue worldwide as affecting the environment and health adversely.

Objectives: The present study aimed to observe the perception, attitude and practice regarding disposal of unused, expired and left over medicines among undergraduate university students of basic health sciences.

Methodology: This was a cross sectional, descriptive study, conducted from November 2018 to February 2019, by distributing pretested structured questionnaires. Completely filled questionnaires were then collected by researchers for data analysis using SPSS version 21.0.

Results: Out of n=200, the response rate was 79%. It was found that more than 40% students used to keep medicines at their home, due to poor compliance (39.87%). More than 75% of students had no awareness about proper medication disposal and they disposed unused medicines in the sink or flush. Around 40% students thought that pharmacists should educate about drug disposal while dispensing. About 75% respondents were unaware about availability of official guidelines for disposal or pharmacy take back program for unused medication.

Conclusion: Students were not practicing medication disposal properly. So, awareness regarding proper drug disposal is necessary for all, especially for students belonging to health sciences. Allocation of specific drug disposal sites and pharmacy take back programs are deemed to be necessary to promote a secure environment.

Keywords: *Drug disposal, unused drug, Expired medicines, medication take-back programs, Health sciences.*

INTRODUCTION

Medicines are commonly used to subside diseases and to maintain healthy communities. Unfortunately they bear the potential to contaminate the environmental quality if not managed and discarded properly [1]. In the last few years, improper drug disposal of unused and expired medicines has become a burning issue worldwide. Various methods have been documented for discarding unwanted, leftover and expired medicines globally. The concept of drug disposal was presented in 20th century and the first guidance text was released by United States of America in 2007 [2]. This monograph provides the

appropriate procedures for discarding used/unused and controlled/uncontrolled pharmaceuticals. Several surveys have been conducted in communities to assess the behavior of the residents against the drug removal from their houses [3-5]. KAP (knowledge, attitude, perception) studies for drug disposal of unused medicines were also determined in various regions of the world among young adults of university [6, 7]. Common ways to get rid of unwanted drugs are through the household trash [8], flushing of medicines down in the toilet or sinks [9,10], gifting excess medicines to the friends, colleagues, fellows, family relatives [11] and returning back them to the drug stores/pharmacies [12]. However, all the mentioned ways of drug disposal are inappropriate and have contributed significantly towards environmental contamination. Environmental pollution is considered to be the critical rising problem and the healthcare wastes dumped from the landfills and the sewerage directly affect public health, environmental air and wildlife [13]. Detrimental effects of many medicines that include diclofenac, ethinyl estradiol, acetaminophen, verapamil and many antibiotics have been previously reported [14]. Suitable drug disposal programs should be put into service especially for controlled drugs like opioids and others to overcome misusage, environmental hazards and health risks associated with human and animals [15,16].

Pakistan being a poor economical country has been facing many challenges in healthcare system. Majority of population could hardly bear the medication and hospitalization expenses. Unfortunately “appropriate drug disposal” is a neglected area especially in developing regions of the world [14]. Owing to poor knowledge and lack of information, patients and their attendants are habitual of discarding the expired and unused drugs on the road corners, rubbish bins or rinsed down in the sink. Another side of the picture is the non-cooperative behavior of pharmacies and the community retailers to accept such medicines when returned by consumers. In this scenario protocol should be formalized by the regulatory bodies and/or government to be implemented for safe and protected drug destruction. Furthermore, awareness sessions regarding “drug disposals” should be organized periodically in every province and districts of the country to educate local communities.

Drug disposal practices among households, students, drug retailers and pharmacists have been determined all over the world. Karachi is a highly populated city where the utilization of prescription and non-prescription medicines is high. However, limited literature is available on the knowledge and the drug disposal practices for unused/expired medicines. Henceforth, the present study is designed to determine the attitude, knowledge and practice of drug disposal among the under graduate students of basic health sciences recruited from different universities of Karachi, Pakistan, using a pretested questionnaire.

