

Original Article**KNOWLEDGE, ATTITUDE AND PRACTICE STUDY OF SAFE DISPOSAL OF MEDICATIONS
AMONG MEDICAL POST-GRADUATE STUDENTS, INTERNS AND NURSING STAFF OF
TERTIARY CARE HOSPITAL OF CENTRAL GUJARAT, INDIA****MIRAL PATEL, CHIRAG MISTRY, VISHAL GAEKWAD***

Department of Pharmacology, Medical College Baroda, Vadodara, Gujarat-390001, India

*Corresponding author: Vishal Gaekwad; Email: vishal.gaekwad2000@yahoo.com

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ABSTRACT

Objective: To evaluate the knowledge, attitude, and practice about disposing unused medicines in doctors and nurses in a tertiary care hospital in central Gujarat, India.

Methods: A questionnaire comprising eighteen questions evaluating knowledge (5), attitude (8), and practice (5) of unused medicines was prepared which was pre-validated by ten resident doctors of the institute. Before starting the study, permission was obtained from the Institutional Ethics Committee. Informed consent was obtained before administering the questionnaire to the medical post-graduate students, interns, and nursing staff. Responses were recorded in a Microsoft Excel spreadsheet and evaluated for percentage response.

Results: Out of the total staff approached, 326 participants consented to participate. Most (79%) knew eco-pharmacology, and almost all (94%) acknowledged that improper drug disposal contributes to environmental pollution. However, only 28% had received advanced training in proper waste medicine disposal. The most common disposal method was discarding medicines in household trash (53%), followed by returning them to pharmacies (19%). Nearly all participants (90%) supported implementing drug take-back schemes to address improper disposal.

Conclusion: Overall, most healthcare staff is aware of the importance of safe medicine disposal; still there is a gap in their attitudes and practices. Greater emphasis on training and awareness is essential to improve proper disposal practices.

Keywords: Attitude, Eco-pharmacology, Knowledge, Medicine disposal, Practice, Unused medicines

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INTRODUCTION

In today's era, medicines play a vital role in our lives, and we cannot imagine a world without them. Drug discovery has significantly contributed to the prevention, diagnosis, and treatment of several life-threatening conditions, reducing morbidity and mortality from various chronic diseases. However, with the vast availability of medicines, rational and responsible use is crucial. A common issue encountered while using medicines is the disposal of accumulated, unused, leftover, or expired medications. Reasons for this accumulation include prescription changes due to adverse drug reactions, inadequate therapeutic effects, and unclear instructions leading to non-adherence or storing medicines for future use [1].

Society is unaware of proper disposal methods and the environmental pollution caused by improper disposal of unused and expired medicines. Pharmaceutical chemicals enter the environment through various routes, such as pharmaceutical industry waste, disposal by pharmacies or clinics, improper disposal by individuals, excretion in urine or feces, and veterinary use of medicine. This can lead to large-scale ecological disasters. For instance, a study in Patancheru, Hyderabad, India, found alarmingly high concentrations of Ciprofloxacin in effluent from a wastewater treatment plant, posing a threat to bacteria and promoting antibiotic resistance [2].

Improper disposal also led to a decline in the vulture population in the Indian subcontinent, as vultures fed on cattle carcasses treated with diclofenac, causing renal failure [3]. Eco-pharmacology studies the entry of chemicals or medications into the environment and their ecological impact, while eco-pharmacovigilance focuses on detecting, assessing, and preventing adverse environmental effects of medicines [4, 5]. The National Formulary of India suggests proper disposal methods to mitigate these issues [6]. Studies have shown a lack of awareness and proper practices among medical professionals, highlighting the need for better education on safe medicine disposal, so this study

aims to assess the knowledge, attitude, and practices of medical postgraduate (PG) students, interns, and nursing staff regarding the safe disposal of medicines [7].

