



A STUDY TO EVALUATE THE KNOWLEDGE OF MEDICAL UNDERGRADUATES ON DISPOSAL OF UNWANTED MEDICATIONS AT A UNIVERSITY MEDICAL COLLEGE AND ATTACHED HOSPITALS

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Abstract

Introduction: Environmental impact of medicines has not been well studied as their disposal is not regulated. Furthermore, improving the knowledge about practice of safe methods of disposal, educational interventions to improve awareness, and introduction of regulatory principles is the need of the hour. Therefore, this study was planned to evaluate the knowledge of medical undergraduates on disposal of unwanted medications at a university medical college and its attached hospital.

Methodology: An observational cross sectional study was conducted at a tertiary healthcare government teaching hospital from March to October 2020. All the medical undergraduate students of any gender and above 18 years of age who consented to participate in the study were enrolled. The cross-sectional online survey was in the form of a pre-validated self-administered Google form questionnaire. All data was entered on the excel sheet and data was presented as frequency and percentage.

Results: A total of 206 participants were included in the study. Unused medicines were disposed of by 53.39% of participants, 71.84% preferred dustbin while 8.25% participants did not know the exact method for safe drug disposal; 98.05% of the participants were aware of checking expiry date of medicine before taking it. Majority (82.03%) of individuals were aware of the environmental hazards caused due to improper disposal of medicines and 90.30% individuals showed interest to learn more about safe disposal of medicine.

Conclusion: There is a paucity in the current knowledge of the medical undergraduate students on safe disposal of unused medicine and therefore, training of medical undergraduates on safe drug disposal is a vital component of their education that holds far-reaching implications for both public health and environmental sustainability.

Keywords: Medical undergraduates, Safe disposal, Unused medicines, Unwanted medications.

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DOI: - 10.48047/ecb/2023.12.Si6.735

INTRODUCTION

Global Medicine consumption is increasing day by day, especially in countries like India and China.¹ Consequently, the state and national regulatory authorities have also become more vigilant to ensure the rational use of medicines meaning thereby that the patient should receive the right medicines at the right time and use them appropriately. But most of the time, these prescribed medicines are left unused by patients due to various reasons like the change of treatment by the treating doctor, self-discontinuation of treatment course due to side effects of the medicine or improvement in patient's condition. It has been observed that most of the people continue to keep their unused medicines and subsequently re-use them for self-medication which is unsafe and should be done only under the supervision of a medical professional. In addition, storage of these unused medicines at inappropriate places and sub-standard storage conditions at home may increase the risk of a wide range of potential medicine-related problems like errors in taking medications, accidental consumption by children or pets, and adverse medicine reactions due to use of expired medicines, and improper disposal of medicines.

Improper disposal of medicines has recently caused much global concern since this predisposes to environmental contamination by medicines leading to multitude of health hazards. One of the examples of direct impact of medicine to the wild life is the decline of vulture population in south Asia by Diclofenac through cattle.² The excretion of synthetic gestagens, levonorgestrel and drospirenone, from the body into water bodies has adversely affected aquatic life causing masculinization of female fishes and inhibition of their reproduction.³ In India, the bacteria resistant to Ciprofloxacin have been found downstream of a pharmaceutical factory and multi resistant Salmonella have been identified in water sprayed on vegetables.

Medicine disposal habits are influenced by environmental awareness, availability of guidelines, dosage form, and social and cultural attitudes. The most environmentally unfriendly methods of medicine disposition include flushing them into the sink, toilet, or throwing them into the dustbin. In addition to the availability of required infrastructure (e.g. landfill, incinerator) to dispose of unwanted and expired medicines, it is imperative that the public, including health care professionals, are aware of proper disposal methods and harms associated with their improper disposal.³

Globally, safe disposal of expired, unwanted, or unused medication particularly by the consumers is of high concern. This is a serious threat worldwide and has opened a new branch of science called Ecopharmacovigilance (EPV). EPV is concerned with detection, assessment, understanding, and prevention of adverse effects related to the presence of pharmaceuticals in the environment, which affects human and other animal species. Many developed countries have programs that aim at disposal of unused medicines. For instance, Australia and Canada have the National Return and Disposal of Unwanted Medicines Project which is fully supported by the government and pharmaceutical industries. The Medicine take back programs are also common in the United Kingdom and Sweden.⁴ The environmental impact of improper disposal is expected to be all the more in countries which have poor waste management systems.