METHODS

Study Setting, Recruitment, and Data Collection

This was a cross-sectional, non-interventional, questionnaire-based descriptive study which was conducted from November 2018 to February 2019 amongst undergraduate students of health sciences in local universities of Karachi, using convenience sampling. The students were given sufficient time to fill the questionnaire at their convenience. Students’ written consent was taken after informing the purpose of study with assurance of data confidentiality. The physical presence of the researchers permitted the students to fill out the questionnaires at their ease to increase their engagement and the response rate. Completely filled questionnaires were then collected by the researchers for final analysis.

Sample size Calculation

A non-probability sampling technique (convenience method) was employed to select study subjects. Sample size of the study was computed to be 185 by online available Raosoft calculator [17] using 90% confidence interval, 10,000 population size, 6% margin error and 50% of response distribution. However, additional samples (n=15) were collected to overcome the chances of incomplete information (if any), provided by the students.

Study Instrument

A structured questionnaire was formulated in English language and piloted by randomly distributing them initially to n=20 students. This was done to take the views and feedback of students concerning the language and ease of use, to measure questionnaire feasibility and for face validity. Then the questionnaire was finalized and the data collected from the pilot study was not included in the final analysis. The questionnaire included items related to the students'

characteristics, questions evaluating traits of drugs' use, their storage, attitude towards drug disposal, and intents about drug disposal.

Statistical Analysis

Filled questionnaires were double verified by research team for accuracy and were analyzed using SPSS version 21 software. The descriptive statistical analysis such as frequencies and percentages were calculated for general items related to attitude and practice. Mann-Whitney U test was applied to evaluate the difference between the practice of trained and untrained respondents. The statistical significance was set at a *p* value of <0.05.

RESULTS

Overall, 60% of students were male and 40% were female, of age 21.34±3.65 years. 42.58% of students retained the unused medicines at their homes without checking the expiry of dosage forms. Among various reasons for the drug stocking, poor compliance (39.87%) and incomplete therapy course (26.58%) were reported mainly. Only 22.15% of the students were ever educated/ trained regarding the disposal technique of different dosage forms. Other factors about awareness and perception are provided in Table **1**. Figure **1** shows the storage places pointed out by students for keeping unused drugs while Figure **2** illustrates the types of medicines stored in home. The practice of drug disposal is shown in Table **2**. Figure **3** reflects the potential barriers mentioned by the students. Students strongly believed that awareness for proper drug disposal should be created among young adults and it is the responsibility of pharmacists' chiefly (Figure **4**). About 57% and 42% of the trained and untrained students, respectively, were returning the expired medicinal units to the pharmacy stores. Statistically insignificant differences were seen by analyzing through Mann-Whitney U test amongst certain drug disposal practices of trained and untrained students, such as rinsing down of medicines in to the sink (p=0.053), discarding the medicines with house hold garbage (p=0.518), or returning the medicines to the pharmacy (p=0.754). Whereas, significant difference was observed between the trained and untrained groups in practice of flushing down the medicines in to the toilet (p=0.006).

Table 1. Awareness & perception of respondents towards drug disposal.

S. No	Stem	Options	Responses (%)
1	Are you keeping medicine at your home	Yes	42.58
		No	54.72
2	Which type of therapy is mainly followed in your home	Allopathic	82.91
		Homeopathic	2.53
		Home remedy	8.86
		Herbal	0.63
3	How do you get your Medicine	Through Prescription	42.40
		Without Prescription	8.86
		Both	48.74
4	Which type of medicinal dosage form is highly used in your homes	Tablet/capsule, powders	87.83
		Liquid/syrup	10.12
		Ointments/pastes/topical	3.16
		Injections	1.89
5	Do you checked the expiry date of the medicines while purchasing/storing	Yes	58.22
		No	41.77