MATERIALS AND METHODS

This was a cross-sectional, questionnaire-based observational study conducted in a tertiary care teaching hospital in central Gujarat for 3 mo. The study population included medical post-graduate students, interns, and nursing staff. The study was approved by the Institutional Ethics Committee for Biomedical and Health Research (Approval No.: IECBHR/172-2023.) The study included all the medical post-graduate students, interns, and nursing staff who gave consent. The medical post-graduate students, interns, and nursing staff who did not give consent were excluded from the study.

The sample size was calculated based on the result of a reference study conducted by Kamalpreet Kaur *et al.* [8], a total sample size of 322 using the formula $[n = z^2pq/d^2]$ [Where, n=sample size, z=1.96, at 95% confidence level, p=expected proportion, p=30% or 0.3, q=100-p, d=0.05 (allowable error)]

For sampling and data collection, all medical postgraduate students, interns, and nursing staff were approached personally, and a questionnaire was given to evaluate the Knowledge, Attitude, and Practice (KAP) parameters.

The study questionnaire had 18 questions in total. It included the following sections: Part A: Participant's profile, Part B: Knowledge about medication disposal, Part C: Attitude regarding medication disposal, and Part D: Practices followed in medication disposal.

Medical post-graduate students, interns, and nursing staff were contacted personally during their convenient time and were explained about the study objectives and methodology. After obtaining informed consent, they were provided with the Google form/physical copy of the pre-validated study questionnaire. Google

form of the study included a digital consent form. Each participant was encouraged to participate in the study.

Statistical analysis was done by entering the collected data from Google Forms or physical copies into a Microsoft Excel sheet. All data were analyzed using appropriate statistical software.

RESULTS

All medical postgraduate students, Bachelor of Medicine, Bachelor of Surgery (M. B. B. S.) trainee interns, and nursing staff were approached. A total of 326 participants filled out the questionnaire, which included 109 (33%) medical postgraduate students, 107 (33%) interns, and 110 (34%) nursing staff.

Analysis of knowledge components (table 1): 258 (79%) participants were aware of the concept of "Eco-pharmacology". Awareness of eco-pharmacology within different participant groups was 85% among postgraduate students, 82% among interns, and 70% among nursing staff. Around 307 (94%) participants knew improper drug disposal could lead to environmental pollution.

Overall, 66% of participants knew improperly discarded medicines leading to acute/chronic toxicity or poisoning and 50% recognized it as a possible reason for antibiotic resistance. Moreover, 183 (56%) participants did not receive and 52 (16%) did not remember receiving any training regarding proper disposal of unused/expired medicines at home. Only 28% of participants have received such training.

Table 1: Analysis of knowledge components

KAP study questionnaire (Knowledge about medication disposal)	Frequency distribution [Total participants N=326] (Percentage (%))	
1. What is Eco-pharmacology?	Correct Answer (n) =258 (79%)	
2. Are you aware that the medicines you dispose of can cause environmental (water, soil, and air) pollution?	Yes	307 (94%)
	No	19 (6%)
3. Can environmental pollution caused by medicines be a reason for antibiotic resistance?	Yes	163 (50%)
	No	39 (12%)
	May be	124 (38%)
4. Can acute/chronic toxicity or poisoning occur due to improperly discarded medicines?	Yes	215 (66%)
	No	26 (8%)
	May be	85 (26%)
5. Have you received any training regarding the proper disposal of unused or expired medicines?	Yes	91 (28%)
	No	183 (56%)
	Do not remember	52 (16%)

