

Assessment of Knowledge, Attitude and Practice on Disposal of Unused and Expired Medications Among Dwellers of Selected Slums in Kolkata

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ABSTRACT

Background: Awareness about unused and expired medicines and its disposal practices is becoming a global concern due to environmental contamination and other health issues. Currently, there is not much data available in the community settings regarding knowledge, attitude and methods of medication disposal in India. The objectives were to evaluate the knowledge, attitude and practice about disposal of unused and expired medications among selected slum of Kolkata.

Materials And Methods: Community-based descriptive cross-sectional study was conducted among selected urban slum dwellers in Kolkata over a period of 2 months. A total of 183 adult study participants were selected through Multistage random sampling, were interviewed using a pre-designed, pretested and structured schedule that includes sociodemographic variables and 29 questions on knowledge, attitude and practice. Pearson's chi square test followed by Binary logistic regression was performed; considering p-value <0.05 to find out association.

Results: About 61.7% were males. The mean ($\pm$ SD) age was 37 ± 11 years. While 65.5% (n=120) of the respondents heard about medication waste, 46.6% of them agrees that inappropriate disposal can cause potential harm. Merely 14.1% accepts that medication waste should not be disposed along with household waste. 46.6% showed positive attitude towards medication disposal. 68.3% (n = 82) of the respondents were having leftover medicines in their households, of which 100% dispose them by throwing in dustbin. Statistically significant association was found between education, socio-economic status and occupation with knowledge, whereas education and occupation with attitude.

Conclusions: The majority of slum dwellers had poor knowledge, a negative attitude, and inappropriate practices regarding the disposal of unused and expired medicines.

Keywords: unused medications, expired medications, medication disposal, Kolkata, slum

INTRODUCTION

Expired medications are beyond their 'use-by' date, resulting in a loss of efficacy, potency, safety and leading to the formation

of products that possess health risks and equally dangerous for the ecosystem. Unused medications are defined as non-expired medicines that were previously prescribed or

recommended by a healthcare professional but are no longer being used by the patient.

[1]

Globally, India holds the fifth position in terms of volume production of pharmaceutical products [2] of which a considerable portion of these remain unused or expired. [3,4] According to the World Health Organization (WHO), approximately 50% of medicines are prescribed, dispensed, or sold inappropriately, while nearly half of all patients fail to use medicines as directed. [6] Several factors contribute to the non-use and subsequent disposal of medicines, including changes in prescriptions, drug-related adverse effects, unclear medication instructions, resolution of the underlying condition or clinical symptoms, and medicines reaching their expiry date. Consequently, inappropriate or incomplete medication use may result in the accumulation of unused medicines in households, leading to medication wastage. Improper storage and disposal of these medicines may contribute to environmental contamination and increase the potential for medication misuse and abuse, with subsequent implications for morbidity, mortality, and healthcare expenditure. [7] Prolonged environmental exposure to pharmaceutical residues may also have adverse effects, particularly among vulnerable populations such as pregnant women, newborns, and children. In addition to environmental and ecological concerns, the accumulation of unused or expired medicines in households, as well as their inappropriate donation to others, may result in accidental or unintended ingestion and increase the risk of adverse drug effects. Evidence from recent reviews indicates that consumers employ a variety of methods to dispose of unused medicines, with common practices including disposal in household garbage, toilets, or sinks. [9-20]

Several developed countries have implemented structured medication take-back and disposal programs with support from governmental agencies and the pharmaceutical industry. In Australia and

Canada, initiatives such as the “National Return and Disposal of Unwanted Medicines Project” facilitate the safe collection and disposal of unwanted medicines, while the United Kingdom and Sweden have also promoted drug take-back programs. [4,8] The WHO has published evidence-based recommendations for the safe disposal of unused, unwanted, or expired medicines, including returning such medicines to local pharmacies, clinics, or healthcare providers for appropriate disposal. [2] Despite being a major consumer of medicines, India currently lacks comprehensive and effectively implemented regulatory mechanisms to guide consumers regarding the safe disposal of unused and expired medications. Although the National Formulary of India, 2011, provides recommendations for medicine disposal, [5] awareness and adherence to these guidelines among the general population remain limited. Furthermore, drug take-back programs are not yet widely available or effectively implemented across the country. There is limited evidence from community settings in India regarding the knowledge, attitudes, and practices related to the disposal of unused and expired medicines. Therefore, considering these concerns, the present study aimed to assess the knowledge, attitudes, and practices regarding the disposal of unused and expired medications among selected slum-dwelling populations in Kolkata and to identify associated factors, if any.

