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Original Article

Assessment of Knowledge and Awareness on the Disposal of Expired and Unused Medicines among Medication Consumers

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ABSTRACT

Objectives: Safe disposal of expired, unwanted, or unused medications by the consumers is a major challenge worldwide. The knowledge, attitude and practice of consumers on disposal of unused and expired medicines were assessed. **Methods:** Data on demographics, educational, occupation, socioeconomic status, drugs purchased, number of unused or expired drugs were obtained from medicine consumers. Knowledge, attitude and practice of safe disposal methods, number, most common class, dosage forms of leftover drugs and the reasons were assessed using a questionnaire. Effect of educational, occupational, socioeconomic status on purchase of drugs, awareness on the consequences of improper disposal of drugs were assessed using chi square test. **Results:** Of 145 participants, 46 % were females and 54% were males with a mean age of 36.76 + 13.60 years. 66 participants stated 1-5 drugs as leftover at home and the reason for possession of unused medicines as self-discontinuation after the condition was resolved. Most common drugs left unused at home were analgesics and the dosage form was tablets. 76.6% were unaware of the consequences of improper drug disposal. 65.5% stated the acceptable method to dispose medicines as collection of unused drug by Municipality. Majority (88%) disposed unused or expired medicines in the garbage. There was a statistically significant association between educational, occupational and socio economic status, purchase of drugs and awareness on consequences of improper drug disposal ($P<0.05$). **Conclusion:** Most of the participants had leftover of unused or expired drugs in their households and there was lack of awareness on safe disposal of medicines.

Key words: Drug disposal, Unused drugs, Expiry drugs, Knowledge, Awareness, Medicine consumers.

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INTRODUCTION

Medicine consumption is increasing day by day globally, especially in countries like India and China.[1] Use of drugs for humans and veterinary practices is increasing daily and most consumers are left with some unused medicine at one time or other.[2] Then the disposal of unwanted medicines from households is also becoming an increasing problem for local and natural health environmental authorities.[3] More emphasis is made on the rational use of medicine such that patients should receive the right medicines at the right time and use them appropriately.[4] There is a lack of knowledge on how to dispose expired, unwanted and unused medications among our participant population. Studies done across the globe have stated that most patients stored their medications unwilling to waste them, never read and checked the expiry date, were unaware of the proper and safe way to dispose medicines, all of which might result in undesirable effects or unintentional risks.[5]

A substantial environmental risk may arise from improper disposal of medications and a long term environmental exposure to pharmaceuticals could lead to harmful effects especially on vulnerable population, including pregnant women, newborn and children.[6] Furthermore, there are greater chances for misuse and abuse of unwanted or unused medications when stored in the household.[7] Studies conducted in Kenya[8] and Nigeria[9] identified the most preferred method of unused medicines disposal as throwing in garbage bins followed by flushing in the toilets. Some studies also identified that the unused medicines were kept in the household due to unawareness of methods to dispose them, providing an opportunity to share to friends and families.[10,11]

Disposal practice of unused medicines has become a worldwide challenge for the policy makers, health professionals, pharmaceuticals companies and the community in general. Many developed countries like Australia and Canada have programs supported by government and Pharmaceutical industries aiming at disposal of unused medicines like the "National Return and Disposal of Unwanted Medicines Project". United Kingdom and Sweden encourages the drug take-back programs.[12] Creating awareness among medicine users about proper disposal method would be a promising step to protect the environment from this kind of pharmaceutical waste.[13]

Evidence-based guidelines was published by the World Health Organization (WHO) in 1996, 1999 and 2010 to and empower drug recipients and control the practice of drug donations. As the quality of donated drugs cannot be guaranteed, the guidelines clearly prohibited donating of drugs that have been issued to patients and then returned to a pharmacy or elsewhere, or were given to health professionals as free samples.[14]

Another method of disposal suggested by WHO was to return expired, unwanted, or unused medication to a local pharmacy and clinic or to a healthcare provider for safe disposal. Though such practices are in practice in some countries, patients are seldom aware of the existence of service as they rarely show interest to get proper information on the safe and appropriate ways to dispose medications.[15]

Ecopharmacovigilance is of significant concern as the adverse impact of human pharmaceuticals is on the rise in environment in the recent

years especially in surface water. There is a dire need to address the challenges related to the improper disposal of unused and expired medicines immediately to minimize the hazardous effect of improper disposal of medicines on the environment.[16]

Despite being a major consumer of medicines, there are no stringent regulatory policies for the consumers towards safe disposal of medicines in India and drug take-back programs are not functional/effective as in other countries. The National Formulary of India, specifies guidelines for the proper disposal of medicines. However most of the people in India are not aware of these guidelines and the importance to follow them. This is also substantiated by the recommendations given by an Indian study on the knowledge, attitude and belief of dental students about the disposal methods of expired and leftover medicines on the need to improve the awareness about safe and judicious disposal methods.[17] It is, thus, important to assess the knowledge, attitude and practice of consumers of medicines about the disposal of unused and expired medicines.

