Unmasking the awareness and attitude regarding disposal of unused/expired medicines- A study from Metropolitan City, India

Priti P Dhande[1], Rahee P Borulkar[1], Yash Dombale[2]
[1]*Department of Pharmacology, Bharati Vidyapeeth (Deemed to be University), Medical College and Hospital, Pune, Maharashtra, India*
[2]*Bharati Vidyapeeth (Deemed to be University), Medical College, Pune, Maharashtra, India*

Corresponding Author
Priti P Dhande
E-mail ID: priti.dhande@bharatividyapeeth.edu

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Abstract

Background: Unused and expired medicines pose a significant risk to the environment if they are not stored or disposed of properly. Proper knowledge and understanding of the dangers posed by these medicines to the environment and their disposal techniques is necessary. **Aim:** To evaluate the knowledge and attitude of consumers as well as students regarding the disposal of unused medications. **Material and Methods:** Evaluation of awareness and attitude regarding the disposal of medicines and their adverse effects was done using a questionnaire among 346 participants (MBBS and BDS students and the consumers). Results were expressed in frequency and percentages. Comparative analysis between medical students and consumers for the above parameters was done using Pearson's Chi-Square test. **Results:** Awareness and attitude possessed by the participants were subpar than expected. Even if the attitudes of the consumers and medical students were comparable, the latter were significantly less aware of the effects (81% v/s 69%; p=0.009) of improper disposal on the environment and humans. **Conclusion:** Both consumers and medical students had a basic understanding of medication pollution but need a comprehensive understanding of the causes and effects of this issue. The consumers comparatively had higher awareness about disposal and adverse effects of unused/expired medications than medical students.

Keywords: Environment pollution, medicines, awareness, consumers, students

Introduction

Pharmaceutical pollution is a term that has surfaced frequently in recent times with raging evidence of how it has a negative effect on the ecosystem as well on human health. The existence of pharmaceutical products in the environment and their harmful effects have been an issue of discussion since the 1980s[(1)]. One of the common reasons for the existing drug pollution is wastage caused due to unused medications from households and hospitals. In today's world, it is a common habit of every citizen existing out there to store medicines in their houses for any emergency use. However, it is impossible for every individual to supervise these medicines regarding their storage, expiry, and disposal instructions. These leftover or expired medicines are often improperly disposed of by the consumers. The National guidelines for discarding medicines have been formulated for their safe and harmless disposal[(2)]. However, these guidelines are designed for the disposal of unused or expired medicines from hospitals and local clinics. Awareness about these guidelines is essential on both ends, i.e., the prescribers' and consumers' end, as improper disposal of these medicines can pose an environmental contamination threat[(3)].

Underutilization and unnecessary hoarding of medications in the house can be attributed to many reasons. Patients' lack of perception to consume medications on time, non-adherence to the medication routine, not consuming medications due to fear of side-effects, a fast-paced lifestyle[(4)], forgetfulness leading to lack of medication adherence[(5)], anxiety of shortage of household storage of medicines[(6)], storage of medication in unsuitable environment and not cohering to instructions[(7)], are few of the reasons why the medications in houses of people remain unused. The usage of medications has skyrocketed, with people seeking treatment for even minor symptoms that were formerly considered normal. Efforts to reduce medicine waste should be pursued, particularly those connected to the primary source of waste-consumers[(8)].

The use of medications is expanding globally[(9)], and newly discovered contaminants may pose a concern in the future to the environment[(10)]. Aside from the environmental and ecological implications, keeping expired or unused drugs at hand or distributing them to others might lead to inadvertent or inappropriate intake, raising the risk of a variety of potential drug-related issues such as medication errors, adverse drug responses, and can be regarded as a waste of resources[(11)]. Lack of awareness regarding the proper disposal of such medicines is a prime culprit which can have an environmental impact. So, the knowledge of proper drug disposal is essential for a safe environment.

This study aimed to assess awareness and attitude towards proper and environmentally safe methods of disposing of

expired/unused drugs amongst responsible citizens of society- future caregivers and consumers.