MATERIALS & METHODS

Study design, area, participants

A community based cross-sectional study was conducted among dwellers of selected slums in urban field practice area of a tertiary care hospital of Kolkata under ward-81, over a period of 2 months i.e. August 2023 to September 2023. One adult member from each household were interviewed, while those refused to give informed written consent were excluded.

Sample size and sampling technique

Cochran's formula, $n = Z^2pq/d^2$, was used to determine the sample size. Z stands for the standard normal deviate (1.96), which corresponds to 5% types I error; p is the estimated percentage of participants who store unused medications at home (68%), based on the study by Sonowal S et al. [9]; q is equal to 1 – p; and d is the relative error, which was set at 10% in this study. The multistage sampling design was taken into consideration by incorporating a design effect of 2. These presumptions led to the final sample size calculation of 183 participants. A multistage random sample procedure was then used to choose eligible participants. From the 18 slums under ward-81, 3 were selected randomly, subsequently probability proportionate to population size was applied to select the households from each slum.

Study technique and tool

The data were collected by face-to-face interview during house-to-house visit using a pre-designed, pre-tested structured schedule, which comprised of socio-demographic variables, morbidity profile, knowledge, attitude and practice variables of unused and expired medications. The schedule was developed by reviewing different literatures, [9-17] content was validated by subject experts, each item was rated using 3-point scale, content validity ratio (CVR) was calculated for each item, items with CVR more than 0.78 were included while rest were eliminated. The tool was translated into local languages (Bengali & Hindi) and back translated to English for reliability, and a pretest was done among 10 slum dwellers before actual data collection commenced. Of the 183 study participants, those who ever heard about medication waste were approached for knowledge, attitude and practice variables, comprised of 120 slum dwellers.

The schedule consists of 10 questions for assessing participants' knowledge of expired and unused medications, comprising of 'True', 'False' and 'Do not know' options, for

each correct option 1 mark was allotted while 0 for incorrect. Median score was calculated, score more than equal to median (Median=4) were considered to have adequate knowledge while less than median had inadequate knowledge. Attitude was assessed using 5-point Likert scale comprising of 9 questions with responses varied from 'strongly disagree' to 'strongly agree' and categorized based on median values (Median=33) as positive or negative attitude, while 10 questions were to assess their practices related to the disposal of expired and unused medications.

Data analysis

Data were analysed using IBM SPSS version 25 (IBM Corporation, Armonk, NY, USA). Descriptive statistics were used to summarize the socio-demographic characteristics and morbidity status of study participants. Categorical variables were presented as frequencies and percentages. Median and interquartile range were used for presenting continuous variables. Normality assumption of knowledge and attitude score was assessed using Kolmogorov-Smirnov test and Shapiro-Wilk test as well as using graphical methods (Histogram, Q-Q plot). The distribution of the scores was not normal ($p < 0.05$); hence Pearson's Chi-square test was done to identify possible association, variables with p-values less than 0.25 in the bivariate analysis were included in the multivariable logistic regression. To demonstrate the strength of the relationship, the adjusted odds ratio (AOR) with the corresponding 95% confidence interval (CI) was used.

Ethical considerations

Ethical approval was obtained from the Institutional Ethics committee (IEC) of IPGME&R, Kolkata (Vide memo no. IPGME&R/IEC/2023/1080). An informed written consent was taken from each selected participant; they were assured about their privacy and confidentiality.

RESULTS

Socio-demographic Characteristics of the Respondents: A total of 183 participants were included in the study, of which 61.7% were males and 38.2% were females with a mean ($\pm$ SD) age of 37 ± 11 years. Half of the participants were educated up to secondary (52.0%), belonged to lower and lower-middle class (55.1%). Mostly were students and homemaker (44.8%).