6	Why do you keep unused medicines	In case they needed later	8.22
		Not sure why to dispose them	5.06
		To keep stockpile in shortage	13.95
		Poor/higher patient compliance	39.87
		Incomplete course of therapy	26.58
		Others	6.32
7	Have you ever been trained or educated regarding proper medication disposal	Yes	22.15
		No	77.85
		Do not remember	1.3
8	Have healthcare professionals ever advised you about medication disposal	Yes	6.96
		No	74.68
		Do not remember	16.45
9	Are you aware with any state/federal guideline for drug disposal of prescribed medicine	Yes	6.96
		No	75.94
		Cannot remember	15.18
10	How could hazardous effect of unused and expired medicines be minimized or controlled	Lowering the number of prescribed medicines	3.16
		Donating used medicines	4.43
		Providing proper guidance to consumer	41.77
		Prescribing specific quantities & duration	49.36
11	Do you know Pharmacies take back unwanted/expired medicine program	Yes	29.74
		No	70.25
12	If a secure disposal location is available, would you utilized this place for medicine disposal	Yes	65.18
		No	34.81
13	If a secure disposal location is available, would you provide this information to others	Yes	82.91
		No	12.65
		Not Sure	4.43

Table 2. Practice of respondents to dispose unused/expired medicines.

S. No	Options	Trained (%)	Untrained (%)	*p*-value
1	By rinsing down the sink	64.80	35.20	0.053
2	By flushing down the toilet	61.05	38.98	0.006
3	Discarded with household rubbish	45.10	54.90	0.518
4	Return to Pharmacy stores	57.50	42.50	0.754
5	Awareness about the environmental implications related to improper disposal	22.07	77.9	0.000

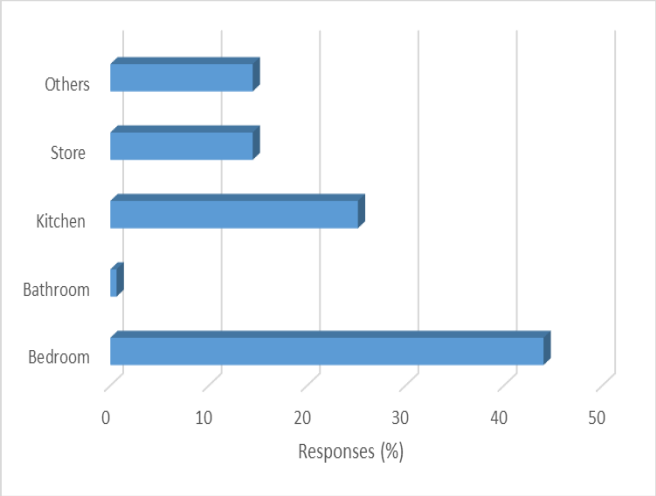

Figure 1. Storage areas indicated by respondents for medicines at home.

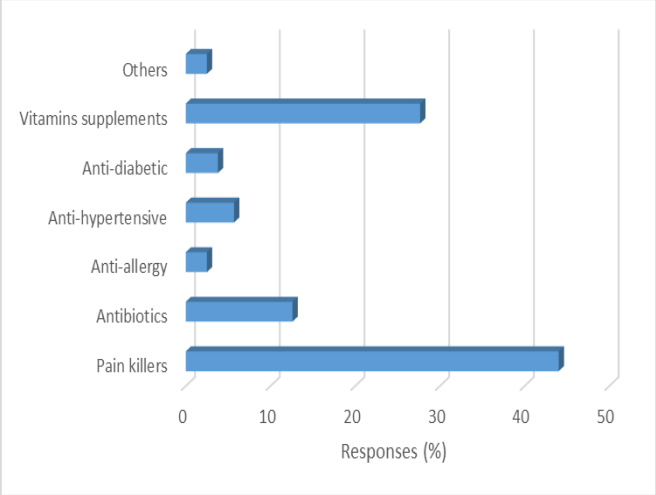

Figure 2. Types of drugs stored at home by respondents.

