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RESEARCH ARTICLE

Knowledge and awareness of disposal of unused and expired medications among medical undergraduates of a tertiary care teaching hospital at B G Nagar: A cross-sectional observational study

Padmanabha Thiruganahalli Shivaraju, Manu Gangadhar

Department of Pharmacology, Adichunchanagiri Institute of Medical Sciences, B G Nagar, Mandya, Karnataka, India

Corresponding to: Manu Gangadhar, E-mail: drmanugigu@gmail.com

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ABSTRACT

Background: Majority of the consumers remain unaware about the disposal of unused or expired medicines. The misuse and improper disposal of medications are a major safety and environmental concern, and therefore the proper disposal of these medications is critically important. **Aims and Objectives:** The aim of this study was to know the behavior of individual's disposal practices of unused and expired medicines among the medical undergraduate in B G Nagar. **Materials and Methods:** This was a descriptive, cross-sectional questionnaire based study done on 2nd year medical students of Adichunchanagiri Institute of Medical Sciences, B G Nagar. Returned questionnaires were double-checked for accuracy. Statistical Package for Social Science (SPSS) and Microsoft excel was used for statistical analysis. **Results:** Total of 128 valid questionnaires were returned with 38.28% male and 61.72% female student participation. About half of the respondents (50%) stored more than 5 medicines followed by 46.88% stored 1-5 medications at home. Majority of them disposed unused/expired drugs in municipality garbage. Majority of respondents held government responsible for creation of awareness for proper medicine disposal. 71.43% felt that drug leftover at home was in tablet form. 74.22% of them were aware of the environmental damage due to unscientific way of drug disposal methods. **Conclusion:** The present study demonstrated that the awareness of proper and safe drug disposal among the medical students is quite fair. To make it more effective, the concerned authorities need to implement educational programs regularly.

KEY WORDS: Unused Medicine; Drug Disposal; Expired Drugs; Medical Undergraduates

INTRODUCTION

Improper disposal of medication has several possible consequences such as childhood poisoning, environmental pollution, a negative impact on wildlife, and antibiotic resistance.[1,2]

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Effectiveness of health care system is evaluated by measuring the drug wastage.[3]

Most of the active pharmaceutical ingredients (APIs) are polar compounds. Such APIs are called ''small molecules'' and are part of the compounds called ''micropollutants'' because they are often found in the mg or ng range in the aquatic environment.[4]

Pharmaceuticals from human use have serious effect on the environment due to micropollutants released into the nature, with well-known examples, i.e., estrogens and their effects on fish and the effects of diclofenac on vultures through chemical analysis.[4]

The importance of pharmaceutical waste in the environment increased after the diclofenac disaster. Vulture population reduced after they fed on cattle treated with diclofenac.[4,5] The feminization and demasculisation of male fish are attributed estrogens which are formed as by-products in industries.[6]

If unused post expiry date medicines may further increase the threat to the environment like expired tetracyclines can cause renal tubular damage.[7]

Storing of unused and expired medicines at households results from excessive prescribing by doctors[8] or poor patients' adherence to prescribed medicines.[9]

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.[10] An Indian study recommended the need to improve their awareness about safe and prudent disposal methods.[11]

Sink, toilet, and rubbish bins are the most commonly used but environmentally unfriendly routes of drug disposal. A huge pileup of expired and unused medications in the medicine cabinets among public reflects ignorance regarding disposal techniques.[12]

These leftover, accumulated drugs represent sub-optimal delivery of health care and the potential for environmentally unsound disposal, which can pose exposure risks for humans and wildlife. A major unknown with respect to drugs as pollutants is what fractions of drug residues occurring in the ambient environment result from discarding leftover drugs.[13]

Moreover, many research indicates that a majority of patients store unused, unwanted, or expired medications, thereby increasing opportunities for nonmedical use as a self-prescription.[14-17]

It also indicates that adolescents tend to have unsupervised access to medications in the home,[18] therefore the drugs with abuse potential may not be stored in secure locations within homes.