Knowledge of the Respondents: The majority of respondents ($n = 120$; 65.57%) had heard about medicine waste. Among these respondents, 82.5% knew that medicine waste includes both expired and unused medications. However, only 46.6% were aware that inappropriate disposal of medicines could have multiple harmful consequences, including environmental contamination, harm to wildlife, unintended or illegal use, and accidental ingestion by children. Only 14.1% knew that medicine waste should not be disposed of along with household waste. Approximately 29.1% were aware that medicines discarded into toilets or sinks could reach groundwater, while only 25.0% knew that wastewater treatment may not completely remove pharmaceutical residues from the environment and ecosystem. About 20.8% were aware that medicines discarded on open ground could adversely affect soil quality. A large majority of respondents (87.5%) agreed that the expiry date of medications should be checked before consumption. However, only 36.6% correctly identified returning unused medications to pharmacies or healthcare facilities as an appropriate disposal practice. All respondents (100%) preferred healthcare personnel as the source for creating public awareness regarding the proper disposal of unused and expired medicines.

Overall, 35.8% of the study population had adequate knowledge regarding the disposal of unused and expired medications. On applying Pearson's chi-square test, knowledge was found to be significantly

associated with marital status, educational level, occupation, and socioeconomic status (**Table 1**). On multivariate binary logistic regression analysis, respondents educated above the secondary level, as well as students and homemakers, had significantly higher odds of having adequate knowledge, as shown in **Table 3**.

Attitude of the respondents: The majority of respondents (96.9%) demonstrated a high level of awareness regarding their responsibility towards the environment and family members in preventing unintended harmful exposure to medication waste. Most respondents (88.4%) believed that discarding unused medicines that were still in good condition constituted a waste of resources. However, nearly half of the respondents (49.1%) were unwilling to donate their unused medicines before expiry.

Less than half of the respondents agreed that medication waste should be disposed of at designated locations (42.5%) and believed that the availability of such locations would improve medication disposal practices (43.3%). Similarly, 48.3% agreed that the ability to locate drug disposal facilities through a smartphone application could facilitate safe medication disposal. About 47.4% of respondents believed that medications prescribed to them could be used by others.

Overall, 46.6% of the study participants demonstrated a positive attitude towards the disposal of unused and expired medications. On applying Pearson's chi-square test, attitude was found to be significantly associated with marital status, educational level, and occupation (**Table 2**). On multivariate binary logistic regression analysis, respondents educated above the secondary level, as well as students and homemakers, had significantly higher odds of having a positive attitude, as shown in **Table 3**.

Table 1: Association of Adequate Knowledge with various sociodemographic variables (n = 120)

Sociodemographic variables	Knowledge Adequate (n=43)	Chi-square (p-value)	OR (CI), p-value
Gender			
• Male	25 (58.2%)	0.544 (0.461)	1
• Female	18 (41.8%)		1.333(0.620-2.867), 0.461
Age			
• ≤ 45 years	36 (83.7%)	2.275 (0.131)	2.057(0.797-5.312), 0.136
• > 45 years	7 (16.3%)		1
Marital status			
• Unmarried	17 (39.5%)	12.606 (< 0.001)	4.940(1.957-12.468), 0.001
• Married	26 (60.5%)		1
Type of family			
• Nuclear	25 (58.1%)	0.267 (0.605)	1.220(0.574-2.590), 0.606
• Joint	18 (41.9%)		1
Education			
• Secondary and below	11 (25.6%)	11.970 (0.001)	1
• Above secondary	32 (74.4%)		4.091(1.799-9.301), 0.001
Socioeconomic Status			
• Lower, lower-middle	22 (51.1%)	8.068 (0.018)	1
• Middle	15 (34.9%)		0.937(0.422-2.084), 0.874
• Upper, upper-middle	6 (14.0%)		12.00(1.359-105.942), 0.025
Occupation			
• Unskilled/Semi-skilled/Skilled	10 (23.3%)	10.467 (0.005)	1
• Students/ Home-makers	29 (67.4%)		3.963(1.672-9.359), 0.002
• Semi-professionals/ Professionals	4 (9.3%)		2.733(0.647-11.556), 0.172
Health conditions			
• Present	18 (41.8%)	0.011 (0.916)	1.042(0.489-2.217), 0.916
• Absent	25 (58.2%)		1