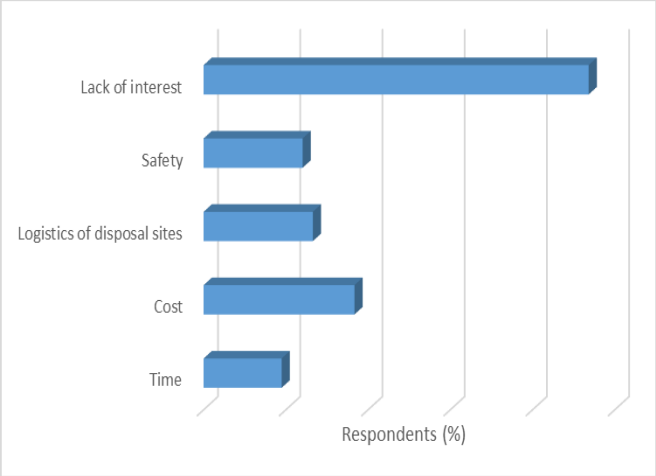

Figure 3. Potential Barriers against Drug Disposal Program.

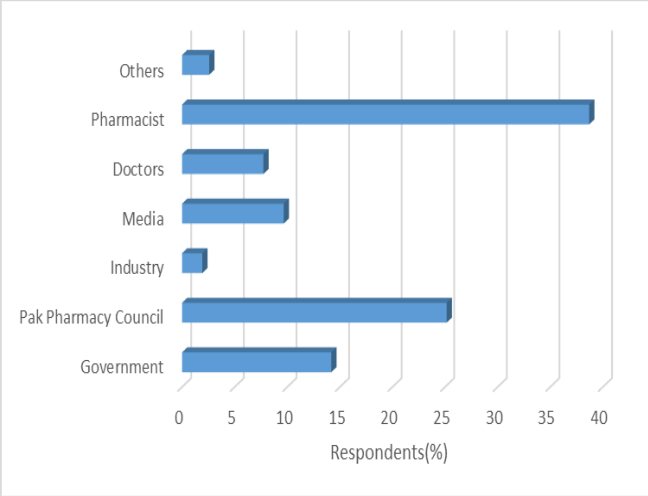

Figure 4. Responsibility of creating awareness for drug disposal.

DISCUSSION

The consumption of medicines has increased much throughout the world due to increased prevalence of chronic illnesses [18]. As a result, patients stock many left over, unused, or expired drugs due to their health disorders [19]. By the time passage, this is not only resulting in money wastage but also becoming environmental threat for living beings as well [20-22]. WHO's European Centre for Environment and Health created a practical guide through an international working group in order to address problems associated with Health Care Waste Management in the developing countries, in particular [23]. There are many published guidelines regarding the safe disposal of unused medications [24-26], majority people seem to be unaware and untrained regarding the drug disposal appropriately [27-29]. A big disaster was seen in the Afghanistan where the by-products of polio vaccine were thrown in the municipal waste, consequently leading to serious infections in those individuals who were involved in search of used articles from the garbage sites [14].

Based up on such reported facts, the present study was carried out in undergraduate students of health sciences to observe their perception, attitude and practice of drug disposal for unused, old and expired medicines. (42.58%) Students were found habitual to retain the unused/expired medicines at homes (Table **1**). This appears comparable to the outcomes of different published studies [14, 30-31]. Among various reasons observed in our study for the drug stocking, the main ones were poor compliance (39.87%) and

incomplete therapy course (26.58%). A two phase study was conducted in 2017, by Hussain and coworkers in mega city of Karachi, Pakistan, revealing that about 54% of the participants were keeping unused or expired medicines at their home and working place also. The causes were high dissatisfaction from the treatment, side effects, missed doses and poor adherence to the drug therapy. It was also noted that many of the individuals usually did not find time to look upon the expiry dates of the medication but in our study, 58.22% students responded that they checked the date while purchasing or storing the medication [32].