Monitoring and detection of pharmaceutical impact on the environment has to be done on priority. India is facing multi medicine-resistant bacterial infections which are only the visual impact of our doing-undoing. Environmental impact of medicines has not been well studied as their disposal is not regulated. Currently, no methods exist to assess the negative environmental impact of medicines in the long and short-term exposure to synthetic medicines. Furthermore, improving the knowledge about practice of safe methods of disposal, educational interventions to improve awareness, and introduction of regulatory principles is the need of the hour. Therefore, this study was planned to evaluate the knowledge of medical undergraduates on disposal of unwanted medications at a university medical college and its attached hospital.

METHODS

An observational cross-sectional study was conducted in the Departments of Pharmacology and Physiology at a tertiary healthcare government teaching hospital from March to October 2020. All the medical undergraduate students of any gender and above 18 years of age who consented to participate in the study were enrolled.

The study protocol was approved by the institutional ethics committee and permissions were taken from the concerned administrative heads. The cross-sectional online survey was in the form of a pre-validated self-administered Google form questionnaire (attached as annexure 1). For face and content validity, the questionnaire

was pre-tested with 15 respondents after review by the experts. A link to Google form was sent to the participants. An informed consent document consisting of the participant information sheet and informed consent form was included in the beginning of the Google form questionnaire and only those participants who gave informed consent were allowed further access to the questionnaire. The questionnaire is a 27 item questionnaire consisting of 7 questions on demographic data, 08 on knowledge, 04 on attitude, and 08 on practices of disposition of unused or expired medications.

All data was entered on the excel sheet and data was presented as frequency and percentage.

RESULTS

A total of 206 participants were included in the study. Among these 102 (49.52%) were males while 104 (50.48) were female participants. History of chronic illness was found in 22.82% of participants' families.

Drug disposal practice

Majority (68.44%) of the participants prefer to store their medicines in their bedroom. Around 82.34% of the participants kept a separate medicine box for the storage of medicines while the rest of them preferred a cupboard, pocket, handbag, etc. Unused medicines were disposed of by 53.39% of participants while 46.60% kept them in the houses. The reason to keep unused medicines in houses, cited by the majority of participants, was that they think that unused medicine can be used later (57.76%). Amongst the participants who dispose of their medicine, 71.84% preferred dustbin while 8.25% participants did not know the exact method. 98.05% of the participants were aware of checking expiry date of medicine before taking it. Table 1 provides the detailed description of drug disposal practices of the study participants.

Table 1: Drug disposal practices of the study participants (n=206)

Drug Disposal Practice	Frequency (N)	Percentage (%)
1. At what place in your house do you usually keep your medicines?		
a) Kitchen	10	4.44%
b) Bedroom	154	68.44%
c) Bathroom	2	0.88%
d) Store-room	15	6.66%
e) Drawing room	44	19.55%
f) Car	0	0.00%
2. How do you store your medicines?		
a) Separate medicine box	183	82.43%
b) Refrigerator	8	3.60%
c) Hand Bag	19	8.55%
d) As such in pocket	9	4.05%
e) Shaving cupboard	3	1.35%
3. What do you do with your unused medicines?		
a) I keep them in the house	96	46.60%
b) I dispose them	110	53.39%
4. What is the reason that medicines remain unused in your house?		
a) I do not want to waste them	5	2.42%
b) In case they are needed later	119	57.76%
c) Not sure how to dispose of them	3	1.45%
d) To give them away to friends/relatives	2	0.97%
e) To keep a 'stockpile' in case of shortages	13	6.31%
f) I do not keep them, I dispose them	64	31.06%
5. How do you dispose your UNUSED medicines?		
a) Throw in dust-bin	148	71.84%
b) Return them to Medical Store	27	13.10%
c) Burn them	11	5.33%
d) Flush them down to the sink and toilet	3	1.45%
e) Do not know	17	8.25%
6. Do you check the expiry date of medicines before taking them?		
a) Yes	202	98.05%
b) No	4	1.94%
7. How do you discard the expired medicines at your home?		