Materials and Methods

Participants in the study were MBBS and BDS students from colleges, along with local consumers residing in that city. Based on previous studies[12,13] where awareness regarding the disposal of medicines was evaluated, the minimum sample size had come to a total of 263 participants. We managed to involve a total of 346 participants- 198 (medical + dental) students and 148 participants in the consumer (local residents) group, respectively.

This was a cross-sectional, questionnaire-based study, where participants filled out a Google form containing four questions on their demographic details, five on awareness, and six about attitude regarding the disposal of unused/expired medicines. Consent for participation in the study was included in the Google form questionnaire. The questionnaire was prepared after referring to various studies conducted in India and other countries among healthcare professionals, medical students, or consumers[14-16]. The prepared questionnaire was circulated among faculty members of the Pharmacology and Community Medicine departments to scrutinize it and get their feedback so that appropriate modifications could be made to get the final questionnaire. It was then pre-validated among randomly selected medical students and local residents (a total of 25) before being applied to the study participants. After filling out the questionnaire, each participant received a message about the safe method of drug disposal as information.

Statistical analysis: Responses given by the participants were entered in a Microsoft Excel sheet and then analyzed. Results were expressed in frequencies and percentages. A comparison of awareness and attitude was made between categories of participants using Pearson's Chi-square test.

Results

Figure 1 depicts the distribution of the study population (346 responders); and female participants (67.5%) outweighed the male responders (32.5%) while responding to the study questionnaire.

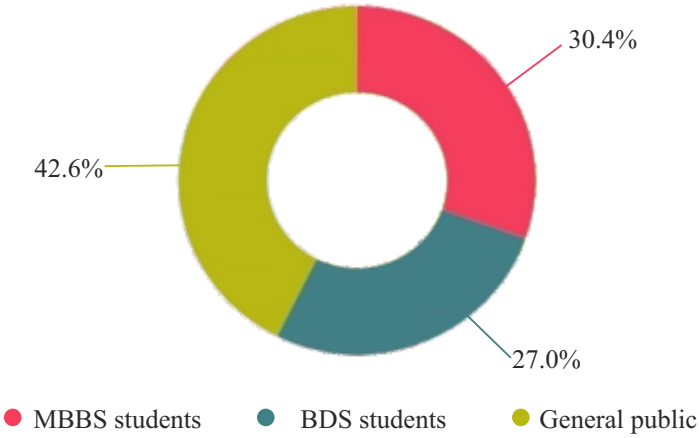

Figure 1: Categorical distribution of participants responding to the questionnaire (n=346)

Table 1: Knowledge of participants regarding disposal of unused/ expired medications (n= 346)

Sr. No.	Questions	Options and Responses of the participants (%)
1.	Did any quantity of the medicine purchased remain unused in your home?	1) Yes: 82 2) No: 17.9
2.	What do you do with unused leftover medicines at your home?	1) Throw away in household garbage: 34.1 2) Give to friends or relatives or house-help: 6.9 3) Return to medical stores: 10.6 4) Keep at home until expiry: 45.6 5) Flush unused medicines in the toilet: 2.3
3.	Who is responsible for creating awareness about the proper disposal of unused and expired medicines?	1) State Government agency: 20.2 2) Pharmaceutical industries: 37.5 3) Doctors: 13.5 4) Municipal corporation: 13 5) Pharmacists: 15.3
4.	Can improper disposal of unused and expired medicines affect the environment and health?	1) Yes: 95.9 2) No: 4.04

Table 1 depicts the knowledge of participants to various questions asked regarding the safe disposal of medications. Among the participants, 82% agreed to have unused medicine at home, which most of them kept stored for re-use until expiry or threw away in household garbage. About 7% of the participants also responded to give the leftover medicines to friends, relatives, or housemaids if required. Only 2.3% of responders had flushed such medicine in the toilet. 11% returned the drugs to the medical stores, while 46% of participants kept those unused medications at home until expiry. According to participants, when asked whose responsibility it was to create awareness about the proper disposal of expired medicines, 37% of them responded that the work should be done by pharmaceutical industries, 20% think an agency by the State government should take the initiative while 15% think that awareness should be created by the pharmacists. Doctors and Municipal corporations should pay contributions to this work, according to 13% of the study participants. When leadingly asked whether improper disposal of unused and expired medicines will affect the environment and health, 95.9% of participants agreed to this fact, and most of them (59.8%) believed that consumption of such medicines might lead to serious reactions (Figure 2).

