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RESEARCH ARTICLE

EVALUATION OF THE PREVALENCE, PREDICTORS AND DISPOSAL METHODS OF LEFTOVER AND EXPIRED MEDICATIONS IN HOUSEHOLDS: A CROSS-SECTIONAL SURVEY

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Abstract: Improper disposal of unused and expired medications poses a growing environmental and public-health challenge. Hence it is important to assess the prevalence, predictors, and disposal practices of leftover and expired medicines among households. A community-based, cross-sectional, prospective survey was conducted among 236 adults in South Coimbatore, Tamil Nadu, India using a validated questionnaire. Data on demographics, storage patterns, reasons for non-usage, and disposal methods were analyzed using descriptive statistics. A total of 97.1% of respondents reported storing unused or expired medications at home. Tablets (88.9%) were the most common dosage form retained, followed by syrups (39.4%) and topical formulations (35.6%). The main reasons for leftover medicines were non-adherence (24.5%), over-medication (22.9%), and changes in therapy. Over half (56.4%) of respondents disposed of unused medicines with household garbage, while only 40.3% were aware of appropriate disposal methods. Although 67.8% recognized that improper disposal damages the environment, this awareness did not consistently translate into proper practice. Disposal practices for leftover and expired medicines were largely inappropriate despite moderate awareness of environmental risks. Implementation of public-awareness initiatives and pharmacist-led drug take-back programs is essential to promote environmentally safe and sustainable medication disposal in the community.

Keywords: Unused medications; Expired drugs; Drug disposal; Household waste; Drug take-back program;

INTRODUCTION

Medications, whether prescribed or purchased over the counter play a critical role in disease prevention, management, and improving quality of life [1, 2]. Nevertheless, the accumulation of leftover and expired drugs in households has become an emerging environmental and public-health concern [3 – 5]. Improper disposal through household garbage, flushing, or open burning can contaminates soil and groundwater, it also promotes antimicrobial resistance, and contributes to ecological imbalance [6 – 8]. Worldwide, 50 – 90 % of households store unused medicines due to non-adherence, therapy changes or recovery from their illness [9, 10]. Such storage increases the risk of accidental poisoning and drug misuse, particularly among children and the elderly population [11, 12]. Pharmaceutical residues entering water systems have been shown to harm aquatic organisms and threaten human health [13 – 15]. In India, the absence of national guidelines and the limited availability of community take-back programs further aggravate this problem [16 – 18]. Although the Central Pollution Control Board (CPCB) has issued biomedical-waste rules, this household pharmaceutical waste remains largely unregulated [19]. Assessing public awareness, attitudes, and practices regarding medication disposal is therefore vital for developing sustainable interventions [20 – 22]. The present study aimed to evaluate the prevalence, predictors, and disposal practices of leftover and expired medications among households to identify knowledge gaps that could inform future awareness initiatives [23 – 25].

MATERIAL AND METHODS

Study was community-based, cross-sectional, prospective survey conducted in South Coimbatore, Tamil Nadu, India. Adults aged ≥18 years residing in the community were eligible. Pharmacy-professionals were excluded to avoid professional bias. Participants had to consent and return a complete questionnaire; incomplete or unreturned forms were excluded. Purposive sampling was used to select respondents from various residential areas in South Coimbatore, aiming for a heterogeneous sample in terms of age,

education and socioeconomic status. The study was carried out over six months, comprising the phases of literature review, questionnaire development, pilot testing, data collection and analysis. A total of 236 fully completed questionnaires constituted the analytical sample. A structured, Validated questionnaire was used, covering: (i) demographic information; (ii) prevalence of leftover/expired medications in the household; (iii) types and dosage forms of unused medications; (iv) reasons for non-usage; and (v) knowledge and disposal practices of unwanted medications. All the responses were collected and entered into Microsoft Excel and analyzed using descriptive statistics. Frequencies and percentages were computed for categorical variables. Tables were used to present demographic patterns and disposal behavior s.

RESULTS AND OBSERVATIONS:

Demographic characteristics of the study participants were shown in the Table 1. Among 236 participants, the age distribution was: <20 yrs – 27.97%; 20–30 yrs – 46.61%; 30–40 yrs – 7.20%; 40–50 yrs – 12.71%; ≥50 yrs – 5.51%. Educational status shows majority of the participants were completed their degree (77.97%). A striking 97.1% of respondents reported having leftover or expired medications at home. In terms of dosage form, tablets (88.86%) were most frequent, followed by syrups (39.41%), creams/ointments (35.6%), capsules (22.88%), eye-drops/others (8.9%), and lozenges (1.26%). Result also shows that majority of the participants (67.6%) has 5–10 numbers of unused drugs. Of all the leftover medicines, 57.0% were prescribed drugs while 43.53% were over-the-counter (OTC) medications. The leading reported reasons for leftover of the unused drugs among households included non-adherence to prescription regimens (24.5%), over-medication (22.8%), change of treatment (26.69%), fear of taking a large number of medications (3.38%), side-effects or complications (5.08%), and illiteracy (Table 2). Regarding expiry-date checking, 88.98% affirmed they routinely checked before use; 11.02% did not. On awareness of correct disposal methods, 88.98% claimed some idea, and 11.09% did not. Disposal methods used: thrown in household garbage (56.35%); kept for future use (15.66%); given to friends (11.86%); stored indefinitely (12.71%); burned in open space (8.05%). Additionally, 40.25% reported actual expiry drugs within the leftover medicines at home, while 59.75% did not. The majority (67.8%) acknowledged that improper disposal can damage the environment; 32.2% did not.