Unused prescription drugs are sometimes brought to "pill parties" (also called "pharm" or "Skittles" parties), where adolescents experiment with pills they select from the pool of medications brought by partygoers. With opioids, in particular, some products contain enough active ingredient in a single tablet to cause death in a naive patient, especially if mixed with other sedatives or alcohol.[19]

To minimize the adverse impact of pharmaceutical compounds on the environment as well as the danger consequences like abuse, addiction and also death, so the challenges related to the improper disposal of unused and expired medicines needs to be addressed.

The number of studies conducted to know pharmaceutical disposal practices is limited, particularly in the South India.

The present study aims to assess and compare the attitude and practice of medical undergraduates regarding unused or leftover drug disposal techniques and the knowledge about environment-friendly techniques of disposal.

Aims and Objectives

- To know the behavior, attitude and practice of safe disposal of unused/expired drugs among medical undergraduate.
- To make aware of the importance of safe disposal of medicines.

MATERIALS AND METHODS

The study was conducted in a rural tertiary care teaching hospital, Adichunchanagiri Institute of Medical Sciences, B G Nagar, during March 2017. It was a descriptive cross-sectional questionnaire based study conducted among medical undergraduates. Institutional Ethics Committee permission was taken before the beginning of the study. Informed consent was taken from the students before the study. Students of 2nd year MBBS were included in the study. The students who were unwilling to fill the questionnaire were excluded from the study. Time of 15 minutes was given for each student to fill the questionnaire. Questionnaire evaluates mainly the attitude and practice of drug disposal regarding safe disposal methods. The questionnaire was validated before the study by conducting a pilot test. The questionnaire included demographic data, number of leftover drugs, reasons for leftover, most common class of leftover drugs and dosage form. Results are expressed in frequency and percentages; unpaired student *t*-test was applied and $P < 0.05$ is taken has significant.

RESULTS

Table 1 contains the questionnaire used for knowing drug disposal methods. Table 2 summarizes the total response of all individuals where majority cited 1-5 drugs were leftover drugs at home. 74.22% were aware of the consequences of improper disposal methods. More than half respondents said self-discontinuation when illness improved followed by leftover from over the counter (OTC) was the important reasons for drug storage. 63.28% agreed for disposing municipality collection was the acceptable method. Class of drugs at home were topical drugs, analgesic, antipyretics, antibiotics, vitamin, etc., in the form of tablets (82.81%). Adopted method for disposal of solid to liquid forms was municipality garbage, followed by toilet and sink. Tables 3 and 4 summarize the response with respect to the male and female medical undergraduates. Table 5 summarizes the difference among male and female respondents.

Table 1: Drug disposal questionnaire

Question (Q) and options	a	b	c	d	e	f	g
Number of unused/leftover drugs at your home	0	1-5	6-10	11-25	>25		
Awareness regarding consequences of improper drug disposal?	Aware	Unaware					
Reasons for possession of unused medications at home	Doctor changed treatment	Prescribed more than needed	Self-discontinuation after condition resolved	Leftover from previous over-the-counter drug purchase	Passed expiry date	Adverse effect to prescribed drug	Others (specify)
Acceptable method to dispose medication	Rinsing down a sink	flushing down a toilet	Returning to pharmacist	Municipality collection at home	Giving away to friends, relatives, etc.	Others (specify)	
Classes of unused/expired drugs present at your home	Antibiotics	Antipyretics	Analgesics	Antacids	Antihistamines	Vitamin supplementation	Topical drugs (eye drops, creams, ointments, sprays, etc.)
Most common leftover dosage form at home	Tablets	Capsules	Syrups	Respules	Lozenges	Creams/ ointments/ lotions	Other (specify)
Methods of drug disposal adopted for							
Solids	Toilet	Sink	Garbage				
Semi-solids	Toilet	Sink	Garbage				
Liquids	Toilet	Sink	Garbage				

