

Original Research Article

Assessment of knowledge, attitudes and practices regarding disposal of unused and expired medicines among the general public in Bathinda district, Punjab

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ABSTRACT

Background: Improper disposal of unused and expired medicines has become an important public health and environmental concern. Lack of awareness regarding safe medication disposal practices may lead to environmental pollution, drug resistance, and adverse health outcomes. The present study aimed to assess the knowledge, attitude, and consumer practices regarding disposal of unused and expired medicines among the general public in Bathinda district, Punjab.

Methods: A community-based cross-sectional observational study was conducted among 152 participants aged above 18 years in Bhuchokalan, Bhuchokhurd, and Bhuchokmandi areas of Bathinda district. Data were collected using a structured questionnaire through face-to-face interviews after obtaining informed consent. Statistical analysis was performed using Microsoft Excel and IBM SPSS version 22.0. Chi-square test was applied and $p < 0.05$ was considered statistically significant.

Results: Majority of participants (61.2%) reported the availability of expired medicines at home. About 53.3% participants understood expiry of medicines as loss of shelf life, treatment failure, and production of toxins. Most respondents disposed medicines in household trash (59.2%) and only a few returned medicines to pharmacies (5.3%). Significant association was observed between checking expiry dates and demographic factors such as age, education, and occupation status ($p < 0.05$).

Conclusions: Although the public showed awareness regarding environmental hazards associated with improper disposal of medicines, inappropriate disposal practices were still common. Awareness programs, written instructions, and drug take-back initiatives are required to improve safe disposal practices among the general population.

Keywords: Unused medicines, Expired medicines, Disposal practices, Public awareness, Environmental pollution, Community health

INTRODUCTION

Medicines are essential for the prevention, treatment, and management of various acute and chronic diseases. Appropriate use of medicines improves patient outcomes and enhances quality of life. However, changes in treatment regimens, recovery from illness, adverse drug

reactions, non-adherence to therapy, and over-purchasing of medicines often result in the accumulation of unused and expired medicines in households. The presence of such medicines in homes has become a growing public health concern worldwide.¹⁻⁴ Improper storage and disposal of unused and expired medicines may lead to several health and environmental problems. Expired

medicines may lose their effectiveness, cause treatment failure, or produce undesirable effects. In addition, the accumulation of medicines at home increases the risk of accidental poisoning, self-medication, medication errors, and misuse by family members. Improper disposal practices such as throwing medicines into household garbage, flushing them into sinks or toilets, and open dumping may contribute to environmental contamination.^{5,6}

Pharmaceutical waste has gained increasing attention because drug residues released into the environment may contaminate soil and water resources. Various national and international organizations have emphasized the need for safe disposal of medicines to minimize environmental hazards and protect public health. The World Health Organization (WHO) and the United States Food and Drug Administration (FDA) recommend appropriate disposal methods, including medicine take-back programs and return-to-pharmacy systems, for the safe management of unused and expired medicines.^{7,8}

Several studies conducted in different countries have reported inadequate knowledge and inappropriate disposal practices among the general public. Previous investigations have shown that many individuals commonly dispose of expired medicines through household trash instead of returning them to pharmacies or authorized collection centers. Studies have also reported that lack of awareness regarding proper disposal methods remains a major challenge in effective pharmaceutical waste management.⁹⁻¹² In India, awareness regarding the safe disposal of unused and expired medicines is still limited, particularly in community settings. Most people are unaware of recommended disposal guidelines and continue to follow unsafe disposal practices. Although some studies have evaluated public knowledge and disposal practices in different regions of India, limited information is available from North Indian populations, especially in Punjab.^{11,12}

Assessment of public knowledge, attitude, and consumer practices regarding medicine disposal is important for identifying existing gaps and developing effective awareness programs. Understanding community behavior can help healthcare professionals and policymakers formulate strategies to improve safe disposal practices and reduce environmental risks associated with pharmaceutical waste.^{13,14} Therefore, the present study was conducted to assess the knowledge, attitude, and consumer practices regarding disposal of unused and expired medicines among the general public in Bathinda district, Punjab. The study also aimed to evaluate the association between demographic characteristics and disposal-related knowledge and practices.

METHODS

A community-based cross-sectional observational study was conducted over a period of six months from March

2024 to August 2024 in Bhucho-kalan, Bhucho-khurd, and Bhucho-mandi areas of Bathinda district, Punjab, India. The study was carried out after obtaining approval from the Ethics Committee of Biomedical and Health Research, Adesh University, Bathinda.

The study population included both male and female participants aged 18 years and above who were using prescription medicines or over-the-counter medications and purchased medicines themselves. Participants who were willing to provide written informed consent were included in the study.

