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USE, STORAGE, & DISPOSAL OF UNUSED MEDICINES AMONG MEDICAL STUDENTS: A SURVEY-BASED STUDY

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ABSTRACT: Introduction: The increase in drug consumption in India has resulted in significant health hazards due to improper consumption, storage, and disposal practices among the general population. This study aims to evaluate the awareness and practices of medical students regarding the consumption, storage, and disposal of unused and leftover medications at their homes. **Materials and Methods:** A questionnaire-based cross-sectional survey was conducted over three months at a tertiary care teaching hospital in Southern Rajasthan. The study included 258 MBBS students who had voluntarily responded to a survey consisting of 15 questions. The survey assessed demographics, medication storage and use, disposal practices, adverse drug effects, and self-medication habits. Data were analysed in MS Excel as frequency and percentages. **Results:** Out of 400 medical students approached, 258 (64.5%) responded. Among them, 49.61% always stored medicines at home, mainly painkillers (82.23%) and antibiotics (74.13%). While 87.2% routinely checked expiry dates before consumption, 75.19% disposed of unused/leftover medicines in the trash. Self-medication was practiced by 12.4% of students, with nausea and vomiting being the most reported adverse drug reactions (ADRs). **Conclusion:** Medical students are aware about the expiry date, and they procure medicines mainly after seeking professional consultation. Yet medicine storage and disposal practices were largely inadequate. There is a need to increase awareness among them regarding proper storage and disposal practices as well as to sensitize them about the possible hazards of inappropriate drug disposal to human beings and the environment.

INTRODUCTION: Medicines and pharmaceutical products play an important role in the healthcare of any population. With the advancement of science and new technologies, the quantity and availability of medicines have increased everywhere.

The pharmaceutical sector in India holds the third position worldwide in terms of pharmaceutical manufacturing based on quantity, with a total annual revenue of INR 3,44,125 crore (equivalent to USD 42.34 billion) in the financial year 2021-2022¹.

The rise in consumption of drugs has resulted into an emerging health hazard of inappropriate consumption, storage, and disposal habits in the general population. The management of pharmaceutical products and biomedical waste presents a significant challenge to India's healthcare system, with the knowledge, attitudes and practices

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of the general population being pivotal in mitigating the associated risks². The World Health Organization has issued various guidelines on the proper disposal of drugs and biomedical waste. It includes strategies such as returning expired drugs to the manufacturer, land filling after effective immobilization, incineration at suitable temperatures and chemical decomposition. These collective measures, when rightfully deployed, can potentially curtail the environmental and health repercussions emanating from expired and unused drugs³. The FDA has given guidelines for the disposal of unused medicines at individual households. Medicines not included in the flush list should not be discarded in sewage waste⁴. Studies on medicine storage and disposal practices of the general population have been reported, but data from India is limited. Most of the studies on the storage & disposal of medicines have been conducted either in hospital setups or in the general population^{5, 6, 7, 8, 9}.

As medical students are the future ambassadors of healthcare among the general population, it is important that they are trained about the proper storage & disposal practices. Their role is not just in treatment of various ailments, but also in providing awareness and counselling for patients in handling leftover medicines at home. This study was thus planned to understand the awareness and practices of medical students regarding consumption, storage, and disposal of unused and leftover medications at their home.

MATERIALS AND METHODS: A questionnaire-based study was conducted among medical students at a Government Medical college of Southern Rajasthan. Medical students of 1st and 2nd professional year of MBBS were included in the study. The study design, methodology, and validated questionnaire were approved by the Institutional Ethical Committee.

Study Instruments: The questionnaire was prepared after a thorough literature search for comparable studies⁵⁻¹⁹. It consisted of 15 questions and was divided into five sections. The questionnaire collected data on demographics, medication storage and usage practices, disposal practices, adverse drug effects experienced with medicines stored at home, and self-medication

practices. The questionnaire was validated by the faculty of Pharmacology and Medicine department of the institute for its content and face validity. The suggestions were incorporated into the questionnaire.

Data Collection: Medical students were contacted at the end of their lectures and informed about the study in brief. After obtaining written informed consent, they were distributed the questionnaire and were asked to fill it. It took approximately ten to fifteen minutes in filling the questionnaire. Those who were not willing to provide consent, were not included in the study.

All the data collected was entered in the latest version of Microsoft excel, analysed and expressed as frequency and percentages.