In this survey, it was explored that the common places for storing the medicines were bedrooms and kitchen cabinets due to their easy access upon need (Figure **1**). More than 40% students kept the drugs in bedrooms as these are cool and dry places. This was found in one study revealing that majority students (*n* = 368/464; 79%) stored their drugs in bedroom or kitchen (*n* = 237/464; 51%) [33]. But, if the drugs are stored in the kitchen cabinets, they may get deteriorated due to high temperature exposure and hence become hazardous for living beings.

It was found that majority of the students in our study preferred the tablet forms (87.83%) over other types of pharmaceutical dosage formulations. They mainly chose the allopathic system of treatment, but various other home remedies were also popular in their homes (Table **1**). It was noted that approximately 49% students used to get their medication with or without prescription, or both. Self-medication has dramatically raised the utilization of the OTC drugs to overcome pyrexia, analgesia, cold and cough [34]. Among various prescription and non-prescription drugs, painkillers (44.03%) were the most commonly consumed class of medicines found in this study, followed by multi vitamins (27.67%) and then antibiotics (12.6%), as shown in Figure **2**. Actually painkillers are highly purchased and utilized drug category by the individuals all over the world [35]. Ahmed and coworkers documented that residents of the Karachi were used to purchase pain killers excessively than any other class of drugs [11]. In other studies, the most commonly stored drugs were found as those for cold, cough, or flu and then creams and ointments; some other studies stated antibiotics as the most commonly stored drugs at home [20, 28, 34-36].

Another important finding of our survey is that many of the students (70.25%) never knew about the pharmacy takeback program of unwanted medicines; majority (65.18%) surely agreed to use a secure location for drug disposal, if provided by the state institutions in their community area. Pharmacists play a substantial role in drug take-back programs in some countries, and work as campaigners for proper disposal of drugs [37, 38]. Pharmacy take back program is considered to be a gold standard for safe drug disposal, but only few of the individuals (less 1%) of even the developed countries are accustomed to return the unused/ expired medicines to the pharmacy stores [39]. The results of our study also indicated that about only 30% of the students were aware about this program (Table **1**).

About 83% students in our study were willing to provide the information to others about secure disposal location (Table **1**). Similarly, a study reported that about (73%) students responded that they were willing for drug disposal in specific or convenient places [33]. In our study, main barriers to initiate the medication disposal program were observed to be lack of interest (47.2%), cost (18.2%), safety (11.9%), logistics (10.7%) and the time (9.4%) as displayed in Figure **3**. Hence, as stated by Wieczorkiewicz *et al*. [40], drug disposal costs should be supported by the local establishments, pharmaceutical industry, health insurance companies, or government because the general population was not willing to pay for this; in the US there is government funding [38], in the United Kingdom there are pharmacies to take back and finance drug disposal system and also promoting their awareness drives [41]. In the present study, only 22.15% of the students were found to be ever educated regarding disposal techniques of different dosage forms (Table **1**). One study reported that despite half of the students (56%) knew how to dispose off the medicines, the knowledge and practices concerning drug disposal were poor among them [33].

The practice of drug disposal (Table **2**) was observed and statistically compared among trained (aware) and untrained (unaware) undergraduate students by using Mann Whitney U Test through SPSS (version 21) software. About 57% and 42% of the trained and untrained students, respectively, returned expired medicinal units to the pharmacy stores. Statistically insignificant differences were seen among the drug disposal practices of trained and untrained students,

except for the practice of drug disposal of unused medicines by flushing down the toilet (p=0.006) and awareness about the environmental implications related to improper disposal (p=0.000). This practice of drug disposal is in line with some more investigations conducted globally in the past, where more than half of the drug consumers used to dispose off expired or unused medicines by flushing down the sink or toilet, henceforward contaminating and damaging the aquatic environment and landfill [37. 42]. Many active drug ingredients were identified in different waste water plants i.e. antipsychotics and anti-hypertensive agents, that could adversely affect the growth and life of living beings [21,43].