Table 2: Total response to drug disposal questionnaire

Total response (*n*=128)	*n* (%)						
	a	b	c	d	e	f	g
Q1	4 (3.13)	60 (46.88)	35 (27.34)	16 (12.5)	13 (10.16)	-	-
Q2	95 (74.22)	33 (25.78)	-	-	-	-	-
Q3	50 (39.06)	20 (15.630	70 (54.69)	59 (46.09)	51 (39.84)	11 (8.59)	5 (3.91)
Q4	2 (1.56)	6 (4.69)	40 (31.25)	81 (63.28)	2 (1.56)	11 (8.59)	-
Q5	62 (48.44)	70 (54.69)	76 (59.36)	46 (35.94)	19 (14.84)	55 (42.97)	82 (64.06)
Q6	106 (82.81)	28 (21.88)	59 (46.09)	-	1 (0.78)	76 (59.34)	-
Q7i	5 (3.91)	2 (1.56)	117 (91.41)	-	-	-	-
Q7ii	5 (3.910	15 (11.72)	113 (88.28)	-	-	-	-
Q7iii	13 (10.16)	27 (21.09)	94 (73.44)	-	-	-	-

DISCUSSION

Out of 128 responses, 60 (46.88%) had 1-5 unused drugs at home followed by 35 (27.34%), 16 (12.5%), and 13 (10.16%) had 6-10, 11-25, and >25 unused drugs, respectively. Only 4 (3.13%) had none. In majority of the students had unused drugs at their home which is similar to findings of Sirisha et al. study where 43.37% had 1-5 leftover drugs in tablet form in majority of cases.[20]

The first most common reason given for drugs present at home was "self-discontinuation" after illness recovery (70%) before the prescribed period, our findings were similar to Maharana et al. (61.4%),[21] Sirisha et al.,[20] and

Table 3: Male medical undergraduate response to drug disposal questionnaires

Male (total=49)	*n* (%)						
	a	b	c	d	e	f	g
Q1	2 (4.08)	26 (53.06)	12 (24.49)	4 (8.16)	2 (4.08)	0	0
Q2	37 (75.51)	12 (24.49)	0	0	0	0	0
Q3	18 (36.73)	6 (12.24)	19 (38.78)	21 (42.8)	18 (36.73)	7 (14.29)	1 (2.04)
Q4	1 (2.04)	2 (4.08)	19 (38.78)	24 (48.98)	2 (4.08)	2 (4.08)	0
Q5	21 (42.86)	22 (44.89)	24 (48.98)	11 (22.45)	7 (14.29)	13 (26.53)	26 (53.06)
Q6	35 (71.43)	10 (20.41)	21 (42.86)	-	-	22 (44.89)	-
Q7i	4 (8.16)	2 (4.08)	40 (81.63)	-	-	-	-
Q7ii	4 (8.16)	6 (12.24)	39 (79.59)	-	-	-	-
Q7iii	7 (14.29)	11 (22.45)	29 (59.18)	-	-	-	-

Table 4: Female medical undergraduate response to drug disposal questionnaires

Female (total=79)	*n* (%)						
	a	b	c	d	e	f	g
Q1	2 (2.53)	34 (43.04)	23 (29.11)	12 (15.19)	11 (13.92)	-	-
Q2	58 (73.42)	21 (26.58)	-	-	-	-	-
Q3	32 (40.51)	14 (17.72)	51 (64.56)	38 (48.10)	33 (41.77)	4 (5.06)	4 (5.060
Q4	1 (1.27)	4 (5.06)	21 (26.58)	57 (72.15)	0	9 (11.39)	0
Q5	41 (51.89)	48 (60.76)	52 (65.82)	35 (44.30)	12 (15.19)	42 (53.16)	56 (70.89)
Q6	71 (89.87)	18 (22.78)	38 (48.10)	-	1 (1.27)	54 (68.35)	-
Q7i	1 (1.27)	0	77 (97.47)	-	-	-	-
Q7ii	1 (1.27)	9 (11.39)	74 (93.67)	-	-	-	-
Q7iii	6 (7.59)	16 (20.25)	65 (82.28)	-	-	-	-

Table 5: Comparison of male and female medical undergraduate response to drug disposal questionnaire