Table: 1 Demographic details of the participants

DEMOGRAPIC	PERCENTAGE
Age; Below 20 yrs 20 to 30 yrs 30 to 40 yrs 40 to 50 yrs 50yrs and above	 27.97% 46.61% 7.20% 12.71% 5.51%
Education; No education Schooling College	 10.59% 11.44% 77.97%

Table :2 Storage patterns, Reasons for non-usage and disposal methods of study participants

QUESTIONS	PERCENTAGE
Number of unused drugs in the leftover medication at your home	
Below 5	67.6%
5 to 10	12.71%
10 to 15	7.6%
15 to 20 and above	10.5%
No unused drug	2.9%
From the unused medication how many numbers of medication are:	
OTC (non-prescribed medicine)	43.53%
Prescribed medicine	57%
Dosage form: Tablet	88.86%
Capsules	22.88%
Syrups	39.41%
Cream/Ointment/lotion	35.6%
Lozenges	1.26%
Others	8.9%
What is the reason for left over medication at home	
Improper medication adherence	24.5%
Over medication	28.38%
Illiteracy	
Change to take large number of medication	26.69%
Fearness to take large no of medication	22.8%
Side effect or complication with medication	3.38%
Other	5.08%
Will you check the expired date before taking the medicine at home	
Yes	88.98%
No	11.02%
Do you have any idea that how to dispose unwanted medication or Expiry medication	
Yes	88.98%
No	11.09%
What will you do unused /leftover drug and expiry drug	
□Kept for future use.	15.66%
□Throw in garbage.	56.35%
□Burning it in open space.	8.05%
□Giving to friends.	11.86%
□Stored and never disposal	12.71%
Is there is any expired drugs in the left over medicine at home	
Yes	40.25%
No	59.75%
Do you known that improper disposal of unused medicines case damage of environment	
Yes	67.8%
No	32.2%

DISCUSSION

Our study demonstrated that almost all surveyed households possessed unused or expired medicines, confirming widespread drug retention similar to previous Indian and global findings [10, 26, 27]. Although most respondents were educated, awareness of safe disposal methods was insufficient [28, 29].

Tablets were the most common dosage form retained, consistent with earlier reports highlighting oral solids as the predominant leftover category [30, 31]. The main reasons are non-adherence and over-prescription [32 – 34]. These outcomes underscore the importance of prescriber counseling and pharmacist-led adherence programs to minimize waste [35 – 37]. More than half of participants discarded drugs with household garbage, posing risks of accidental ingestion and environmental contamination [5, 6, 11]. Although two-thirds recognized that improper disposal damages the environment, fewer than half knew the correct method—reflecting the gap between awareness and practice [14, 15, 33]. Countries such as the United States, Canada, and Sweden have successfully implemented community pharmacy–based take-back systems that significantly reduce household

pharmaceutical waste [8, 9, 17]. India's pilot pharmacy initiatives show promise but require national coordination and public participation [16, 18, 35]. Integrating pharmacists and primary-care centers into structured return programs, along with targeted education campaigns, would likely improve disposal behaviors and reduce environmental hazards [20, 25, 36]. Overall, tudy highlights an urgent need for awareness initiatives, inclusion of disposal instructions on drug packaging, and the establishment of sustainable, pharmacist-led take-back programs to safeguard human and ecological health [22, 35 – 38].

CONCLUSION

Our study highlights that household practices for disposing of leftover, unused, and expired medications remain largely inappropriate, despite moderate awareness of their potential environmental impact. Most participants acknowledged that improper disposal can harm the environment; however, practical knowledge of safe and approved disposal methods was limited. There is an urgent need for comprehensive public-health initiatives to promote responsible medication disposal. Community pharmacists, primary health centers, and local authorities should collaborate to educate the public through awareness campaigns, pamphlets, television and social-media advertisements, and radio messages. Furthermore, the implementation of structured drug take-back programs at community and institutional levels is strongly recommended to ensure environmentally safe management of pharmaceutical waste. These collective efforts will help minimize environmental contamination, reduce accidental exposure or misuse of medicines, and foster sustainable pharmaceutical waste-management practices in the community.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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