Table 2: Association of Positive Attitude with various sociodemographic variables (n = 120)

Sociodemographic variables	Attitude Positive (n=56)	Chi-square (p-value)	OR (CI), p-value
Gender			
• Male	32 (57.1%)	1.286 (0.257)	1
• Female	24 (42.9%)		1.536(0.730-3.229), 0.258
Age			
• ≤ 45 years	46 (82.2%)	2.281 (0.131)	1.942(0.814-4.631), 0.134
• > 45 years	10 (17.8%)		1

Marital status			
• Unmarried	18 (32.1%)	6.790 (0.009)	3.316(1.309-8.397), 0.011
• Married	38 (67.9%)		1
Type of family			
• Nuclear	35 (62.5%)	2.386 (0.122)	1.774(0.855-3.682), 0.124
• Joint	21 (37.5%)		1
Education			
• Secondary and below	12 (21.4%)	26.872 (< 0.001)	1
• Above secondary	44 (78.6%)		8.067(3.522-18.476), < 0.001
Socioeconomic Status			
• Lower, lower-middle	26 (46.4%)	3.931 (0.140)	1
• Middle	25 (44.6%)		1.748(0.821-3.725), 0.148
• Upper, upper-middle	5 (9.0%)		3.846(0.694-21.319), 0.123
Occupation			
• Unskilled/Semi-skilled/Skilled	14 (25.0%)	13.162 (0.001)	1
• Students/ Home-makers	36 (64.2%)		4.137(1.845-9.275), 0.001
• Semi-professionals/ Professionals	6 (10.3%)		3.964(0.971-16.184), 0.055
Health conditions			
• Present	23 (41.1%)	0.088 (0.767)	1.116(0.540-2.307), 0.767
• Absent	33 (58.9%)		1

Table 3: Adjusted odds ratio of adequate knowledge and positive attitude with socio-demographic variables (n = 120)

SD variable	Knowledge		Attitude	
	Adequate (n=43)	AOR (CI)*, p-value	Positive (n=56)	AOR (CI)#, p-value
Age				
• ≤ 45 years	36 (83.7%)	0.881(0.250-3.111), 0.844	46 (82.2%)	0.973(0.316-2.999), 0.962
• > 45 years	7 (16.3%)	1	10 (17.8%)	1
Marital status				
• Unmarried	17 (39.5%)	1.998(0.635-6.279), 0.236	18 (32.1%)	1.094(0.346-3.460), 0.878
• Married	26 (60.5%)	1	38 (67.9%)	1
Education				
• Secondary and below	11 (25.6%)	1	12 (21.4%)	1
• Above secondary	32 (74.4%)	4.152(1.545-11.160), 0.005	44 (78.6%)	8.912(3.136-25.325), < 0.001
Socioeconomic Status				
• Lower, lower-middle	22 (51.1%)	1	26 (46.4%)	1
• Middle	15 (34.9%)	0.455(0.151-1.371), 0.162	25 (44.6%)	1.045(0.384-2.846), 0.932

• Upper, upper-middle Occupation	6 (14.0%)	8.587(0.388-189.806), 0.173	5 (9.0%)	1.164(0.131-10.309), 0.891
• Unskilled/Semi-skilled/Skilled	10 (23.3%)	1	14 (25.0%)	1
• Students/Home-makers	29 (67.4%)	4.170(1.356-12.824), 0.013	36 (64.2%)	4.631(1.615-13.281), 0.004
• Semi-professionals/ Professionals	4 (9.3%)	0.582(0.053-6.449), 0.660	6 (10.3%)	1.416(0.239-8.391), 0.701
CI- Confidence interval; * Model fitness: Omnibus-0.000, Nagelkerke R square-0.527, Hosmer Lemeshow-0.887; # Model fitness: Omnibus-0.000, Nagelkerke R square-0.453, Hosmer Lemeshow-0.541				