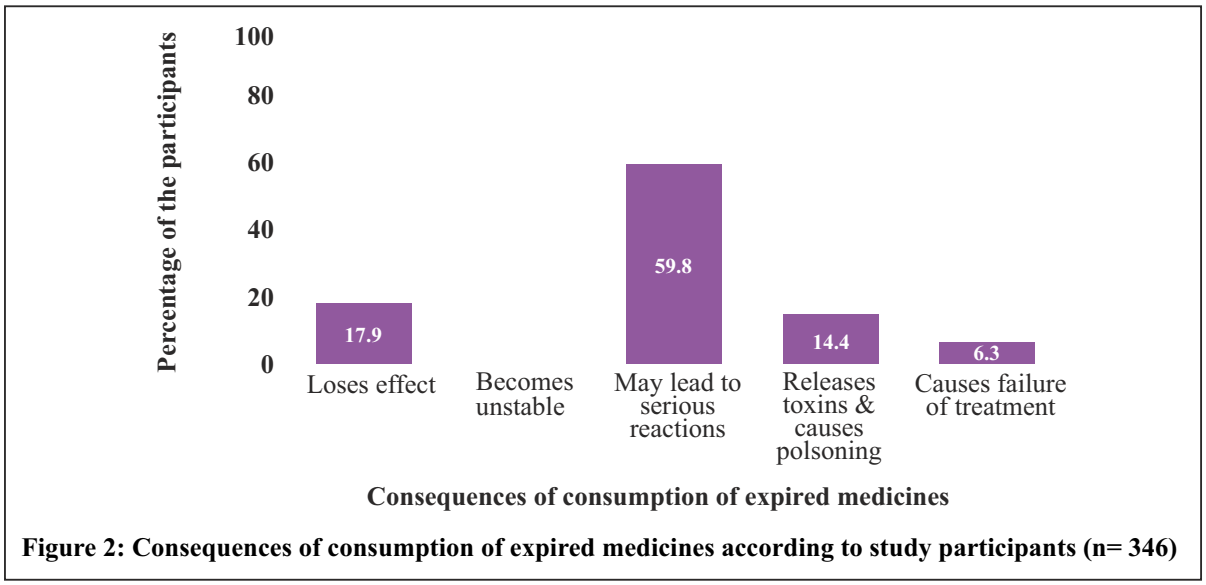

Figure 2: Consequences of consumption of expired medicines according to study participants (n= 346)

Table 2: Attitude of participants regarding disposal of unused/ expired medications (n= 346)

Sr. No.	Questions	Options and % Responses of the participants
1.	Which will be the best source to create awareness in society for proper disposal of medicines?	1) Newspaper: 1.4 2) Electronic media: 2.02 3) Internet/Social-media: 13.5 4) Pharmacists: 0.5 5) Doctors: 1.7 6) All of the above: 80.3
2.	The possibility of household unused and expired medicines can be minimized or controlled by:	1) Limiting the sale of medicines without prescriptions: 16.7 2) Donating the unused medicines: 15.02 3) Providing proper guidance to consumers: 29.7 4) Prescribing in quantities and required duration: 38.1
3.	Are you aware of any guidelines for the disposal of expired medicines?	1) Yes: 36.1 2) No: 63.5
4.	Do you feel the need for collection of household expired medicine for safe disposal?	1) Yes: 92.7 2) No: 7.2
5.	In your opinion, collection of expired medicines for safe disposal should be arranged by	1) Volunteers of a campaign: 23.4 2) Municipal workers: 34.6 3) Local corporator/politician: 21.6 4) Pharmacists: 19.9

Table 2 shows that to gain knowledge regarding the safe disposal of unused/expired medicines, study participants use multiple options like- newspapers, electronic media, internet/social media, pharmacists as well as doctors. There was a variety of responses from the participants when enquired about the ways to minimize the possibility of household unused and expired medicines- 38.1% selected the option of prescribing in quantities and required duration, while 29.7% of them mentioned that proper guidance should be provided to the consumer regarding this aspect. Some (16.7%) of the participants also wish that the sale of medicines without prescriptions should be limited, while others (15.02%) felt that donating unused medicines could reduce the chances of household unused and expired medicines.