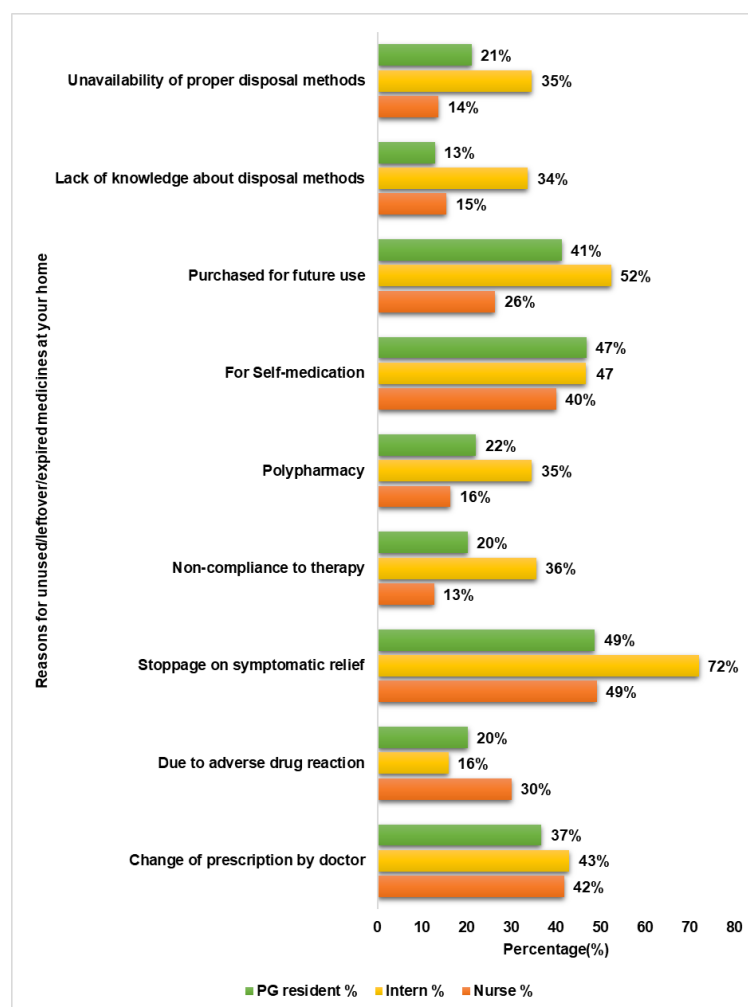


Fig. 1: What are the reasons for unused/leftover/expired medicines at your home?

Analysis of attitude components (table 2)

In the questionnaire related to attitude, 159 (49%) participants were concerned about how to dispose of excess/unused/leftover medicines at home. The issue of disposal of excess/unused/leftover medicines concerned “sometimes” to 102 (31%) and “not at all” to 65 (20%) of the participants.

In our study, leading reasons cited for unused/leftover/expired medicines were stoppage of treatment on symptomatic relief-185 (57%), self-medication-145 (44%), change of prescription by doctor-13 (41%), and purchase of more medicines for future use-13 (40%). Leftover medicines due to stoppage of treatment after symptomatic relief were highest, with 49% in post-graduate students, 72% in interns, and 49% in nursing staff. (fig. 1) 243(75%)

participants agreed that purchasing medicines without prescription adds to the load of unused medicines.

When asked about the most appropriate method of drug disposal 206 (63%) participants chose returning excess/unused/leftover medicines to a pharmacy or hospital. While 53 (16%) and 42 (13%) participants chose to throw in household trash and flush in the sink or toilet as the appropriate method of medicine disposal respectively. Only 10 (3%) knew that mixing with used tea/ground coffee followed by throwing in a dustbin is the correct method of disposal. In response to this question, 72% of postgraduates and 82% of interns chose to return excess/expired medicines to the pharmacy. Among nursing staff, 39% chose to return to the pharmacy/hospital, while 34% and 24% opted for disposal in household trash or sink/toilet, respectively (fig. 2).