MATERIALS AND METHODS

A questionnaire based study was conducted in the consumers of medicines from the outpatient pharmacy of a tertiary care hospital with the approval of the Institutional Ethics Committee (CSP/18/NOV/74/312). Based on the literature,[18,19] sample size was determined using Epi. Software 3 version with a power of 80 and the confidence interval of 95%. The calculated sample size was 132 and with 10% as attrition rate (132+13) the sample size was finalized as 145. Therefore, the study randomly included 145 medicine consumers of either sex, aged above 18 years and were willing to participate in the study. Those with language barriers, difficulty in understanding the questions and did not consent to participate in the study were excluded. Data on the demographics (age in years, sex), marital status, educational status, occupation and income per annum, socio economic status as per modified Kuppuswamy scale,[20] drugs purchased, number of unused or expired drugs available in their home as leftovers and the reasons for leftovers were all obtained from the study participants by direct interview and entered in the data collection form designed for the study.

A pre-validated interviewer administered Questionnaire developed by Shivaraju, *et al.*[21] was used with the permission of the author to evaluate the knowledge, attitude of the study participants on safe disposal methods of unused and expired drugs and their practice of drug disposal. The questionnaire contains seven questions to obtain data on number of leftover drugs, reasons for leftover, most common class of leftover drugs and dosage form. The first question is "Number of unused/left over drugs at home" and the responses are categorized into five options as 0, 1-5. 6-10, 11-25 and >25. The second question is "Awareness regarding consequences of improper drug disposal" and the responses are categorized into two options as Aware and unaware. Questions 3 to 6 have seven options for responses. The third question is "Reasons for possession of unused medications at home" and the responding options are doctor changed treatment, prescribed more than needed, self-discontinuation after condition resolved, leftover from previous over-the counter drug purchase, passed expiry date, adverse effects to prescribed drugs and others to be specified. The fourth question is "Acceptable method to dispose medication" and the responding options are rinsing down a sink, flushing down a toilet, returning to pharmacist, Municipality collection at home, giving away to friends, relatives etc. and others to be specified. The fifth question is "Classes of unused/expired drugs present at home" and the options are Antibiotics, Antipyretics, Analgesics, Antacids, Antihistamines, Vitamin supplementation, Topical drugs (eye drops, creams, ointments, sprays, etc.). The sixth question is "Most common leftover dosage form at home" and the responding options are Tablets, Capsules, Syrups, Respules, Lozenges, Creams/ointments/ lotions and others to be specified. The seventh question focuses on "Methods of drug disposal adopted for solids, semisolids and liquids" and the responses are categorized into 3 options as toilet, sink and garbage.

The data collected were entered in an excel spreadsheet and analyzed using SPSS statistical software version 21.0. Categorical data were expressed as frequency, percentage and continuous data were expressed as mean, standard deviation. The responses to the questions reflecting on the knowledge and attitude of the study participants were also expressed as frequency and percentage. The effect of educational, occupational and socioeconomic status on the ways of purchasing drugs, awareness of the participants about the consequences of improper disposal of drugs was assessed using chi square test. A P value of <0.05 was considered statistically significant.

RESULTS

The study included 145 medicine consumers of which, 66 (46 %) were females and 79 (54%) were males. The mean age of the study participants was 36.76 + 13.60 years. There were 23 (15.83%) males and 22 (15.172%) females in the age range of 18 – 28 years; 26 (17.93%) males and 21 (14.48%) females in the age range of 29 – 38 years; 12 (8.275%) males and 12 (8.275%) females in the age range of 39 – 48 years; 12 (8.275%) males and 8 (5.517%) females in the age range of 49 – 58 years; 2 (1.379%) males and 2 (1.379%) females in the age range of 59 – 68 years; 4 (2.758%) males and 1 (0.689%) female in the age range of >68 years.