We also questioned the participants whether they were aware of the guidelines for the disposal of the medicines, and it came to light that only 36.1% of them claimed to know about the guidelines. On further analysis, we found that out of those aware of the guidelines, 41.6% of participants belonged to the general public category, while the rest were MBBS and BDS students. When asked about their view, 34.6% of participants opined that municipal workers should be given the responsibility to collect expired medications, while 23.4% mentioned that volunteers should be chosen to head a campaign for the safe disposal of medicines. Some participants also mentioned involving a local corporator/politician to lead this responsibility.

Figure 3 depicts the participants' opinion about the necessity of safe disposal of medicines where prevention of environmental pollution (79.4%) and adverse reactions (76.8%) due to such drugs were the main options chosen. A good number (56.8%) of participants also affirmed that proper disposal of medicines should be done to prevent their illegal or unintentional use.

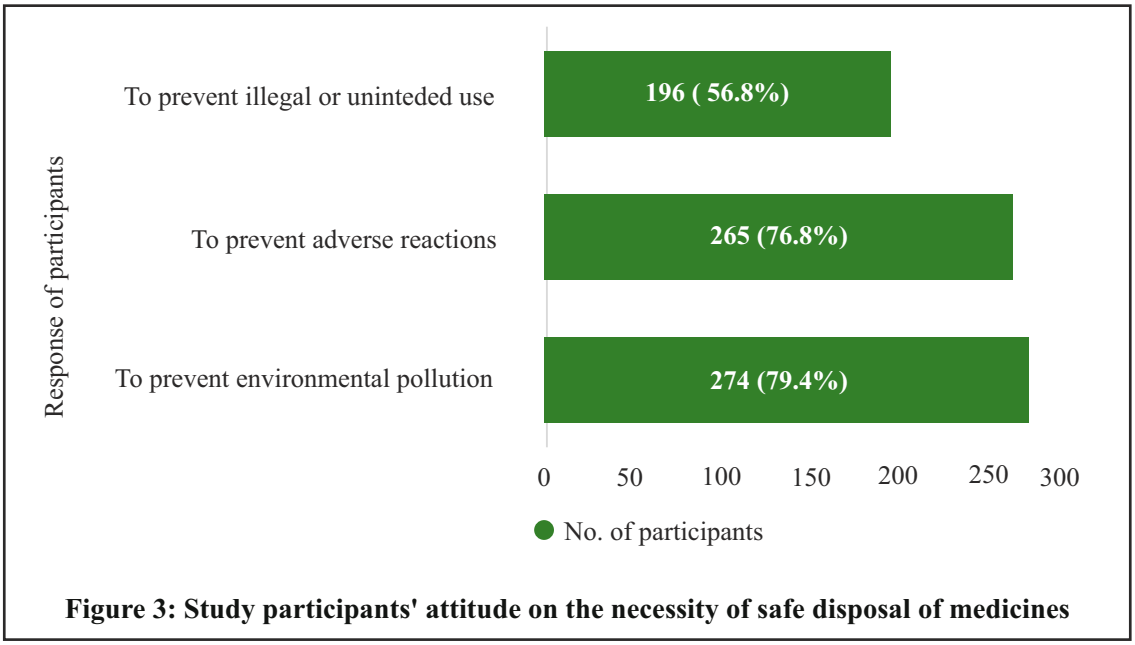

Figure 3: Study participants' attitude on the necessity of safe disposal of medicines

Table 3: Comparison of Knowledge of categories of participants regarding disposal of unused/expired drugs using the Chi-Square test (n=346)

Sr. No.	Category of Participants	Good awarenessn n (%)	Poor Awarenessn n (%)	Total	Chi-Square p-value
1	General public	120 (81.08)	28 (18.9)	148	
2	Medical students (MBBS and BDS)	137 (69.2)	61 (30.8)	198	**0.009***