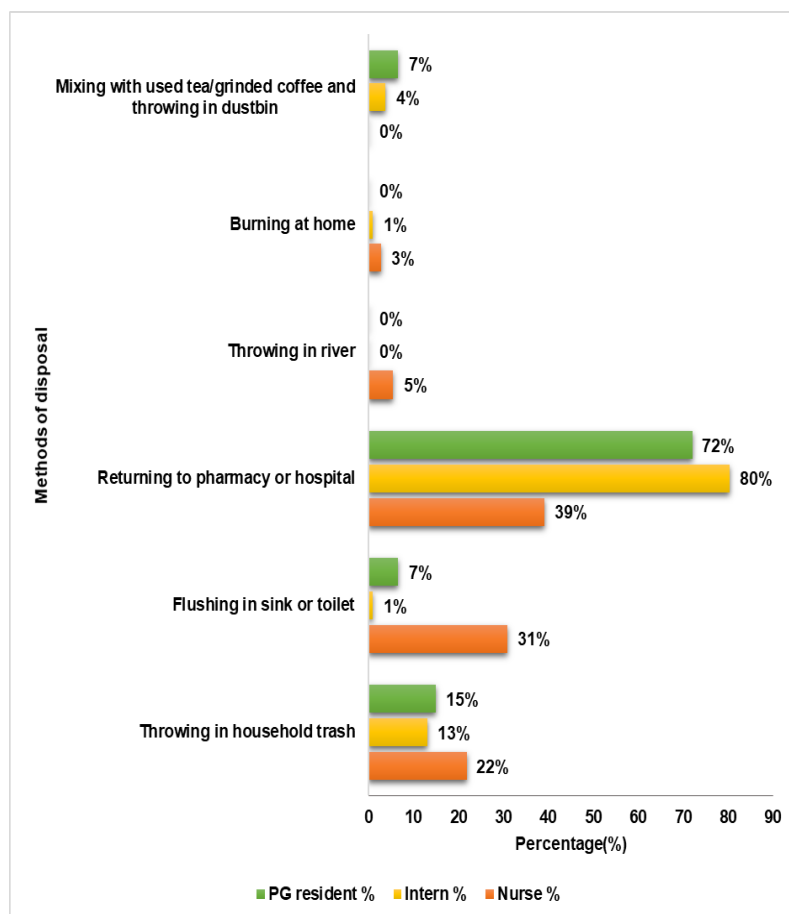


Fig. 2: According to you, which is the appropriate method of medicine disposal?

308 (94%) participants think the government should formulate and publish guidelines regarding medicine disposal. 292 (90%) agree that hospitals/pharmacies should start “drug take-back schemes” for unused medicines. For spreading awareness about safe medicine disposal, common methods chosen were information broadcast in newspapers, television, and social media-97 (30%), patient education by doctors, nursing staff, and pharmacists-65 (20%), posters of information in hospitals-65 (20%). 219 (67%) agreed to participate in activities like campaigns and patient counseling for creating awareness about safe disposal of medicines.

Analysis of practice components (table 3)

When asked about the practice of having unused/expired medicines at home, 74 (23%) didn't have any stored medicines. While 192 (59%) participants had 1 to less than 5, and 46 (14%) had 5-10 medicines stored in their cabinet at home. Antipyretics-260 (80%), antacids-214 (66%), oral analgesics-

179 (55%), cough syrup-136 (42%), and oral anti-microbial-69 (21%) were among the common groups of medicine stored by the participants (fig. 3).

When asked about practice followed by participants for disposing of unused/expired solid medicines most common method used was throwing it into household trash-172 (53%). 62 (19%) participants returned medicines to the pharmacy or hospital, while only 21 (6%) disposed of medicines by mixing them with used tea/ground coffee and threw them into the dustbin. The practice of disposing of solid medicines by throwing them in household trash and returning them to the pharmacy/hospital is followed by 56% and 23% of post-graduate students, respectively. Amongst interns, the practice of throwing excess solid medicines in household trash and returning to the pharmacy/hospital was followed by 69% and 14%, respectively. While in nursing staff, throwing in household

trash (36%), flushing in the sink/toilet (37%), and returning to the pharmacy/hospital (22%) were common practices (fig. 4).

In the case of liquid medicines, common practices followed were throwing in household trash and flushing in sink/toilet in 155 (48%)

and 65 (20%) participants, respectively. In nursing staff, flushing in the sink/toilet was a primary choice in 40% of the participants (fig. 5). Common sources of obtaining information about methods of medicine disposal were doctors (42%), the Internet (25%), nursing staff (25%), and books (25%).

