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Original Research Article

## Knowledge, attitude, and practice of disposal of unused or expired medicines among medical students of South Delhi

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### ABSTRACT

**Background:** Many people are unaware about the disposal of expired medications. Improper disposal and misuse of medicines have major safety and environmental concerns, which makes appropriate disposal practices essential. Objectives were to evaluate the knowledge, attitude, and practice of disposal of unused or expired medications among medical students.

**Methods:** A cross-sectional, questionnaire-based study was conducted among 150 first-year medical undergraduate students. Data were collected using a Google form designed to evaluate knowledge, attitude, and practices related to the disposal of unused and expired medications. Responses were analysed using Microsoft excel (2019 version) and explained in frequencies and percentages.

**Results:** Among the 150 participants, 52% were aged 19-20 years and 56.7% were female. 74.7% were correct that the expiration date was the date after which a medicine becomes unsuitable for use. 20.7% returned unused medicines to medical stores, while 3.3% believed that using expired medicines is illegal. Approximately 19.3% think that unused medicines should be disposed in the red bag. Few (10%) think that the health care system should be responsible for the disposal of unused/expired drugs. The 8.7% consider disposal of aerosol canisters into water bodies. Awareness about the medicine disposal policy in India was low (10.7%). Although 88.7% checked expiry dates before using medicines, improper disposal practices were still observed. The 96.7% required educational programs on safe medication disposal.

**Conclusions:** The study revealed poor awareness among first-year medical students regarding hazards of improper drug disposal. Knowledge gaps led to incorrect practices. WHO guidelines should be implemented, with regular awareness programs promoting safe medication disposal practices.

**Keywords:** Unused, Expired, Medication disposal, Medical students knowledge

### INTRODUCTION

The global burden of disease has increased significantly due to the adoption of unhealthy and sedentary lifestyles. In the context of disease management, pharmaceuticals play a critical role not only in treatment but also in diagnosis and prevention. However, a significant challenge in public health today is the widespread lack of medication adherence, which has emerged as a global concern. Non-adherence to prescribed therapeutic

regimens frequently results in the accumulation of unused or expired medications within households.<sup>1</sup>

Several factors contribute to pharmaceutical waste, including premature discontinuation of therapy by patients once symptoms abate, changes in prescribed medications or therapeutic regimens, and excessive prescribing practices, sometimes influenced by pharmaceutical representatives.<sup>2</sup> A considerable proportion of the general population remains unaware of the appropriate procedures

for the disposal of expired or unused medications. Hence, there is a pressing need to educate the public on the available methods for the safe disposal of pharmaceutical waste.

In the absence of adequate knowledge, individuals often resort to disposing of medications through household trash or sanitary systems such as sinks and toilets. Such practices can result in contamination of drinking water sources and broader environmental pollution.<sup>3</sup>

The consequences of improper disposal of pharmaceutical products are multifaceted and severe. These include contamination of community water supplies, posing significant health hazards, exposure of manual scavengers and children to expired medications at unsecured landfill sites, potential diversion and reuse of waste medications, raising concerns about counterfeit or unsafe drugs entering the market and atmospheric pollution due to open incineration of pharmaceutical waste, leading to the release of toxic substances.<sup>4</sup>

Numerous documented instances underscore the importance of the safe disposal of pharmaceutical products. Various studies have identified widespread improper disposal practices. For example, the release of oestrogenic compounds from contraceptives into aquatic environments has been associated with endocrine disruption in fish, including feminization and reproductive impairment.<sup>5-7</sup> Additionally, exposure to degraded tetracyclines has been linked to renal tubular dysfunction. Accidental poisoning and drug misuse-particularly among children and adolescents-are further consequences of inadequate disposal measures.<sup>5</sup> Emerging hypotheses also suggest that the unregulated disposal of antimicrobial agents could contribute to the development of antimicrobial resistance (AMR), posing a significant threat to global health.<sup>8</sup>

In response to these concerns, there is an urgent need for the development and implementation of scientifically sound and practical guidelines for the disposal of unused and expired pharmaceuticals. The world health organization's European centre for environment and health has recently issued a practical guide to address this issue.<sup>9</sup> However, many developing countries still lack standardized protocols for pharmaceutical waste management, exacerbating the risk of unsafe disposal practices. This present study aims to evaluate the knowledge, attitude, and practice of disposal of unused or expired medications among medical students of South Delhi.