a) Crushed before discarding	45	20.08%
b) Diluted	18	8.03%
c) Don't know	18	8.03%
d) As they are	143	63.83%
8. Is there any system in place for taking back unused/expired medicines in your area?		
a) Yes	15	7.28%
b) No	191	92.72%

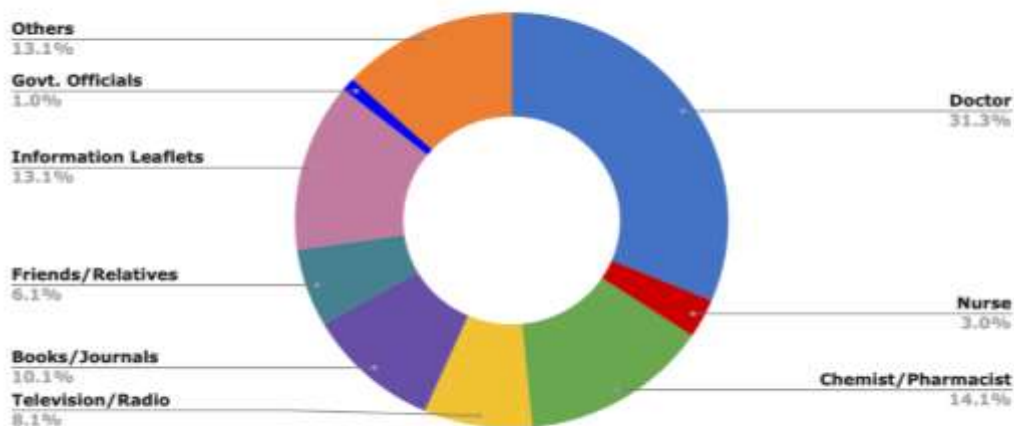


Figure 1: Source of information about the proper storage of medicines

Knowledge on safe drug disposal

When asked about their source of information about safe disposal of unused medicines, the majority (31%) of the participants received such information from doctors followed by chemist/pharmacist (14%), and others (Figure 1). When asked about the importance of proper storage of medicines, around 38.34% participants think that the effect of medicine is decreased if they are not stored properly and 36.89% think it can be misused specially by children while 15.53% participants were unaware about the effect

of improper storage of medicine. 88.34% of individuals believed that medicine either becomes toxic or loses its effects beyond their expiry date while no person believed that medicine can remain unchanged after its expiry date. Improper disposal of unused and expired antibiotics may cause medicine resistance according to 62.14% participants, while 37.86% had no such knowledge. Table 2 provides the detailed description of knowledge of the study participants on safe drug disposal.

Table 2: Knowledge of study participants on safe drug disposal

Knowledge	Frequency (n)	Percentage
1. What will happen to the medicines if they are not stored properly?		
a) Decrease in the effect of medicine	79	38.34%
b) Change in the appearance of the medicine	12	5.82%
c) Leads to misuse of the medicine especially by children	76	36.89%
d) Don't know	32	15.53%
e) Other	7	3.39%
2. If just the month and year are indicated, the medicine can be used or dispensed until the last day of that month.		
a) Yes	127	61.66%
b) No	79	38.34%
3. What change can occur in medicines beyond their expiry date?		
a) Toxic	6	2.91%
b) Remains same	0	0.00%
c) Loses its effect	18	8.73%
d) Both (a) and (c)	182	88.34%
4. Do you know that improper disposal of unused/ expired antibiotics may cause medicine resistance?		
a) Yes	128	62.14%
b) No	78	37.86%

5. Have you ever attended any formal lecture/program on safe disposal of unused /expired Medicine?		
a) Yes	25	12.14%
b) No	181	87.86%
6. Have you been taught on standard medicine disposal methods in programmed lectures/TV/ Newspapers?		
a) Yes	40	19.42%
b) No	166	80.58%

Attitude towards safe drug disposal
Majority (82.03%) of individuals were aware of the environmental hazards caused due to improper

disposal of medicines and 90.30% individuals showed interest to learn more about safe disposal of medicine (Table 3).