A total of 152 participants were enrolled using a time-bound sampling approach. Data were collected through face-to-face interviews using a pre-designed structured questionnaire. The questionnaire consisted of demographic details including age, gender, marital status, educational qualification, occupation, and residence status. Additional questions were included to assess knowledge, attitude, and consumer practices regarding storage and disposal of unused and expired medicines.^{4,13}

The questionnaire also included information regarding common medicines stored at home, methods of disposal of expired medicines, reasons for keeping unused medicines, and awareness regarding environmental hazards caused by improper disposal. Participants were interviewed in Hindi, Punjabi, or English according to their convenience.^{4,13}

Written informed consent was obtained from all participants prior to data collection. Confidentiality and anonymity of study participants were maintained throughout the research process. Data obtained from the study were entered into Microsoft Excel and analyzed using IBM SPSS version 22.0. Descriptive statistics such as frequency and percentage were used to summarize the findings. Chi-square test was applied to determine associations between demographic variables and knowledge or consumer practices related to disposal of medicines. A p-value less than 0.05 was considered statistically significant.

RESULTS

Distribution of demographic data

Among the 152 participants enrolled in the study, 83 (54.6%) were males and 69 (45.4%) were females. Majority of participants belonged to the age group of 18-30 years (25.7%), followed by 41-50 years (22.4%) and 31-40 years (21.7%). Most participants were married (69.7%) and belonged to rural areas (72.4%). Regarding educational status, 34.2% participants had higher education whereas 27.6% were illiterate. About 41.4% participants were suffering from chronic diseases. Diabetes mellitus and hypertension were the most common chronic illnesses reported by the participants (Table 1).

Knowledge about expired drugs

Evaluation of knowledge revealed that 61.2% participants had expired medicines available at home. More than half of the respondents (53.3%) understood expiry of medicines as loss of shelf life, treatment failure, and toxin

production. However, 54.6% participants did not know that expired medicines could contribute to drug resistance. A total of 54.6% participants believed that improper disposal of medicines could lead to environmental pollution, while 49.3% knew that expired medicines may cause adverse drug reactions (Table 2).

Table 1: Representing the demographic data.

Demographic variables		Frequency (n=152)	Percentage (%)
Gender	Male	83	54.6%
	Female	69	45.4%
Age category (years)	18-30	39	25.7%
	31-40	33	21.7%
	41-50	34	22.4%
	51-60	20	13.2%
	above 60	26	17.1%
Marital status	unmarried	40	26.3%
	married	106	69.7%
	widowed	6	3.9%
	divorced	0	0.0%
Education status	illiterate	42	27.6%
	Primary	23	15.1%
	Secondary	35	23.0%
	Higher	52	34.2%
Occupation status	Farmer	47	30.9%
	Housewife	35	23.0%
	Teacher	12	7.9%
	Student	17	11.2%
	Worker	30	19.7%
	Other	11	7.2%
Residence status	Urban	31	20.4%
	Rural	110	72.4%
	semi-urban	11	7.2%

Table 2: Representing the knowledge about expired drugs.

Evaluation of knowledge		Frequency (n=152)	Percentage (%)
Q.1. Availability of expired medication at home	Yes	93	61.2%
	No	59	38.8%
Q.2. What do you understand by expiry of medicines?	Loss of shelf life	30	19.7%
	producing toxin	20	13.2%
	loss of effect	21	13.8%
	all of above	81	53.3%
Q.3. Do expired medicines produce drug resistance?	Yes	50	32.9%
	No	19	12.5%
	don't know	83	54.6%
Q.4. Do you think that disposal of expired medicine lead to environmental pollution?	Yes	83	54.6%
	No	24	15.8%
	don't know	45	29.6%
Q.5. Do expired medicine produce drug reaction?	Yes	75	49.3%
	No	17	11.2%
	don't know	60	39.5%

Consumer practice regarding disposal of unused and expired medicines

In this evaluation, a large portion of population asked that maximum quality of drugs remains unused at their homes. Of 125 (82.2%) subjects declared that they possessed medicine which were unused at home as compared to 27 (17.8%) other subjects. almost 69 (45.4%) of total subjects described that they read the label of expiry date before buying medicine. But more than half subjects 83 (54.6%) did not check the expiry date of drugs as shown in Figure 1.

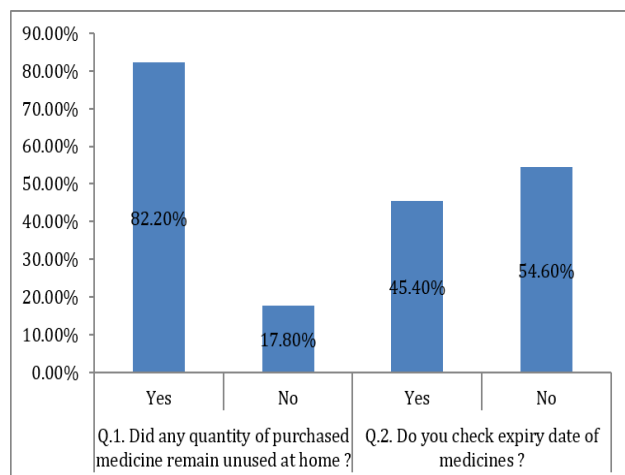


Figure 1: Percentage wise distribution according to consumer practice regarding disposal of unused drugs.