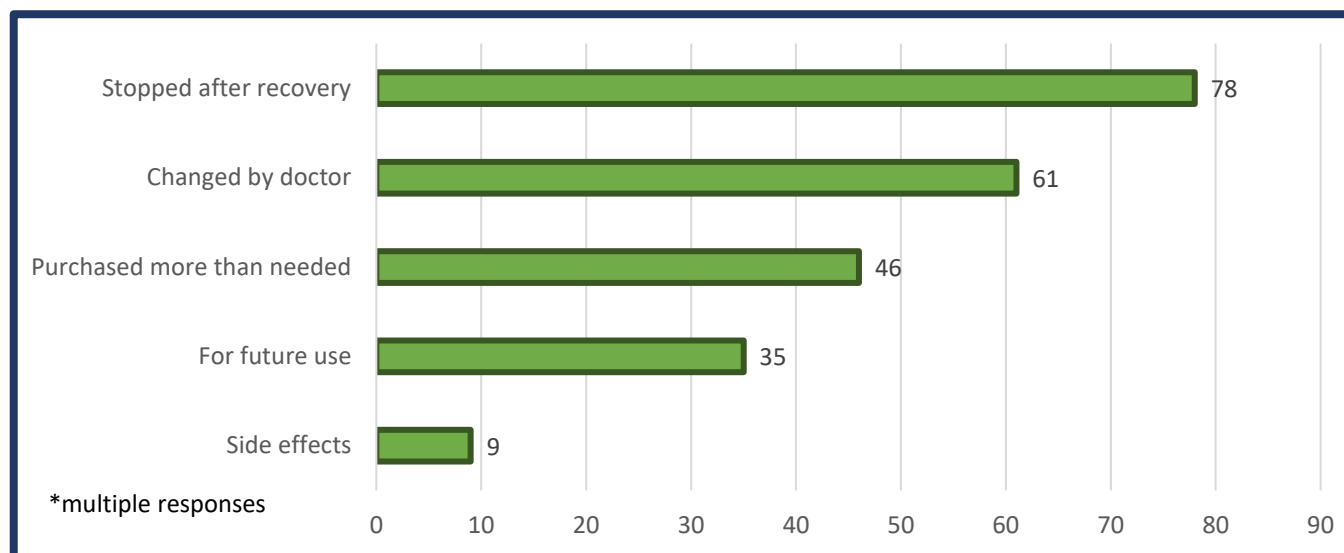


Figure 1: Horizontal bar diagram showing distribution of study participants according to the reasons for keeping unused medications at home (n₂=82*)

