Original Research Article

A study of knowledge and practice for disposal of unused and expired pharmaceuticals among medical undergraduates at tertiary care teaching hospitals in Uttar Pradesh, India

Meenakshi Jindal1, Raj Kumar Goel2*

1Department of Pharmacology, Muzaffarnagar Medical College, Muzaffarnagar, Uttar Pradesh, India
2Department of Pharmacology, LLRM Medical College, Meerut, Uttar Pradesh, India

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*Correspondence to:
Dr. Raj Kumar Goel,
Email: drrajgoel@yahoo.com

ABSTRACT

Background: Increasing disease incidence and prevalence necessitate healthcare practitioners to prescribe diverse medications. Families and patients are in possession of unused or expired medications and its risks have started gaining notice across the world. Majority of them including medical students are unaware about the disposal of unused or expired medicines. Misuse and improper disposal of unused/expired medications is a major safety and environmental concern, and thus proper disposal of those medications is highly important.

Methods: Questionnaire based study was conducted among medical undergraduates of third year MBBS in two tertiary care teaching hospitals of Uttar Pradesh after approval from Institutional Ethical Committees during July-August 2018.

Results: There were 65% of respondent had unused drugs in their home while 30% had the expired drugs. The most common reason for the unused and expiry drugs in the home was self-discontinuation. Analgesics were the main group of drugs possessed by participants. 67% in this study responded that drug disposal method was disposing the expired drugs to garbage. Only 26% know about the area in the city where unused/expired drugs are collected. 46% think that proper education of the community is required for appropriate disposal of unused drugs.

Conclusions: Intervention by education about prudent drug disposal techniques that are also environmentally safe and acceptable is the need of time to change their behavior. There is also needing to understand the practice and awareness of the public to make any such education by program a success.

Keywords: Analgesic, Drug disposal, Expired drugs, Unused drugs, Yellow bags

INTRODUCTION

Increasing disease incidence and prevalence necessitate healthcare practitioners to prescribe and dispense different medications. The patients are not able to use all the dispensed medications because of adverse effects, alteration of dosage, feeling healthy, medications reaching the expiration date, promotional practices by manufacturers’, physicians’ prescribing practices, or dispensers’ practices.1,2 According to World Health Organization (WHO), more than half of all medication is inappropriately prescribed, prescribed and sold, which causes unnecessary storage and creates environmental threat.3 Non-adherence to medication can also cause storage of left over medicines at home. According to WHO 50% of patients fail to take medicine correctly.4 Therefore, it is usual that, families and patients are in possession of unused or expired medications and its risks have gained attention across the world.5

With the increased use of medicines both in human and veterinary practice, the extent of environmental contamination is also high.6 The potential routes of entry of medications into the environment are through patient
excretion into the sewage system, direct release through sewage from manufacturing units, or disposal of unused medication via trash or flushing. Few outcomes of such environmental contamination are a decline in number of vultures, sterility in frogs, and feminization of male fishes.\(^8^9\)

In addition, inappropriate disposal of unwanted medicines including out-of-date medicines may further contaminate the environment.\(^10\) The excretion of synthetic gestagens, levonorgestrel and drospirenone, from the body into water bodies has adversely caused masculinization of female fishes and inhibition of their reproduction.\(^11\) Accumulation of unused and expired medicines at households usually results from excessive prescribing by doctors and/or poor patients’ adherence to prescribed medicines.\(^12\)\(^13\)

This is a serious threat worldwide and has opened a new branch of science called Ecopharmacovigilance (EPV). EPV is concerned with detection, assessment, understanding, and prevention of adverse effects related to the presence of pharmaceuticals in the environment, which affect human and other animal species.\(^14\) The approaches of EPV include green drug design, green chemistry in process development, development of biodegradable products, minimization of manufacturing emissions, education over rational use of drugs, improved prescribing practices, and safe disposal of unused drugs.\(^15\)\(^16\)

If unused postexpiry date medicines are disposed inappropriately, they may further increase the threat to the environment as such medicines may have different safety profile. For example, expired tetracyclines can cause renal tubular damage.\(^17\) The impact of improper disposal of expired medicines has not been studied in the literature. To minimize the adverse impact of pharmaceutical compounds on the environment, the challenges related to the improper disposal of unused and expired medicines needs to be addressed.\(^12\)\(^13\)

For instance, non-steroidal anti-inflammatory drug (NSAID) diclofenac has been shown to induce renal failure in vultures following the ingestion of carrion from cattle treated with this drug.\(^18\) Evidence shows that the presence of antibiotics in water may lead to antibiotic resistance and in long term may cause genetic effects in humans and marine life.\(^19\)\(^20\)

Medication disposal habits are influenced by environmental awareness, availability of guidelines, dosage form, and social and cultural attitudes. The most environmental unfriendly means of drug disposition are disposing drugs into the sink, toilet, or into the dust bin. In India, the major reason for possession of unused, expired medicines is reported to be due to purchase of over the counter (OTC) drugs for self-medication.\(^21\)