Table 3: Attitude of study participants towards safe drug disposal

Attitude	Frequency (n)	Percentage
1. Why do you want to keep unused medicines in your house?		
a) I do not want to waste them	5	2.42%
b) In case they are needed later	119	57.76%
c) Not sure how to dispose of them	3	1.45%
d) To give them away to friends/relatives	2	0.97%
e) To keep a 'stockpile' in case of shortages	13	6.31%
f) I do not keep them, I dispose them	64	31.06%
2. Do you think that improper disposal of unused/expired medicines can cause environmental hazard?		
a) Yes	169	82.03%
b) No	7	3.39%
c) Don't Know	30	14.56%
3. Would you like to know about safe disposal of medicines?		
a) Yes	186	90.30%
b) No	20	9.70%

Lastly, to control the hazardous effects of medicines, 33% of participants believe that proper public education and guidance hazardous effect of medicines will help, 23% suggested strict government policies on safe drug disposal, 22% suggested that medicines should be prescribed

according to the patient compliance, 10% recommended donating the unused medicines, and 8% of them think that reducing the number of prescribed medicines by doctors will help (Figure 2).

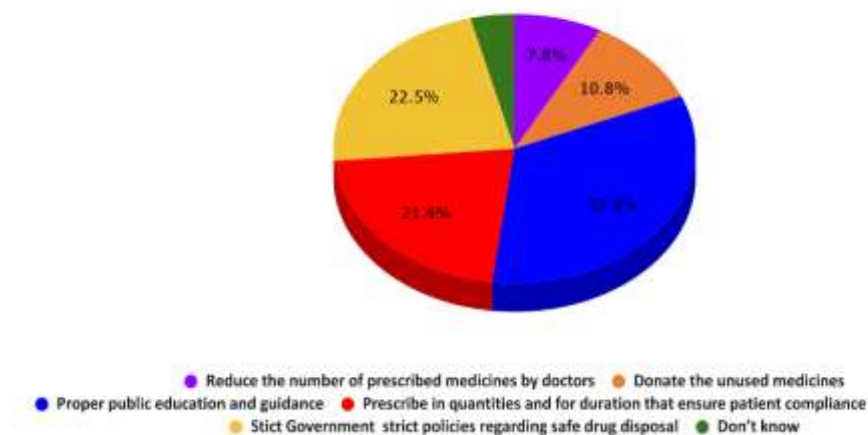


Figure 2: Participant's suggestions for minimizing/controlling hazardous effects of unused/expired medicines.

DISCUSSION

Proper disposal of medicines is a critical but often overlooked aspect of healthcare. The inappropriate *Eur. Chem. Bull. 2023, 12(Special Issue 6), 8174 –8180*

disposal of pharmaceuticals can have detrimental consequences for the environment and public health. In the present study we explored the

knowledge of medical undergraduate students of a tertiary care government teaching hospital on the importance of safe medicine disposal, the potential risks associated with improper disposal, and strategies to address this issue responsibly.

In the present study, a total of 206 participants completed the questionnaire amongst which 22.82% gave a history of chronic disease in the family which is nearly the same as found in the study conducted by Swaroop et al.⁵ The most common reason for keeping unused medicines by the study participants was “in case they are needed later” (57.76%). This is quite higher than 38.16% reported in a previous study.⁶ Also, according to World Health Organization (WHO) more than half of all medication is inappropriately prescribed and sold which causes unnecessary and improper storage.⁷

Results of the present study show that most of the participants (38.34%) believed that if the medicines were not stored properly their effect decreases with time and nearly 98.05% participants were aware to check the expiry date as compared to 78% in a similar study.^c Expiry date of medicine is the date after which a medicine might not be suitable for use as manufactured. At the time of expiry, the medicine is expected to have at least 90% of its original potency under recommended storage conditions.