Reasons for unused medicines

Different reasons for keeping unused medicines at home were identified. Majority of participants 88 (57.9%) discontinued medicines on their own, while 39 (25.7%) stopped medicines on doctor's advice. Other reasons included purchasing excess medicines 10 (6.6%), buying medicines due to advertisements 9 (5.9%), and storing expired medicines 6 (3.9%) (Figure 2).

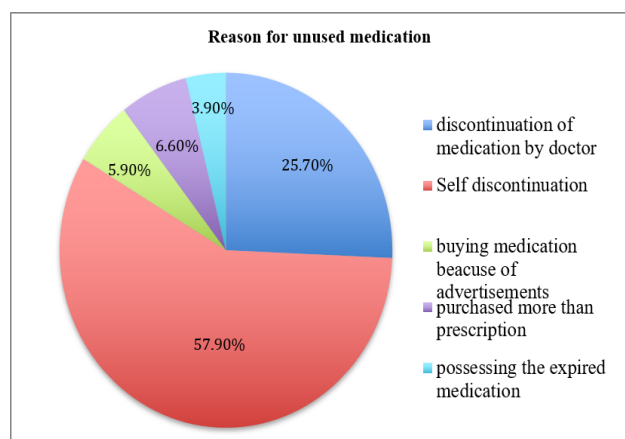


Figure 2: Reasons for unused medicines.

Common medicines stored by subjects

As per respondents, the majority of subjects 74 (48.7%) had used analgesic medicine and 58 (38.2%) had used antacids. But, minimum quantity of 22 (14.5%) and 21 (13.8%) subjects had stored antihypertensive and antidiabetic drugs. Amongst the unused medicine, 24 (15.8%) antibiotic and 26 (17.1%) antipyretic drugs were stored by population at their home.

Different methods of disposing of medicines

Most respondents disposed of unused medicines in household trash instead of returning them to a pharmacy or medical store. A total of 71 (46.7%) participants threw medicines in household trash, while 29 (19.1%) flushed them into sinks or sewer systems. Additionally, 21 (13.8%) burned medicines at home, 19 (12.5%) buried them in the ground, and 12 (7.9%) used other disposal methods (Figure 3).

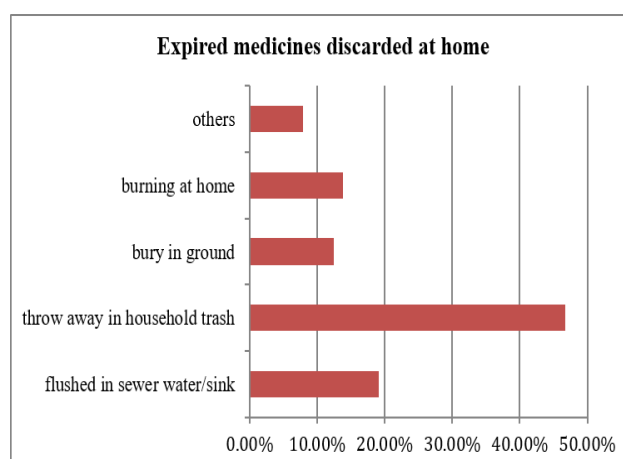


Figure 3: Representing the different methods of disposing of medicines.

Attitude towards practice of disposal of unused medicines

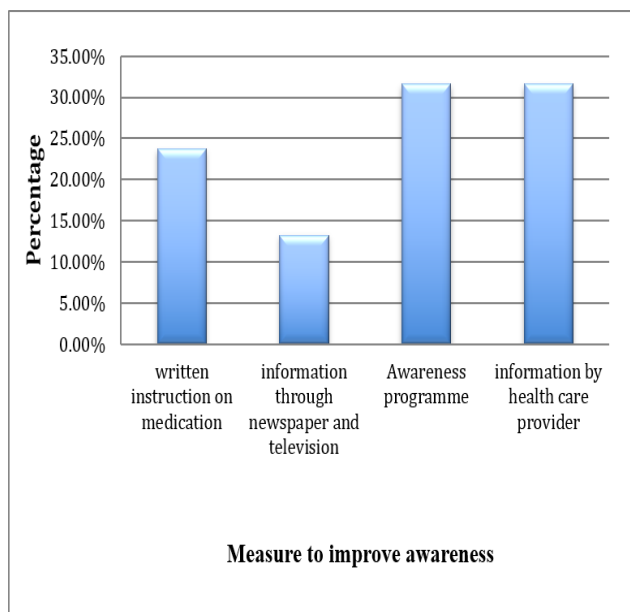
Most participants supported safe disposal practices, with 96.7% considering proper medicine disposal important and 94.1% favoring programs to collect unused or expired medicines from homes. Nearly 98% also agreed on the need for public awareness programs regarding proper drug disposal (Table 3).