## METHODS

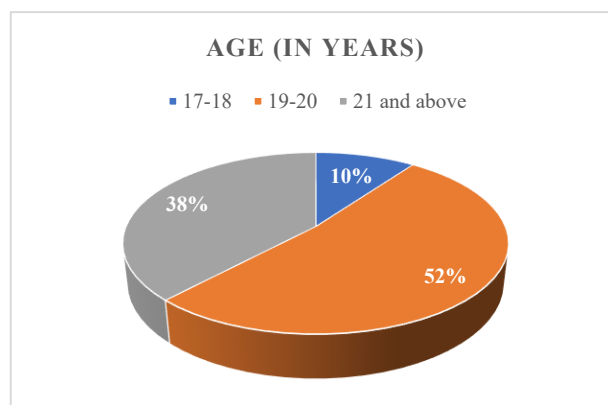
This was a cross-sectional questionnaire-based study. The study was conducted at Hamdard Institute of Medical Sciences and Research, New Delhi for two months from November 2023 to December 2023. The study participants were 150 first-year undergraduate medical students from

Hamdard Institute of Medical Sciences and Research, New Delhi. Informed consent was taken from the students before the study. A questionnaire was designed to evaluate the knowledge, attitude, and practice toward the disposal of unused and expired drugs which includes three parts: Part I includes demographic details of participant and questions on knowledge of safe disposal of expired, unused, and leftover medications, Part II includes questions on attitude toward the safe disposal of expired, unused, and leftover medications, and Part III includes questions on practices toward the safe disposal of expired, unused, and leftover medications. The questionnaire was validated by subject experts before initiating the study with Cronbach's Alpha value 0.7. The Google form was made and shared with the participants. The responses received from the participant were analysed using Microsoft excel (2019 version), and the results are explained in frequency and percentage. The study was done after obtaining the approval from the institutional ethics committee (HIMSR/IEC/00176/2023).

## RESULTS

A total of 150 first year medical undergraduate students participated in the present study. Most of the candidates (52%) are from the age of 19-20 and majority of them (56.7%) are females.

Majority of the candidates (74.7%) gave the correct answer regarding the expiration date of a medicine. The 73.3% of students considered the disposal of unused or expired medicines into the dustbin. 62.7% of students knew the real reason why medicines are not suitable for use after their expiry date. However, many candidates responded correctly (52.7%) when asked about correct bag to dispose unused/expired medicines that is in the yellow bag.



**Figure 1: Demographic details of participant.**

Most of the students (88%) believed that all of us should be responsible for the disposal of unused/expired drugs. However, few of them (51.3%) are not aware of disposal policies of unused and expired medicines in India. Moreover, most of them (59.3%) considered disposal of Aerosol canisters by incineration. Lastly, almost everyone

(96.7%) agreed that educational programs on the safe disposal methods of unused/expired medications among general population should be conducted.

Only (88.7%) of the candidates check for the expiry date on the label before using a medicine. Many students (69.3%) have disposed an unused/expired medicine at least once. Most of them (75.3%) didn't know about the correct way to dispose the liquid expired medicines. Lastly, only few of them (17.3%) checked on internet regarding the safe disposal of unused/expired medicines.

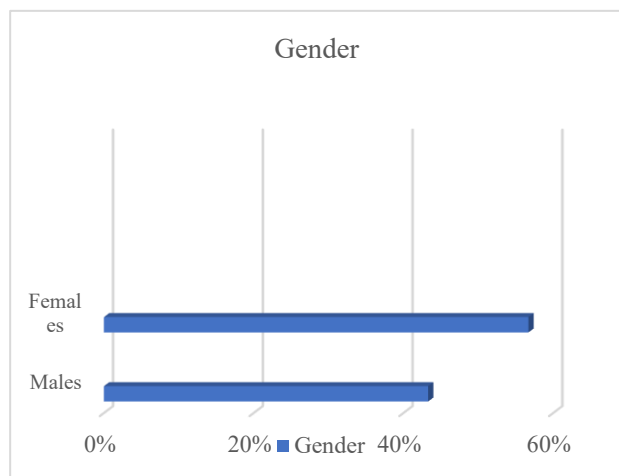


Figure 2: Gender distribution of the participants.

Table 1: Knowledge of safe disposal of expired, unused, and leftover medications.

Questions	N (%)
<b>What do you mean by expiration date of a medicine?</b>	
The date after which the medicine becomes poisonous.	10 (6.7)
The date after which the medicine will not show its effect.	28 (18.7)
The date after which the medicine is unsuitable for use.	112 (74.7)
<b>What should we do to unused or expired medicines?</b>	
Drain them into the sink.	9 (6)
Dispose them into the dustbin.	110 (73.3)
Return them to the medical store.	31 (20.7)
<b>Why are medicines not suitable for use after their expiry date?</b>	
Using expired medicines may be toxic and lead to adverse drug reactions.	94 (62.7)
The medicines lose their effectiveness after the expiry date.	51 (34)
It is illegal to use expired medicines.	5 (3.3)
<b>Which bag should be used for the disposal of unused/expired medicines?</b>	
Yellow bag	79 (52.7)
Red bag	29 (19.3)
Black bag	42 (28)

Table 2: Attitude towards the safe disposal of expired, unused, and leftover medications.