Table 2: Analysis of attitude components

KAP study questionnaire (Attitude regarding medication disposal)	Frequency distribution, [Total participants N=326] (Percentage (%))	
1. Has it ever bothered you, what to do with excess/unused/leftover medicines at home?	Yes	159 (49%)
	No	65 (20%)
	Sometimes	102 (31%)
2. What is the reason for unused/leftover/expired medicines at your home?	Change of prescription by doctor	132 (40%)
	Due to adverse drug reaction	72 (22%)
	Stoppage of treatment on symptomatic relief	184 (56%)
	Non-compliance to therapy	74 (23%)
	Prescription of more number of medicines-polypharmacy	79 (24%)
	For self-medication	145 (44%)
	Purchase of more number of medicines for future family use	130 (40%)
	Lack of knowledge about disposal methods	67 (21%)
	Unavailability of proper disposal methods	75 (23%)
3. Do you think that purchasing medicines without prescription adds to the load of unused medicines?	Yes	243 (75%)
	No	49 (15%)
	May be	34 (10%)
4. Do you think that the government should formulate and publish guidelines regarding medicine disposal?	Yes	308 (94%)
	No	6 (2%)
	May be	12 (4%)
5. According to you, which is the appropriate method of medicine disposal purchased for personal/family use?	Throwing in household trash	53 (16%)
	Flushing in sink or toilet	42 (13%)
	Returning to the pharmacy or hospital	206 (63%)
	Throwing in river	6 (2%)
	Burning at home	4 (1%)
	Mixing with used tea/ground coffee and throwing in a dustbin	10 (3%)
6. Do you think that hospitals/pharmacies should start "drug take-back schemes" for unused/expired medicines?	Yes	292 (90%)
	No	11 (3%)
	May be	23 (7%)
7. Which method do you think is the best for bringing awareness to patients and relatives about safe disposal of medicines?	Patient education by Doctors, Nursing Staff or Pharmacists	65 (20%)
	Posters of Information Education and Communication in hospitals in vernacular language	65 (20%)
	Information broadcast in newspapers, television, and social media	97 (30%)
	Awareness programs and activities by the government	61 (19%)
	Written instructions on box of medicines	34 (10%)
8. Will you participate in activities like campaigns, patient counselling, etc. to bring awareness about the safe disposal of medicine?	Yes	219 (67%)
	No	29 (9%)
	May be	78 (24%)

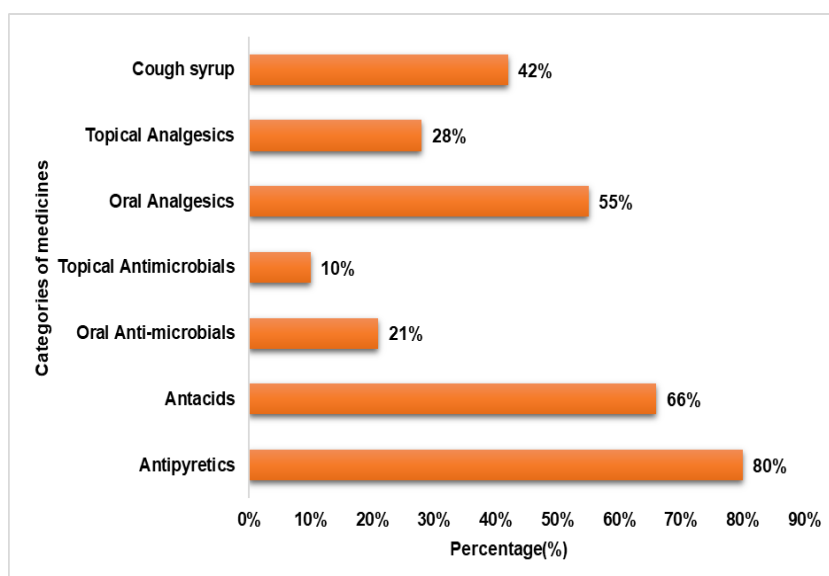


Fig. 3: Which is/are the most common medicine/s stored by you for personal/family use?