It is highly usual for people to prefer to flush their expired or unused medicines down the toilet or put them in the trash; this is endangering the ecosystem due to environmental hazards like toxicity and medicine resistance. According to previous studies conducted in India, knowledge about the disposal of unwanted medication was found to be inadequate.^{3,5} The most common method for disposal of unused medications practiced by the study participants was throwing them in the dustbin. It is practiced the same way not only in India but in many other nations as well. In nations like the UK and Saudi Arabia, the majority of people put it in the trash, but in New Zealand and the USA, toilet flushing is more common.⁸

The implications of improper medicine disposal extend to public health, as unused or expired medications pose risks to individuals and communities. Unintentional ingestions of medicines by children and pets remain a significant concern, emphasizing the need for safe storage and disposal practices. Furthermore, the availability of unused medications in households may facilitate misuse and abuse. Household disposal guidelines, as recommended by country-specific regulatory agencies, offer practical steps

for safe at-home disposal of medicines. These include measures like mixing medications with inedible substances and sealing them in plastic bags, providing clear guidance for individuals. Iweh et al.⁹ underscored in their study the need for improvement on expired drugs management protocols to prevent contaminations and the attendant health hazards.

Since it has been established that improper disposal can contaminate the environment and injure animals/livestock, the safe disposal of unneeded medications is currently a hot topic drawing attention. In the current study, about 82.03% of respondents demonstrated their concern for the environment through incorrect disposal, but Swaroop et al.⁵ found that participants' concerns about the potentially harmful effects of medicines on the environment were growing to 28%. In addition, 5.33% of participants agreed with returning unneeded medication to the pharmacist, which is significantly less than the 62% in the study by Swaroop et al.⁵ It is a welcoming practice, but it must be carried out precisely. In the present study, 33% of participants agreed that there should be proper education and public awareness campaigns for promoting safe medicine disposal practices within communities. Similarly, Supriya et al.¹⁰ concluded that consumers perceive that safe disposal of drugs is necessary and recommended both educational and regulatory interventions to improve their awareness.

The present study highlights the lacunae in the knowledge on proper disposal of medicines by the study participants. Though their attitude towards this public problem appeared promising as evident by the results: 82.03% think that improper disposal of unused/expired medicines can cause environmental hazard and 90.30% wanted to know about safe disposal of medicines. Therefore, intervention by education about medicine disposal techniques that are also environmentally safe and acceptable will help change their behavior. A small study by Valerie et al.¹¹ provides a glimpse of what clients at a village community pharmacy, Malta dispose of in a medication bin when this is readily available in their community pharmacy, a simple measure which, if adopted on a national level, could aid in ensuring the appropriate disposal of wasted medication.

Training medical students on safe drug disposal is a crucial component of their education, since being future healthcare professionals, these students have a responsibility not only to prescribe and administer medications safely but also to ensure the proper disposal of unused or expired

drugs. Furthermore, by instilling the principles of safe drug disposal early in their medical education, we empower these future physicians to become advocates for sustainable healthcare practices. It is an investment in the well-being of both patients and the planet, demonstrating the commitment of the medical community to address the complex challenges of our time.

There is also a pressing need to establish cost-effective and acceptable state-run collection and disposal systems. Conscientious and proper disposal of medications can help to decrease environmental load of medicine. There is also a need to understand the practice and awareness of the public to make any such program a success.

CONCLUSION

In conclusion, the training of medical undergraduates on safe drug disposal is a vital component of their education that holds far-reaching implications for both public health and environmental sustainability. It is through such education and awareness that we can move towards a future where safe drug disposal becomes second nature to healthcare professionals, fostering healthier communities and a more sustainable world.

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