***p<0.05 using Pearson's Chi-square test**

Table 4: Comparison of Attitudes of categories of participants regarding disposal of unused/expired drugs using the Chi-Square test (n= 346)

Sr. No.	Category of Participants	Good attitude n (%)	Poor attitude n (%)	Total	Chi-Square p-value
1	General public	96 (64.8)	52 (35.13)	148	0.9
2	Medical students (MBBS and BDS)	128 (64.6)	70 (35.4)	198	

Table 3 shows that 81.6% of participants from the general public category had good awareness about the disposal of unused/expired medicines, while only 69.2% of medical (MBBS and BDS) students were well aware of this concept and Chi-square analysis for comparison of awareness between the general public and medical students (MBBS and BDS) showed a significant difference (p= 0.009). Likewise, when the attitude of both these groups towards safe disposal of medications was compared, they had a similar score. (Table 4)

Discussion

Safe disposal of medications is an age-old issue faced by society in different aspects. Right from the hoarding of unused medications by consumers and pharmacies to their eventual expiration, leading to their exposure to environmental entities due to improper disposal, medication disposal has become a topic of concern in recent years. The concept of Eco pharmacovigilance is crucial when it comes to talking about disposing of medications. It not only deals with the detection of pharmaceuticals in the environment but also chalks out strategies to prevent adverse consequences of medications on surrounding flora and fauna[17].

As a necessary component of implementing the strategies, consumers must be aware of the facts regarding the safe disposal of medications, as well as their attitude towards this issue. This study evaluates both of these parameters on the consumer level, which includes participants from the medical fraternity, i.e., MBBS and BDS students and the general public. In the current study, 82% of participants admitted to having unused medications at home, and most of them admitted to throwing away these in household garbage. In a study by Kumar et al.,[12] 37.9% of participants admitted to having a minimum of five medications that are unused in their house, while 4.1% of them had more than 25 medications that were unused and stored in their house; 88% of them disposed of these medications in garbage while 9.6% participants mentioned it acceptable to flush the medications down the toilet. Studies conducted by other authors in various countries also depict similar results[3,14,18-20]. Some participants agreed that returning the medicines to pharmacists or a medical store can be helpful in unloading the baggage of unused medications.

Nearly 60% of the study participants were of the view that expired medicines may lead to serious reactions if consumed. This is not true, as after the expiry date, the medicine loses its potency and efficacy but does not cause adverse reactions. The exception to this phenomenon is the tetracycline group of drugs, which, if consumed after the expiry date, may lead to a serious reaction called Fanconi syndrome. Only 18% of participants were of the opinion that medications lose their effect after expiry. The general public, in the study by Manocha et al., also believed that expired medicines may cause adverse drug reactions[3].

Bashaar et al. from Kabul questioned participants on who should be responsible for creating awareness for proper disposal of unused and expired medicines, and participants put the weight on government (61%), pharmacists (22%), and pharmaceutical industries (12%)[15]. In the current study, most of the participants also thought that pharmaceutical industries (38%) or government (20%) should take the responsibility of creating awareness for proper disposal of unused/expired drugs.

Kahsay et al. study from Northern Ethiopia[18] and the current study had a couple of questions in common, which were based on the medium of creating awareness for proper disposal of unused/expired medications and minimizing the number of household unused medications. In a study by Kahsay et al., 49% of participants were of the opinion that maximum awareness could be created via electronic mail, followed by 27% stating that physicians should be involved in this activity. 80% of the current study participants were of the opinion that all the mentioned options were feasible methods of creating and spreading awareness for correct disposal methods of expired medicines.

To minimize the collection of household unused/expired medicines, 38% of respondents mentioned prescribing them in adequate quantities and for the required duration, while 30% were of the opinion that proper guidance should be given to consumers to control the unnecessary collection of medications. Some of them felt donating such medicines would be an appropriate method to prevent hoarding unused medications at home. Around three-fourth, i.e., 72% of participants from the Kahsay et al. study also state that proper guidance to consumers is an apt solution to reduce

unnecessary storage of unused medicines[18]. It is evident from the above results that consumers across and around the globe have similar thinking regarding unused and expired medications.