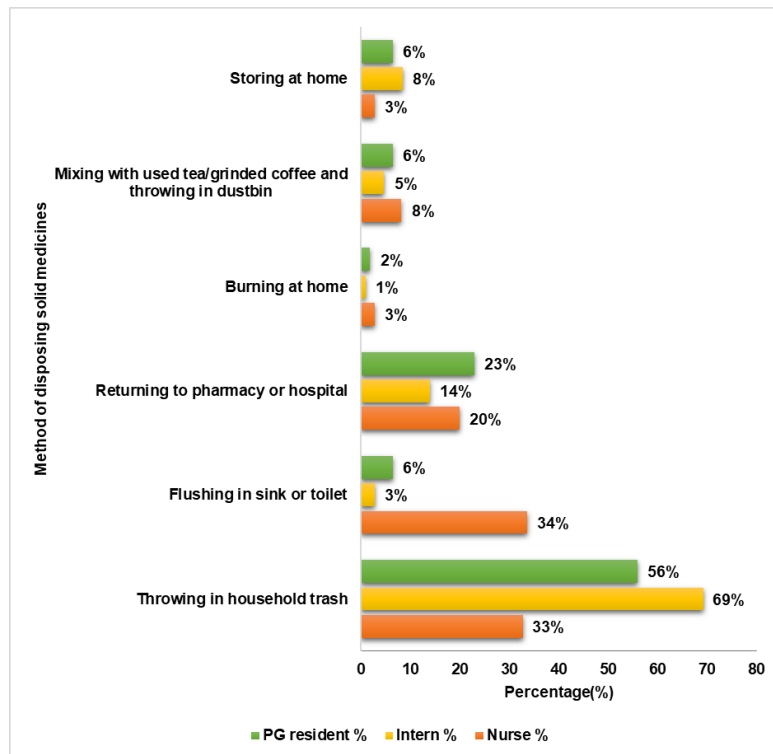


Fig. 4: How do you dispose of unused/expired solid medicines at home?

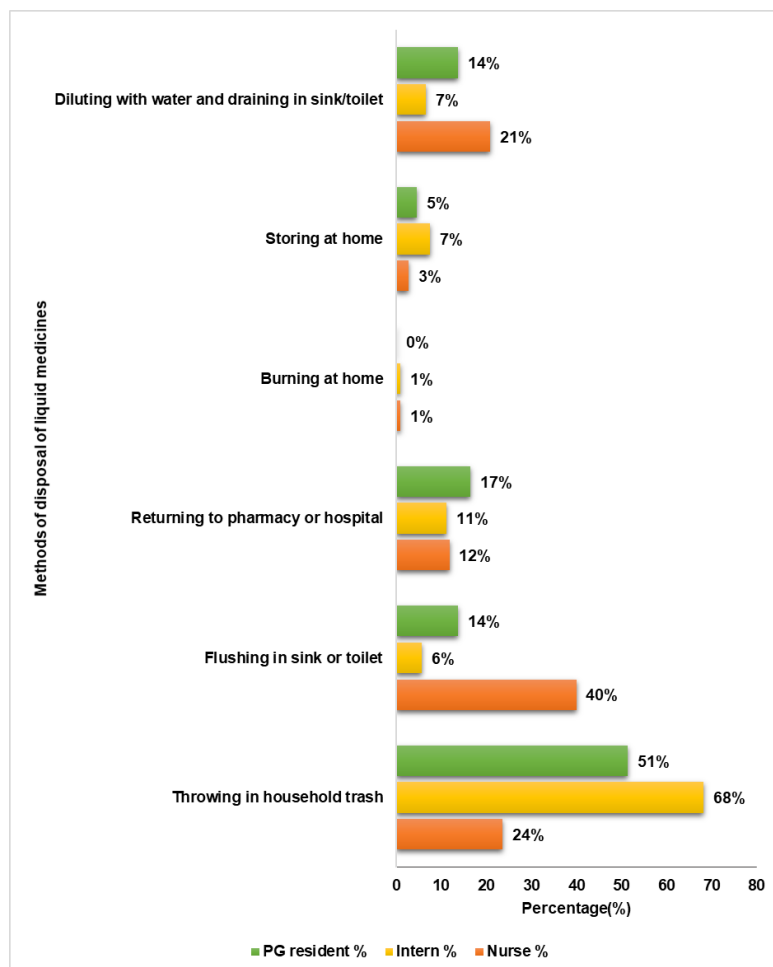


Fig. 5: How do you dispose off unused/expired liquid medicines at home?