Questions	N (%)
<b>Who should be responsible for the disposal of unused/expired drugs?</b>	
Environmentalist	3 (2)
Health care system	15 (10)
All of us	132 (88)
<b>Do you know about the unused/expired medicine disposal policy in India?</b>	
Yes	16 (10.7)
No	77 (51.3)
Will check	57 (38)
<b>How are aerosol canisters disposed?</b>	
They are disposed of by incineration.	89 (59.3)
They are disposed of into water bodies.	13 (8.7)
By landfill waste encapsulation.	48 (32)
<b>Do you think that educational programs on the safe disposal methods of unused/expired medications among population should be conducted?</b>	
Agree	145 (96.7)
Disagree	1 (0.7)
Not sure	4 (2.7)

Table 3: Practices toward the safe disposal of expired, unused, and leftover medications.

Questions	N (%)
<b>Before using a medicine, do you check for the expiry date on its label?</b>	
Always	133 (88.7)
Sometimes	16 (10.7)
Never	1 (0.7)
<b>Have you ever disposed any unused/expired medicine?</b>	
Yes	104 (69.3)
No	29 (19.3)
Can't remember	17 (11.3)
<b>How do you dispose the liquid expired medicines?</b>	
Drain them into the toilet.	11 (7.3)
Drain them into the sink.	26 (17.3)
Dispose them into the dustbin.	113 (75.3)
<b>Did you check on internet regarding the safe disposal of unused/expired medicines?</b>	
Yes	26 (17.3)
No	71 (47.3)
Will do	53 (35.3)

## DISCUSSION

The accumulation of unused or expired medicines poses significant risks to human health, environmental integrity, and animal welfare. In the present study, awareness regarding the hazardous consequences of improper disposal of expired or unused medicines was observed to be markedly low among the participants. Out of 150 students surveyed, only 16 (10.7%) demonstrated awareness, while 134 (89.3%) were unaware of the

potential risks associated this. These findings reflect a substantially lower level of awareness in comparison to a study conducted by Kachhap et al wherein 35% of respondents reported knowledge of the adverse effects linked to unsafe disposal practices.<sup>10</sup> Regarding awareness of safe disposal methods, only 10.7% of participants in the current study were knowledgeable about appropriate pharmaceutical waste management techniques. This figure is significantly lower than that reported by Kachhap et al where 96% of respondents indicated awareness of safe disposal practices.<sup>10</sup> Despite this, a substantial proportion of the present study (96.7%) acknowledged the necessity of implementing educational initiatives aimed at promoting the safe disposal of unused or expired medications.

Concerning specific disposal strategies, particularly for aerosol canisters, responses varied. A majority 89 (59.3%) supported incineration as the preferred method, while 48 participants (32%) recommended landfill encapsulation.

In terms of actual disposal behaviours, 7.3% students reported they have drained unused or expired liquid medications into the toilet, 17.3% drain them into the sink and 75.3% dispose them into the dustbin. Whereas according to Labu et al 20.34% students drain the unused or expired liquid medications into the toilet, 37.9% drain them into the sink and 17.24% dispose them into the dustbin.<sup>11</sup> Among those who disposed of liquid pharmaceutical waste, 75.3% of students reported discarding it in domestic dustbins, while 24.7% opted for drainage via toilets or sinks. These practices align closely with those documented by Raja et al.<sup>12</sup>

Further, few students (17.3%) reported they returned the expired medications to pharmacists or disposed of them via drainage systems, while 7.3% of students admitted to flushing them or distributing them to acquaintances. Comparatively, Raja et al reported that 17% of participants disposed of medicines in household trash, another 17% crushed or altered the form of medications prior to disposal, and only 5% returned them to medical outlets.<sup>12</sup> The primary reasons for retaining unused medications at home are self-discontinuation of prescribed treatments following symptom improvement (56.81%) and the procurement of over-the-counter medications without professional guidance (48.1%).<sup>13</sup>

### Limitations

This study was conducted in only one Medical College and only students of the first year. Students of other years along with interns were not included.

### CONCLUSION

The current study showed that first year undergraduate medical students had little awareness regarding the harmful outcomes associated with inappropriate disposal of unused or expired drugs. But because of lack of

information or gaps in knowledge regarding safe disposal methods, majority of the students were following incorrect ways of disposing unused/expired medicines at home. The guidelines for safe disposal of unused/expired medicines are provided by WHO which need to be circulated and implemented in various teaching institutes. Regular awareness programs, mediated through health-care professionals to bring significant changes about disposal of unused or expired medications should be conducted.

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