RESULTS: A total of 400 medical students were contacted, out of which 258 (64.5%) returned completely filled questionnaire. Out of 258 responders 170 (66%) were males and 88 (34%) were females. 128 (49.61%) participants responded that they always store medicines at home. **Table 1** Most common medicines stored at home were analgesics (212, 82.23%) followed by antibiotics (191, 74.13%) **Fig. 1**.

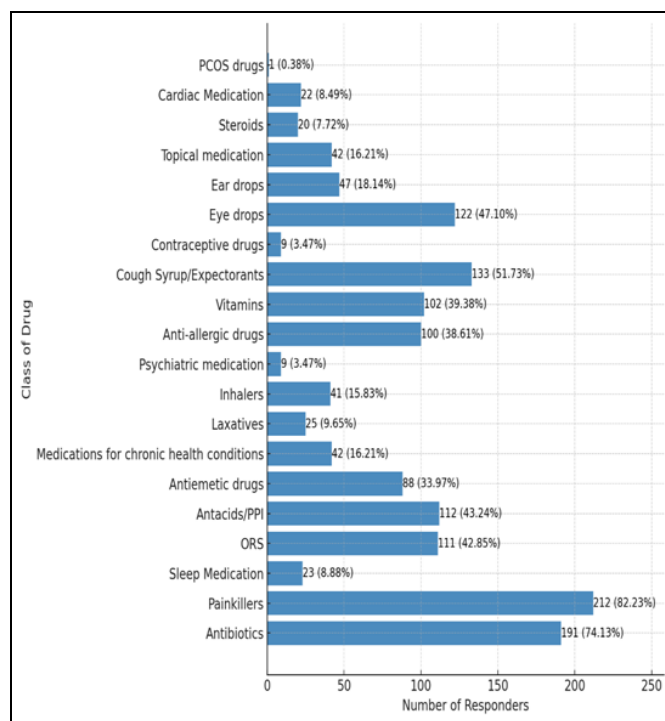


FIG. 1: STORAGE PATTERN OF DIFFERENT CLASSES OF MEDICINES AT HOME AMONG MEDICAL STUDENTS (n=258)

Most common dosage forms available at home pharmacies were tablets (250, 96.9%) followed by

capsules (197, 76.74%) and syrups (179, 68.39%) **Fig. 2.**

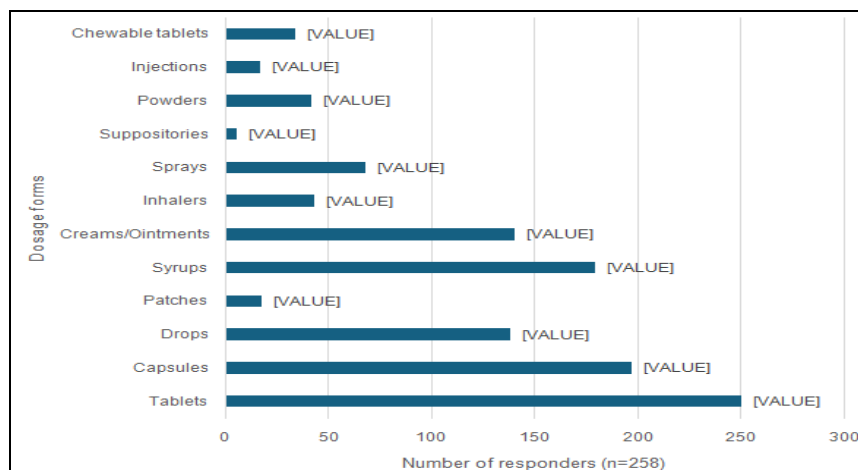


FIG. 2: DIFFERENT DOSAGE FORMS OF MEDICINES STORED AT HOME (n=258)

122 (47.28%) students responded that they complete the entire course of prescribed medicines at home, while 18 (6.97%) responded that they rarely complete the course. 225 (87.2%) participants reported that they routinely check the expiry date before consuming the medicines and 7 (2.71%) reported that they have consumed expired

medicines at home. 23 (8.91%) students reported using the medicines even if the package is unreadable/torn. 210 (81.39%) participants reported that they do not consume medicines when the package is damaged even if the tablet/capsule is left intact **Table 1.**