In addition to the availability of required infrastructure (e.g., landfill, incinerator) to dispose of unwanted and expired medicines, it is imperative that the public, including healthcare professionals (HCPs), are aware of proper disposal methods and harms associated with their improper disposal. A survey conducted in the UK revealed unhealthy practices of 400 households where they disposed unused and expired pharmaceuticals either as household waste or via the sink or toilet.\(^22\) An Indian study on the knowledge, attitude, and beliefs of dental students about the disposal methods for expired and leftover medicines recommended the need to improve their awareness about safe and prudent disposal methods.\(^23\)

Therefore, WHO’s European Centre for Environment and Health in France, set up an international working group to produce a practical guide, addressing particularly the problems of HCWM in developing economies.\(^24\) In addition, some programs such as Disposal of Unwanted Medication Properly (DUMP) campaign was launched in New Zealand and in Canada ENVIRx disposal program was initiated.\(^25\)\(^26\) With this background, the present study was conducted to assess the Knowledge of Practice for disposal of unused and expired pharmaceuticals among medical undergraduates.

**METHODS**

The study was conducted in two tertiary care teaching hospitals of western Uttar Pradesh after approval from Institutional Ethical Committees. It was a descriptive cross sectional, questionnaire based study conducted among medical undergraduates. The study was conducted in the month of July-August 2018. Informed consent was taken from the students prior to the study.

The questionnaire containing thirteen items was distributed among students and time of 20 minutes was given to each student for filling the form. The questionnaire consisted of questions regarding having unused or expired drug, the type of unused/expired medications at home and their numbers, reasons for stockpiling of leftover drugs, dosage forms, disposal techniques and methods adopted by the students to dispose expired medications and questions exploring their knowledge like they know the exact method of disposal of unused / expired drug, if yes then from where did they got such knowledge like books, internet etc. and to assess the practice about safe drug disposal methods. The students were asked about yellow bags where expired drugs are collected. They were also asked about “Aushadi Bank” placed in hospital attached to LLRM Medical College Meerut for collection of unused drugs that can be used for other patients, drop box, NGO who collect the unused drug. They were asked to enumerate the drugs that were usually left unused. The students were asked about the awareness regarding the effect of pharmaceuticals on environment. They were also asked about steps to be taken to educate people about drug disposal and best place to educate them.

Medical undergraduates of second year and third year MBBS were included in the study while first year, final
There were 74% of them do not know the area of city where unused drugs were collected. Only 3% had the correct knowledge about giving to collection center at NGO or drop them in DROP BOXES in the hospitals, 60% showed their concern that improper disposal can affect the environment and health while 40% does not know about hazardous effects of unused/expired drugs. In a Response to a question regarding steps to be taken for proper disposal of unused/ expired drugs; 46% answered for proper education, 20% for awareness and 19% suggested for rallies and plays. 13% of them concern for media through electronic, newspaper (Table 1).

### Table 1: Modes of intervention for proper disposal of unused/expired drugs.

| S. no. | Mode of intervention | Percentage (number) |
|-------|----------------------|---------------------|
| 1     | Education            | 46(n=188)           |
| 2     | Awareness            | 20(n=82)            |
| 3     | Rally and Play       | 19(n=76)            |
| 4     | Media                | 15(n=60)            |

### DISCUSSION

Majority of students in this study had unused drugs at their home which is very high than findings of Sirisha et al study where 67% had upto 5 leftover drugs in tablet form in majority of cases while 46.88% had unused drug in study by Shivaraju et al.27,28

Among the reason for possession of unused drugs, self discontinuation was 75% in this study which is comparable to studies by Maharana et al, Sirisha et al, and Osei-Djarbeng.27,29,30 Our results were far higher than study by Ahmed et al.31 Other reasons like left over from previous OTC, doctor changed the medicines and drug passed expiry date were also there which are at par with other studies.27,29

Most of the unused drugs kept at home belongs to analogesics (34%) and antibiotics (29%) while few of them had antipyretics (11%), cough syrups (10%), topical formulations (8%) and anti-histaminic (8%) (Figure 1).
studies.\textsuperscript{27,32,33} 17\% of them were in favor of rinsing down the sink and flushing in toilet which is very less than study by Swaroop et al, where 83\% empties liquid medicaments in the sink and gives glass bottle for recycle use.\textsuperscript{32}

In the process of drug development, a new chemical entity is not studied for any deterioration in its efficacy, potency, and safety after proposed expiry date; however, its expiry date is based on stability and sterility studies. It is documented that at expiry, drugs should be at least 90\% potent.\textsuperscript{34} 60\% respondent showed their concern for the environment by the improper disposal while it was 74.22\% in a study by Shivaraju et al, and 28\% by Swaroop et al.\textsuperscript{28,32}

In this study, it is quite clear that the Knowledge and practice of drug disposal among the medical undergraduate is inappropriate. Intervention by education about prudent drug disposal techniques that are also environmentally safe and acceptable will help change their behavior. A proactive approach such as incorporating this important issue in their curriculum is the need of the hour. There is also a pressing need to establish cost-effective and acceptable state-run collection and disposal systems. Conscientious and proper disposal of medications can help to decrease environmental load of drugs. There is also need to understand the practice and awareness of the public to make any such program a success.

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