According to the Food and drug administration (FDA), the most appropriate way is to drop off the unused medicines to a specific drug take back location. But in case of any problem (i.e. no nearby facility or take back program or no medication guide/insert), FDA provides the list of drugs and ways for their disposal depending on the nature of chemical. Two drug categories have been proposed by FDA as “flush drugs” and “trash drugs”. If the medicines contain any potentially dangerous compounds like diazepam, hydrocodone, methadone, morphine, and acetaminophen etc., then these agents should be flushed down immediately to avoid any risk of mistaken ingestion by children, other family members and pets. But if medicines are of non-flush (potentially non-toxic) kind, then such drugs should be mixed with some materials (mud/ litter/ salt/ spice) to mask the active contents and then discarded with regular home garbage. Additionally, solid unused medicines including pills, granules and capsules must not be crushed and the labels from these bottles must be removed before recycling or trashing [44]. This practice definitely can overcome the chances of taking medicines by anyone and would also protect the atmosphere from potential hazards. In our study, undergraduate students (whether trained or untrained) did not exhibit proper knowledge about flushing and non-flushing drugs. Majority of trained students used to flush down the expired/ unused drugs while untrained discarded the unused/ old medicines in the trash (Table **2**).

In the present survey, the students were not fully aware about the detrimental effects of the underlying drug disposal practices on our environment. Approximately 75% of students had never been advised by the healthcare professionals for drug disposal of leftover medicines (Table **1**). It was suggested by the students that during drug dispensing, thorough information should be provided to the customers by the pharmacists. The students had the opinion that the pharmacist (37.7%) or drug retailer would be the person responsible for counselling about the drug disposal during dispensing while 24.5% and 13.8% suggested that regulatory authorities and the Government of Pakistan, respectively, must conduct the awareness sessions and campaigns on proper drug utilization, storage indications or precautions and the ways for drug disposing (Figure **4**). It was revealed in a study that majority of respondents (90%) chose the FDA, when asked for opinion about the responsible authority for communication and establishment of safe drug disposal programs [33]. Abdullah *et al*. [20] reported from the western region of Saudi Arabia through a survey that (84.8%) respondents declared MOH as the responsible authority. Alshareef *et al*., [28] from Al-Riyadh found in their study that alternative means of drug disposal was the responsibility of public.

During survey, some students (47.2%) emphasized that the “pharmacy” and the “retail drug stores” did not initiate or offer any take back facility for the unused/ expired medicines. It was also suggested by the students that drug related information should be communicated verbally, through pamphlets (both English & Urdu languages), toll free numbers and websites etc. Approximately 76% students responded that they were not aware of any guidelines for drug disposal provided by the state (Table **1**). Students also highlighted that health and government sectors are not providing proper drug disposal location owing to lack of interest and logistics and also expenditure for the drug disposal programs. According to the students, the hazardous effects of unused or expired drugs could be controlled or minimized by providing proper guidance to the consumers (41.77%) and prescribing the drugs with specific quantities and for adequate duration (49.36%) (Table **1**).

Limitation and future Recommendation of the study

This questionnaire is based on the students’ statements from health sciences only and this might reduce the opportunity of deriving a clear picture of events. Moreover, keeping unused/ expired/ left over drugs at home was not confirmed by direct observation. Data were gathered once and the students' attitudes and practices for drugs may

change over time. Furthermore, the difference between professional and personal practices about drugs may be conflicted in the results. It is recommended to conduct the study on a mass level including students from all fields. Based on the findings, it is further recommended that regulatory bodies should arrange the training/ awareness sessions on proper drug disposing of medicines in local communities periodically, to maintain the environmental quality.

CONCLUSION

It is concluded that the knowledge and practice of drug disposal of unused, left over and expired medicines is inappropriate amid undergraduate students of health sciences. The students were unaware about the current official FDA guidelines also for drug disposal. Drug and container disguising was not practiced by anyone, whether trained or untrained. Proper drug disposal facilities and pharmacy takeback programs should be launched. Awareness sessions should be held frequently for which pharmacists and physicians have a key role.

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