TABLE 1: INFORMATION REGARDING USE AND STORAGE OF MEDICINES AT HOME (n=258)

| S. no. | Questions | Options | No. of responses | Percentage |
|--------|---|---|------------------|------------|
| 1. | How often do you have (stored/left over) medicines at home? | Always | 128 | 49.61 |
| | | Occasionally | 84 | 32.55 |
| | | Rarely | 42 | 16.27 |
| | | Never | 04 | 1.55 |
| 2. | Medications at your home are predominantly stored for | Children (<18 years) | 11 | 4.26 |
| | | Adults (19-59 years) | 210 | 81.39 |
| | | Elderly (>60 years) | 37 | 14.34 |
| 2. | Do you complete the prescribed course of medication as advised by your doctor? | Always | 122 | 47.28 |
| | | Occasionally | 104 | 40.31 |
| | | Rarely | 80 | 6.97 |
| | | Never | 14 | 5.42 |
| 3. | Do you routinely check the expiry date before taking medication? | Always | 225 | 87.20 |
| | | Occasionally | 29 | 11.24 |
| | | Rarely | 3 | 1.16 |
| | | Never | 1 | 0.38 |
| 4. | Have you ever used expired medications without consulting a health-care professional? | Yes | 16 | 6.19 |
| | | No | 242 | 93.79 |
| 5. | If the expiry date on a medication is unreadable or torn, would you still use it? | Yes | 23 | 8.91 |
| | | No | 235 | 91.08 |
| 6. | How do you typically handle leftover medications at your household? | Store all medications for future use in your medicine cabinet | 53 | 20.54 |
| | | Dispose expired medications only and keep the rest for future use | 179 | 69.38 |
| | | Dispose all left over medicines | 26 | 10.08 |
| 7. | If the medicine packaging is damaged but the tablet/capsule is intact, do you still use it? | Yes | 48 | 18.59 |
| | | No | 210 | 81.39 |

Regarding disposal of medicines, 194 students (75.19%) responded that they dispose unused/leftover medicines in the trash/dustbin,

while 27 (10.47%) reported that they return medicines to the pharmacy/hospital **Fig. 3**.

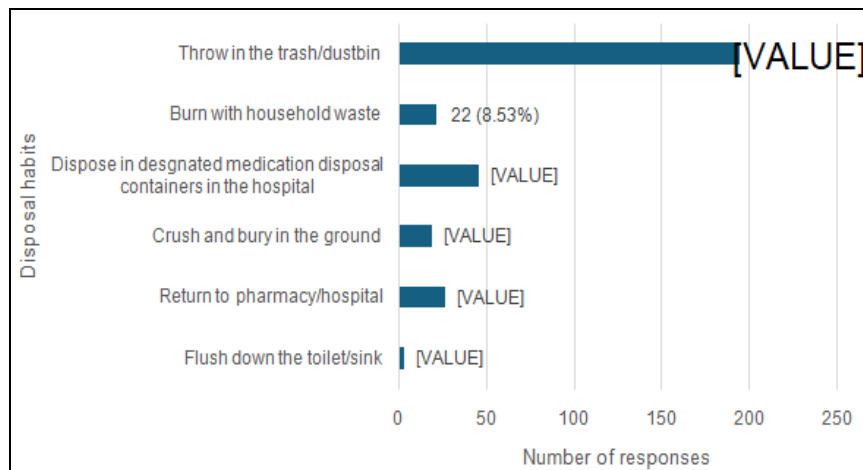


FIG. 3: DISPOSAL HABITS OF LEFTOVER MEDICINES AMONG MEDICAL STUDENTS. (n=258)

32 students (12.4%) reported that they regularly follow self-medication practices. Out of 258 responders 168 (65.12%) did not report any adverse drug reactions (ADRs) and four students do not remember whether they had experienced any such incident. Among those who did experience ADRs, the most prevalent symptoms were nausea (22, 8.52%) and vomiting (26, 10.07%), followed by skin rash and urticaria (10, 3.87%), headaches (5, 1.93%), and dizziness (4, 1.55%). Other reported ADRs included abdominal pain 3 (1.16%), hypotension, constipation, taste disturbances, back pain, hallucination and burning sensation in the eye (1 student each, 0.38%), diarrhoea and anaphylaxis (2 student each, 0.77%).

237 (91.86%) students procured modern (allopathic) medicine prescribed by a Registered Medical Practitioner in their home pharmacies, while 64 (24.81%) students also procured modern medicines without a prescription. Fifty students (19.38%) reported having Ayurvedic medicines prescribed by an Ayurvedic Practitioner, and 28 (10.85%) students procured Ayurvedic medicines without a prescription. Thirty-three (12.79%) students were prescribed Homeopathic medicines by a Registered Homeopathic Practitioner, and six students (2.33%) obtained Homeopathic medicines without a prescription. Seven students (2.71%) received other alternative medicines from a registered practitioner, while twelve students (4.65%) reported receiving no complementary and/or alternative treatment.