An additional comparative analysis in the current study has brought certain facts to light that need attention as the future of the medical field, and the responsibility of protecting the environment lies primarily in the hands of the medical fraternity and, secondly, consumers. Even if the attitude towards proper disposal techniques of unused or expired medicines was comparable among the medical students and consumers, the awareness about these techniques and the ill effects of improper disposal of such drugs was significantly (p=0.009) better among the consumers. The literature showcases multiple studies where the medical fraternity has subpar knowledge about the disposal of unused or expired medicines. Raja et al., in their study, evaluated the awareness and practices of healthcare professionals and students and found that only 11.1% of their participants had partial knowledge about disposal, while 67% of them did not practice proper techniques of discarding medicines[14]. Aditya et al., in their study, found that dental students of their institute had inadequate knowledge about the disposal of unused or expired drugs, and there was a need to increase awareness among them[13]. This issue is not limited to India; it is also prevalent around the world. Mahlaba et al. also evaluated the knowledge and practices of healthcare professionals in their study and realized that there was an urgent need to educate them regarding appropriate medicine waste disposal in South Africa, and this topic should be included in the curriculum to increase awareness[21].

Awareness about the disposal of unused or expired drugs is essential to prevent environmental pollution, and as a responsible citizen of the country, every person should participate in the safe disposal of drugs. National Formulary of India (NFI) 2021 mentions certain rules for the disposal of pharmaceutical and personal products, and the document asserts that it is imperative to ensure regulatory compliance by individuals, retail and wholesale chemists, clinics, hospitals, and clinical research organizations to augment Government efforts. The document suggests sorting medications according to their formulations and their pre-treatment by mixing them with used tea powder or ground coffee before their disposal either in an incinerator or effluent treatment plant[22]. The guidelines by the Maharashtra Pollution Control Board; which is in line with the Central Pollution Control Board, it only mentions biomedical waste disposal applicable to healthcare facilities. Date-expired as well as cytotoxic medicines in all forms to be collected in yellow-coloured non-chlorinated plastic bags or containers labeled with biohazard symbol and then transported to the Common Bio-medical Waste Treatment Facility (CBWTF) in the city for disposal[23].

Disposal of unused and expired medications is a mindful issue that needs circumspection, especially by the medical fraternity. This can be achieved by the inclusion of this topic in the curriculum with the aim of making students completely aware of the appropriate ways of disposing of unused or expired medicines. The ultimate grail to attain knowledge and awareness regarding this issue is that, as the human race, we owe our environment a safety from various man-made disasters so that all the species on the earth can survive in harmony. In the current study, we included a short educational component at the end of the Google form that suggested several ways for study participants to safely dispose of medications that were compliant with NFI 2021. An appeal was also made to study participants to coordinate with local corporators/leaders to spread awareness about the disposal of medications in the community and prevent environmental hazards.

Conclusion

Looking at present circumstances, it is definite that there is a dire need to improve the awareness of the safe disposal of unused/expired medications in the community. In our study, this fact was brought to the fore, which establishes the need for medical students to have a thorough understanding of the topic at hand. It is equally necessary for layman to possess knowledge regarding safe disposal methods, and hence, awareness programs should be implemented by the Government of India to create an effective impact on people's minds and reduce the aftermath of improper disposal on the environment.

Conflict of Interest: Nil

Source of Support: Nil

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ORCiD

Priti P Dhande 0000-0002-5981-8080

Ethical consideration

Institutional Ethics Committee approval was taken prior to the initiation of the study, which was conducted in Medical and Dental colleges and residential areas in a metropolitan city.

Authors' Contribution

PD: conceived the idea questionnaire preparation, manuscript preparation and finalization; RB: drafting of proposal, questionnaire preparation, data analysis, manuscript preparation; YD: drafting of proposal, data collection, data analysis, manuscript preparation.

Data availability statement

Master data sheet, used for analysis, is available with the corresponding author on request

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