Questions	Unpaired *t*-test (*P* value) for male and female responses
Q1	0.34
Q2	0.58
Q3	0.10
Q4	0.49
Q5	0.0046*
Q6	0.29
Q7i	0.71
Q7ii	0.68
Q7iii	0.55

*$P<0.05$ is taken has significant

Osei-Djarbeng et al.[22] studies suggesting that prescribed medicines are not used as prescribed and as soon as the illness improved, drugs were stopped which would have harmful consequence even though they feel better, because this kind of behavior can increase the resistant organisms to active drug molecule[16] and other reasons were leftover from the previous OTC drugs (59%), and around 50% of them cited drugs passed expiry date and doctor changed treatment. These findings were in par with other studies[20,21] and differed from Azad et al. study where majority of them cited reason as doctor prescribed more than required, but other reasons were similar to this study.[23]

81% (63.28%) responded that acceptable drug disposal method adopted was disposing to municipality garbage at their home, this is similar to earlier studies.[11,20,24-26]

40 (31.25%) cited they would return it to pharmacist, which was a good practice when compared the Patel et al. study which cited only 3.2%, but was lesser than Swaroop et al. study (62%). Thus still, there is fair scope to increase this trend by proper education.

Only 8.59% specified they would keep it for reuse which is less than the previous studies.[21,27] This is a positive point which should be encouraged and make aware of the consequences of reuse and storage and disposal practice keeping ecopharmacovigilance in mind.

Most the unused drugs stored at home belongs to the topical drugs such as eye drops, creams, and ointments accounting for 64.06% (82) followed by analgesics (59.36), antipyretics (54.69%), antibiotics (48.44%), vitamin (42.97), and antacids (35.94%). These findings were similar to Sirisha et al. study.[20] Maharana et al. study most

commonly stored antacids which were less in this study.[21] Storing of different class of drugs adds to stock, and this suggests a lack of knowledge regarding proper disposal of drugs.[28]

37 (75.51%) were knowing consequences of storage and improper drug disposal which is good sign suggesting their awareness and knowledge which likely results in drug abuse, drug misuse for recreational purpose, accidental poisoning in children's, and environmental hazards which were in congruence with Sirisha et al. study.[20]

Most common dosage form leftover was tablets (82.81%) followed by creams, ointments, and lotion (59.34%) which differs from Sirisha et al. study where syrups and capsules; and Al-Shareef et al. study[1] where more than 50% were antibiotics, implying that ease of storing and their thinking toward use of the same for future their illness. This reflects the how OTC drug purchase can cause pile up on drug stocks at home. $P < 0.05$ was significant with respect to the most common drugs present at home when compared with the male and female medical undergraduates.

Most of the students said drugs of solid, semi-solid, and liquid forms are disposed to municipality garbage if disposed to the garbage near the fields can damage the ecosystem this was similar to Kuspis and Krenzelok study were 54% disposed of medications in the garbage.[15]

Therefore, the improper method of disposed pharmaceuticals enters the environment as they are disposed of as solid waste into landfills or through sewerage into water system. Throughout the world, the use of pharmaceuticals is increasing with time[29] and because of these pharmaceuticals, relatively newly recognized pollutants can become a threat to the environment in future.[30]

Unused prescription drugs often accumulate in homes and may be misused for recreation, for example, psychotropic drugs, used inappropriately for self-medication of future ailments or ingested accidentally which can lead to acute poisoning.[31,32]

The state, as well as national governing bodies, should take strict, stringent action in managing the same, which is left behind in India which can influence the scientific method of medicine disposal.[33]

Therefore, the proper education through street play, media, conference, and awareness camps in schools and colleges regarding the disposal of drugs which is friendly with the environment can keep the universe from harmful consequence in future.

There are some limitations of this study, i.e., chances of recall bias in remembering information could not be ruled out, and the sample size was small; and the study could be further taken up at larger extent within the institution as well as other institutions to bring awareness on drug disposal methods.

CONCLUSION

In this study, it is quite clear that the awareness of proper and safe drug disposal among the medical undergraduate is quite fair and it can be made even better by making it a priority of concerned authorities to implement educational programs.

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