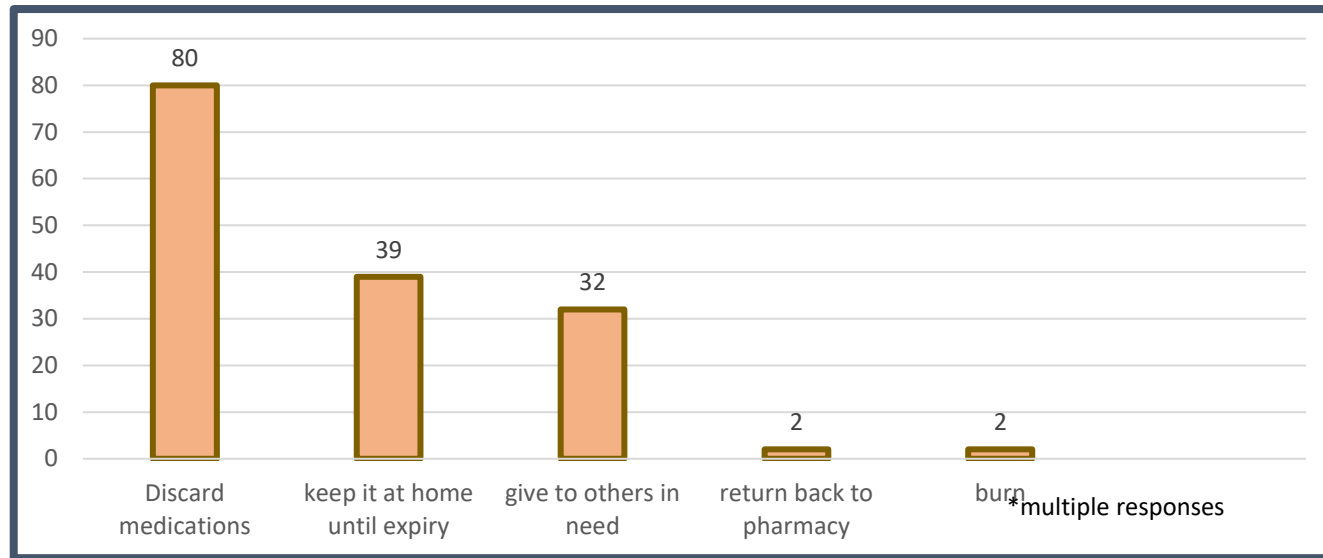


Figure 2: Vertical bar diagram showing distribution of study participants according to the method for disposal of unused medications (n₂=82*)

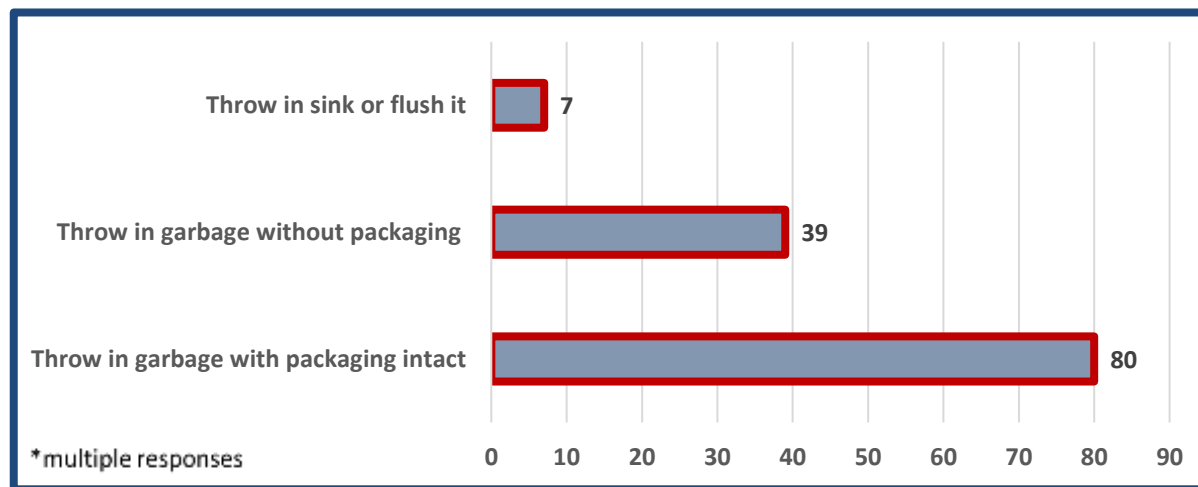


Figure 3: Horizontal bar diagram showing distribution of study participants according to the ways of discarding unused and expired medications (n₃=80*)

Practice of the respondents: About 68.3% (n = 82) of the respondents reported having unused or expired medicines in their households. Improvement in the medical condition was the most commonly reported reason for leftover medications (95.1%). Medicines were predominantly purchased with a prescription on a regular basis (96.3%), whereas over-the-counter medicines were more commonly preferred during emergency situations (69.5%; n = 57). Tablets were the most common dosage form of unused or expired medicines found in households (76%). The most common practice was to discard leftover medications (100%), followed by keeping them at home until they expired (49.9%). Among those who discarded unused medicines, all respondents reported throwing them into household garbage with the original packaging intact.

DISCUSSION

In the present study, among 183 participants, 65.5% (n = 120) had heard about medicine waste and were subsequently interviewed regarding their knowledge, attitude, and practices related to the disposal of unused and expired medicines. Although awareness of medicine waste was relatively high, only 46.6% of the respondents correctly identified the potential harmful consequences of inappropriate disposal. Among them, environmental contamination (74.2%), harm to wildlife (60.0%), and accidental ingestion by children (57.5%) were the most commonly recognized consequences. These findings were lower than those reported by Nigam et al. [12], Jha et al. [13], and Althagafi et al. [16], but were comparatively higher than those reported by Kumar et al. [10] and Shamim et al. [15]. The differences may be attributable to variations in the study population, educational profile, awareness levels, and study settings.