Table 3: Analysis of practice components

KAP study questionnaire (Practices followed for medication disposal)	Frequency distribution, [Total participants N=326] (Percentage (%))	
1. How many different types of unused/expired medicines do you have in your medicine cabinet at home?	None	74 (23%)
	Less than 5	192 (59%)
	5-10	46 (14%)
	More than 10	14 (4%)
2. Which is/are the most common medicine/s stored by you for personal/family use?	Antipyretics	260 (80%)
	Antacids	214 (66%)
	Oral Anti-microbials	69 (21%)
	Topical Anti-microbials	31 (10%)
	Oral Analgesics	179 (55%)
	Topical Analgesics	91 (28%)
	Cough syrup	136 (42%)
3. How do you dispose of unused/expired solid medicines at home?	Throwing in household trash	172 (53%)
	Flushing in sink or toilet	46 (14%)
	Returning to the pharmacy or hospital	62 (19%)
	Burning at home	6 (2%)
	Mixing with used tea/ground coffee and throwing in a dustbin	21 (6%)
	Storing at home	19 (6%)
	Throwing in household trash	155 (48%)
4. How do you dispose of unused/expired liquid medications at home?	Flushing in sink or toilet	65 (20%)
	Returning to the pharmacy or hospital	43 (13%)
	Burning at home	2 (1%)
	Storing at home	16 (5%)
	Diluting with water and draining in sink/toilet	45 (14%)
	Doctors	136 (42%)
	Pharmacists	58 (18%)
5. From where have you gathered information about methods of drug disposal?	Nursing Staff	109 (33%)
	Family and friends	36 (11%)
	Books	79 (24%)
	Journals/Guidelines	69 (21%)
	Internet	83 (25%)

DISCUSSION

"A branch of science that deals with the detection, assessment, understanding, and prevention of adverse effects of medicines in the environment that affect human and other animal species is known as Eco-pharmacovigilance" [5]. Through this study, we have evaluated knowledge, attitude, and practice about the disposal of unused medications among medical post-graduate students, interns, and nursing staff. This was an observational, cross-sectional, questionnaire-based study comprising a total of 18 questions.

In our study, 79% of the participants knew about eco-pharmacology and 94% were aware that improper drug disposal can lead to environmental pollution. In a similar study done by Bhatt *et al.* among M. B. B. S. students, 73.25% of participants knew eco-pharmacology and 91.15% of the participants were aware of the hazardous environmental impact of improper disposal of drugs. In the same study, awareness about environmental pollution by improper drug disposal as one of the causes of antibiotic resistance was found in 86% of participants [9], while it was 50% of our study participants. In a similar study conducted in south India, 75% of participants knew about the environmental hazards due to improper drug disposal [10].

In our study, common reasons noted for stockpiling unused/leftover/expired medicines at home were stoppage of treatment for symptomatic relief (56%), self-medication purposes (44%), change of prescription by doctor (40%), and purchase of a greater number of medicines for future use (40%). In a study done by S. Aditya *et al.*, common reasons cited were left over previous over-the-counter drug purchases (53%) and passing of expiry date (24%). In comparison to our study, in S. Aditya *et al.*'s study, self-discontinuation after symptomatic relief (14%) and change of treatment by doctor (5%) had lower contribution in stockpiling of drugs [11].

Common categories of medicines stored by the participants in our study were antipyretics (80%), antacids (66%), oral analgesics (55%), and cough syrup (42%). 21% stored oral and 10% stored topical antimicrobial in our study. In a similar study, done among

undergraduate dental students, common medicines hoarded at home were antipyretics (54%), analgesics (64%), and antihistamines (35%). In this study, as well 26% of participants had antibiotics among stored medications [11].