Measures to improve awareness regarding disposal of unused and expired medicines

Nearly half 48 (31.6%) of population felt that information for methods of disposal of drugs provided by health care provider or through awareness programmer. A substantial proportion 36 (23.7%) of people felt written instruction on medication labeling and 20 (13.2%) subjects felt that awareness improved by information through newspaper and television (Figure 4).

Table 3: Representing the attitude towards practice of disposal of unused medicines.

Questions	Agree	Neither agree nor disagree	Disagree
Q.1. Is safe the disposal of medicines necessary	147 (96.7%)	4 (2.6%)	1 (0.7%)
Q.2. Is there need for programme to collect unused or expired medicines from home	143 (94.1%)	6 (3.9%)	3 (2.0%)
Q.3. Awareness regarding the hazards of unsafe disposal and safe disposal of medicine among public	149 (98%)	1 (0.7%)	2 (1.3%)

**Figure 4: Percentage wise distribution measures to improve awareness.**

*Statistically significant association was observed between checking expiry dates and age category, educational status, and occupation status ($p < 0.05$). Younger and educated participants were more likely to check expiry dates before purchasing medicines.

DISCUSSION

The present study evaluated knowledge, attitude, and consumer practices regarding disposal of unused and expired medicines among the general public in Bathinda district, Punjab. Findings of the study demonstrated that although participants had moderate awareness regarding harmful effects of improper medicine disposal, inappropriate disposal practices were still highly prevalent.

Majority of participants had unused or expired medicines stored at home. Similar findings have been reported in studies conducted in Delhi, Saudi Arabia, and Serbia, where unused medicines were commonly stored in households due to self-discontinuation of therapy, changes in prescriptions, and expiry of medicines. Storage of unused medicines at home may increase the risk of accidental poisoning, self-medication,

inappropriate sharing of medicines, and environmental contamination.^{15,16}

In the present study, more than half of the participants understood that expired medicines may lead to treatment failure and environmental pollution. However, knowledge regarding drug resistance caused by improper medicine use was still inadequate. These findings indicate the need for continuous public education programs regarding medicine safety and disposal practices.¹⁷

The most common method of disposal identified in this study was throwing medicines into household trash. Similar disposal practices have been reported in previous Indian and international studies. Such practices may contaminate water bodies, soil, and food chains when pharmaceutical compounds enter the environment. Very few participants returned medicines to pharmacies or medical stores, indicating lack of organized drug take-back systems and poor awareness regarding safe disposal options.¹⁸

Educational status played an important role in medicine handling practices. Participants with higher educational qualifications were more likely to check expiry dates before purchasing medicines compared to illiterate participants. Younger participants and healthcare-related professionals also demonstrated better awareness regarding safe medicine practices.^{13,14}

The study additionally evaluated disposal practices during the COVID-19 pandemic. Most participants discarded masks and medicine waste into household trash, whereas a smaller proportion followed safer methods such as wrapping in plastic bags before disposal. This finding highlights the importance of public education regarding biomedical waste management during public health emergencies.

Awareness programs, guidance from healthcare professionals, and written instructions on medicine labels were identified as important measures for improving public knowledge. Participants also suggested establishment of collection containers and drug take-back programs for safe medicine disposal.^{10,18}

Overall, the findings suggest that although awareness regarding environmental hazards exists among the public,

practical implementation of safe disposal methods remains inadequate. Government authorities, pharmacists, and healthcare professionals should work together to establish standardized disposal guidelines and community awareness programs.

Limitations

The study has few limitations that it was conducted among a relatively small sample of 152 participants from selected areas of Bathinda district, which may limit the generalizability of the findings. The use of time-bound sampling and self-reported responses may have introduced selection, recall, and social desirability biases. As the study was cross-sectional, causal relationships could not be established. Future studies with larger, multicentric populations and probability-based sampling are recommended

CONCLUSION

The study concluded that inappropriate disposal practices of unused and expired medicines are highly prevalent among the general public. Although many participants were aware of environmental hazards associated with improper disposal, safe disposal practices were not commonly followed. Government authorities and healthcare professionals should promote awareness campaigns, establish medicine take-back programs, and provide clear disposal guidelines to reduce environmental and public health risks.

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