In the present study, only 36.0% of respondents had adequate knowledge regarding the disposal of unused and expired medicines, which was lower than the 50.3% reported by Nigam et al. [12]. This difference

may partly be explained by differences in the educational profile of the study populations. In the present study, the highest educational attainment among respondents was secondary education, which may have limited their understanding of the environmental and public health consequences associated with improper pharmaceutical waste disposal.

Important gaps in knowledge regarding safe disposal practices were also observed. Three-fourths (75.0%) of the respondents incorrectly believed that wastewater treatment would remove most medicines from the environment, while 85.9% considered disposal of medicines along with household waste to be acceptable. These misconceptions are of particular public health concern because pharmaceutical residues released into domestic waste streams and wastewater may subsequently enter the environment. The observed knowledge gaps were reflected in the reported disposal practices. All respondents who discarded unused medicines reported disposing of them in household garbage with the packaging intact, while 48.7% discarded medicines without packaging and 8.7% reported pouring them into sinks or flushing them down toilets. Similar reliance on household garbage as the predominant disposal method has been reported in several studies, including those by Kumar et al. (94.5%) [10], Kanyari et al. (82.1%) [11], Althagafi et al. (79.5%) [16], Jha et al. (64.3%) [13], Nigam et al. (39.7%) [12], and Sonowal et al. (30.5%) [9]. The consistency of this finding across different settings suggests that disposal through household waste remains a common practice despite its potential environmental and public health implications.

In the present study, 68.3% (n = 82) of respondents reported having unused or expired medicines in their households. This was comparable to the findings of Sonowal et al. (68.0%) [9] and was also consistent with observations from several other studies [10,11,13,17–20]. However, the prevalence was higher than that reported from Ethiopia

(29.0%) [14] and Pakistan (35.3%) [15], as well as by Nigam et al. (58.3%) [12] and Althagafi et al. (49.1%) [16]. Such variation may be related to differences in healthcare-seeking behaviour, prescribing and purchasing practices, accessibility of medicines, socioeconomic characteristics, and the availability of medicine-return or disposal facilities across study settings. Nearly half of the respondents (48.7%) reported keeping unused medicines at home until they expired, primarily to avoid wastage, while 40.0% reported sharing medicines with others. The tendency to retain medicines for future use may be particularly relevant in economically disadvantaged populations, where the perceived value of medicines and concerns regarding the cost of replacement may discourage disposal. Furthermore, the preference for purchasing medicines over the counter during emergencies, along with obtaining medicines from friends or family members, may facilitate the accumulation and subsequent sharing of unused medicines. In the present study, the predominance of respondents from lower socioeconomic and educational backgrounds may have contributed to limited awareness regarding the risks associated with unsupervised medicine use and inappropriate disposal. Economic constraints may also encourage individuals to retain medicines for potential future use rather than discard them. Similar observations regarding medicine retention, sharing, and disposal practices have been reported by Kumar et al., Shamim et al., and Gidey et al. [10,15,18]

Limitations

Due to cross-sectional in design, the consequences of such practices were not explored, hence a more extensive and in-depth studies with qualitative research components if done, might have enriched the data. Participants were the slum dwellers; hence our findings might not be generalizable to the other communities and there is a scope for future studies in varied samples with different literacy and socioeconomic background profile.

CONCLUSIONS & RECOMMENDATIONS

Inadequate knowledge, negative attitude, and inappropriate practices regarding the safe disposal of unused and expired medicines was found among the respondents. Those educated above the secondary level, students and homemakers were more likely to have adequate knowledge and a positive attitude. A substantial proportion of households had leftover unused or expired medicines with disposal through household garbage being the most common practice, posing potential risks of environmental contamination, accidental ingestion and misuse.

Community based awareness through healthcare workers and appropriate behaviour change communication activities to address misconceptions regarding disposal and discourage improper disposal of medicines, incorporation of safe medicine use and disposal into school health education to improve knowledge among students and promote responsible practices at the household level. Regular medicine take-back programmes should be implemented and must be strengthen through pharmacies and healthcare facilities, with appropriate systems for collection and safe final disposal.

Declaration

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Conflict of Interest: The authors declare no conflict of interest.

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