DISCUSSION: Storage of medicines at home is a common practice reported worldwide. Inappropriate medicine storage and disposal increase the risk of adverse effects as well as environmental contamination⁹.

In our study we focused on the medicine storage, usage and disposal practices of medical students as they are the future prescribers and thus it is important to know what they do with the medicines at home. In present study almost half of the responders (49.6%) always store medicines at their home and about one third (32.5%) store medicines occasionally. The most commonly stored medicines in present study were analgesics followed by antibiotics. A similar study by Manocha S *et al* and by Shoaib M *et al* on general population of New Delhi & Pakistan respectively, have reported 87% of participants stored medicines at home^{7, 12}.

Manocha *et al* have also reported analgesics, antibiotics and anti-hypertensives as commonly stored medicines in home pharmacies¹². Yimenu *et al* have reported anti-infective medicines as the most common stored medicines among general population in Ethiopia⁶. Analgesics are over the counter (OTC) drugs and their storage could be justified for symptomatic treatment of aches and pains in family members, but antibiotics are prescription only medicines and their inappropriate use & storage could be hazardous and contribute to ever increasing problem of antimicrobial resistance²⁰. Most common dosage forms stored at home in

present study were tablets and capsules that usually have long shelf life. More than half of the students also reported storage of syrups and creams/ointments. Syrups and other liquid dosage forms have limited shelf life and are at risk of microbial contamination due to sugar base in many preparations²¹.

Further many OTC topical preparations like creams and ointments contain steroids and their inappropriate storage and unsupervised use could be dangerous²². Majority of responders in present study routinely check the expiry date before taking any medicine (87%) and they would not consume a drug if the expiry date were unreadable (91%). Awareness regarding expiry date is lower in general population as almost half of the responders does not check expiry date before consumption in studies by Manocha S *et al* and Shoaib M *et al*^{7,12}.

Medical students are better aware as compared to general population as they are exposed to the knowledge of adverse reactions related to medicines. They are also taught about importance of expiry date and shelf life of medicines. Less than half of the responders (47.2%) in present study stated that they always complete the prescribed course of medication. Similar self-discontinuation of medicines has been reported by other authors also^{12, 23} and is considered as one of the major reasons of accumulation of medicines at home⁹.

In present study almost 70% responded that they dispose expired medicines and store rest all for future use. Such accumulation of medicines may lead to misuse of medicines and should be discouraged by health-care professionals. Majority of participants (75%) reported disposal of medicines by throwing them in trash/dustbin along with general waste. Other studies have also reported disposal in trash/dustbin as the most common method of disposal^{6, 7, 12}. Management of household disposal of pharmaceutical products is a huge challenge, it is mostly unsupervised, mismanaged and poses irreversible risk to the environment⁹. WHO guidelines for safe disposal recommends returning the medicines to pharmacy stores/hospital pharmacies or the manufacturer. Uncontrolled and unsupervised disposal of medicines in open should be avoided. Flushing of anti-neoplastic, undiluted antiseptics and

antimicrobial agents in sewer is also not recommended⁴. There are no specific national guidelines available for household disposal of medicines. There is a need of development of such guidelines as well as spreading awareness related to proper drug disposal practices. National drug take-back programmes can also be organized at frequent intervals.

Self-medication among the participants was lower (12.4%) as compared to other studies. Rathore *et al* have reported 60% self-medication among general population in central India²⁴. Self-medication among medical students is generally considered high, Kasulkar *et al* have reported 71% self-medication among medical students in their study²⁵.

As the participants in our study were mainly 1st and 2nd professional students who are still in initial phase of medical education and are not confident in using medicines, might be a reason for lower prevalence of self-medication. More than 90% participants in present studies procured modern medicines prescribed by registered medical practitioners which is welcoming, though 24% reported that some drugs at home were procured as OTC medicines.

Limitations: The sample size was small, limited to only 1st and 2nd professional medical students and only a single medical college, that limits the generalization of the results. Future research should include a more diverse sample including medical students, pharmacy students, doctors, nurses, pharmacists, and other health-care professionals to enable comprehensive analysis.

CONCLUSION: Present study reflects that medical students are aware about the expiry date and procure medicines mainly after prescription. Yet medicine storage is found in significant numbers of their households and the disposal practices are largely inadequate.

As medical students are the future prescribers, there is a need to increase awareness among them regarding proper storage and disposal practices as well as to sensitize them about the possible hazards of inappropriate drug disposal to human beings and the environment.

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