Regarding practices for medicine disposal most common methods cited in our study were throwing in household trash (53% for solid and 48% for liquid medications), and flushing in the sink or toilet (14% for solid and 20% for liquid medications). The practice of returning the medications to the pharmacy or hospital was followed by 19% for solid and 13% for liquid medications of the participants. Another acceptable method of mixing with used tea/ground coffee followed by throwing it in a dustbin was used by 6% of the participants. In a similar study in north India, disposal in the trash (94%), and flushing in the sink (32%) and toilet (12%) were commonly used methods, while only 3% of participants practiced returning the drugs to the pharmacy [11]. The commonly reported methods practiced by the participants in a study conducted in central India were returning it to the pharmacy in 23% of participants, followed by 21.8% throwing them into household trash and 6% donating medicines to healthcare establishments [12]. Similar kind of results were also observed in a study done among pharmacy students of Ethiopia, where common methods for drug disposal were throwing in household garbage (61%) and flushing in the toilet or sink (32%); while returning to the pharmacy or hospital was followed in only 6% participants [13].

The most common method used by the participants in the above-mentioned studies was throwing the medicines in household trash, which shows ignorance towards proper medication disposal. Improper disposal of medicines in the household trash or flushing in the toilet/sink can lead to environmental pollution. One study measuring the concentration of 56 active pharmaceutical ingredients in 50 big wastewater treatment plants in the United States found Hydrochlorothiazide (a diuretic that treats high blood pressure) in every sample and Carbamazepine (an antiepileptic and mood stabilizer) in more than 90% of the samples [14]. A wide range of antimicrobials have also been observed in the environment. Researchers have found that at the exit of the Yamuna River in Delhi,

the concentration of antimicrobial agents fluconazole and ofloxacin was 80 and 50 times more, respectively than at the entry of the Yamuna River in Delhi [15]. These alarmingly high levels of antimicrobials may provide the breeding environment for superbugs.

The National Formulary of India, 2021 recommends proper drug disposal methods such as returning large quantities of expired or unused pharmaceuticals to wholesalers, mixing medicines with used tea/ground coffee and throwing them in the dustbin for small quantities [6]. 90% of participants in our study strongly agreed that the hospitals/pharmacies should start "drug take-back schemes" for unused/expired medicines. In Australia, under the Return Unwanted Medicine (RUM) project; returned medicines are deposited in RUM bins located within pharmacies, which are then collected by pharmaceutical wholesalers and transferred to designated incineration sites [16]. Similar schemes are also present in countries like Denmark, France and Canada [17, 18]. Such schemes or projects provide structured operating procedures for disposing of unused/expired medicines and thereby decrease the harm caused to the environment.

In our study, the participants of the study had knowledge about the environmental perils caused by improper medicine disposal, but practices are still sub-par and require educational intervention. In this study, the participants were health care providers and their proper training can reduce the scale of problems in larger proportion, as they can instruct their patients about proper disposal of medications. On the topic of ecotoxicology and proper disposal of medications, the stakeholders, including the government, hospitals, doctors, pharmacists, and patients, should work together to ensure health and environmental safety.

LIMITATIONS

This study was conducted with a small sample from a single tertiary care hospital as a short study under the post-graduate curriculum. Future research can be conducted on larger and more diverse populations with varying literacy levels and socioeconomic backgrounds.

CONCLUSION

The majority of the participating doctors and healthcare staff understand the importance of safely disposing of unused or leftover medicines. However, there is a need to improve the attitude and practices regarding proper medicine disposal. Regular sensitization training and informative interventions are recommended to enhance awareness and practices in this area.

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AUTHORS CONTRIBUTIONS

Conception/design: Dr. Miral Patel, Dr. Chirag Mistry, Dr. Vishal Gaekwad. Methodology: Dr. Miral Patel, Dr. Chirag Mistry, Dr. Vishal Gaekwad. Data collection: Dr. Miral Patel. Result analysis and discussion: Dr. Miral Patel, Dr. Chirag Mistry, Dr. Vishal Gaekwad. Manuscript writing and preparation: Dr. Miral Patel, Dr. Chirag Mistry, Dr. Vishal Gaekwad.

CONFLICT OF INTERESTS

There are no conflicts of interest

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