Table 1 explains the characteristics of study population which include the marital status, educational status, occupational status, income and socioeconomic status. The drugs purchased and possessed by the study participants at the time of interview were as follows: 44 (30.3%) of them had purchased NSAIDs; 42 (28.96%) of them had purchased antibiotics; 18 (12.4%) of them had purchased Cough suppressants, 17 (11.7%) of them had purchased Anti-pyretics; 15 (10.3%) of them had purchased Anti-histamine and Anti-emetic; 12 (8.2%) of them had purchased Anti-hypertensives; 10 (6.8%) of them had purchased Muscle relaxants; 8 (5.5%) of them had purchased vitamin supplements; 5 (3.4%) of them had purchased Anti-depressants and Hormones; 4 (2.7%) of them had purchased lipid lowering drugs and Anti-gout drugs each; 3 (2.06%) of them had purchased Anti-ulcers. At the time of survey, 78 (53.7%) of them had purchased 0-5 number of drugs; 39 (26.8%) of them had purchased 6-10 number of drugs; 22 (15.1%) of them had purchased 11-25 number of drugs; 6 (4.4%) of them had purchased more than 25 number of drugs. Mean no. of drugs purchased by the study participants was 5 ± 1.2.

Table 2 explains the responses of the study participants for Questions 1 to 6. For Question 1 (Number of unused/leftover drugs at your home), of 145 study participants, 66 (37.9%) of them answered they had 1-5 unused/leftover drugs at your home; 42 (26.9%) of them answered they had 6-10 unused/leftover drugs at your home; 28 (15.9%) of them answered they had 11-25 unused/leftover drugs at your home; 6 (4.1%) of them answered they had more than 25 unused/leftover drugs at your home; 2 (15.2%) of them answered they had no unused/leftover drugs at your home. For Question 2 (Awareness regarding consequences of improper drug disposal), of 145 study participants, 111 (76.6%) of them answered they were unaware of consequences of improper drug disposal; 34 (23.4%) of them answered they were aware of consequences of improper drug disposal.

For Question 3 (Reasons for possession of unused medications at home), of 145 study participants, 66 (45.5%) of them stated that they had unused medication because of Self discontinuation after condition resolved; 44 (30.3%) of them stated that they had unused medication because those

Table 1: Characteristics of Study Population.

Characteristics	Frequency (N=145)	Percentage (%)
Marital status		
Married	83	57.2
Unmarried	62	42.8
Educational status		
Diploma	10	6.9
Graduate	23	15.9
High school	17	11.7
Intermediate	10	6.9
Middle school	21	14.5
Primary school	27	18.6
Illiterate	37	25.5
Occupational status		
Semi Profession	21	14.5
Semi-Skilled	43	29.7
Shop	11	7.6
Skilled Workers	18	12.4
Unemployed	47	32.4
Unskilled workers	5	3.4
Income (Rs.)		
>30,000	67	46.2
>60,000	47	32.5
<10,000	31	21.3
Socioeconomic status		
Upper lower	66	45.7
Lower middle	39	26.8
Upper middle	18	12.4
Lower	22	15.1
Ways of procuring medicines		
Purchase on prescription	59	40.68
Purchase over the counter	41	28.27
Receive from friend/ colleague	13	8.9
Purchase based upon the advice of a relative or friend	32	22.06
Checking of Expiry dates at the time of purchasing		
Yes	37	25.6
No	28	19.3
Not always	80	55.1
Checking of expiry dates at the time of consuming medicines		
Yes	48	33.1
No	35	24.1
Not always	62	42.8

medicines passed the expiry date; 20 (13.8%) of them stated that they had unused medications as leftovers from previous over-the-counter drugs purchase treatment; 17 (11.7%) of them stated that they had unused medication because Adverse effect to prescribed drug; 14 (9.7%) stated that they had unused medication because the doctor changed treatment; 13 (9%) of them stated that they had unused medication because the doctor had prescribed more than needed. For Question 4 (Acceptable method to dispose medication), of 145 study participants, 95 (65.5%) of them answered as Municipality collection at home; 21 (14.4) of them answered as Returning to pharmacist; 14 (9.6%) of them answered flushing down a toilet; 10 (6.8%) of them answered as Rinsing down a sink; 2 (1.3%) of them answered as Giving away to friends, relatives, etc.

For Question 5 (Classes of unused/expired drugs present at your home), of 145 study participants, 45 (31%) of them answered as Analgesics; 38 (26.2%) of them answered as Antibiotics; 26 (17.9%) of them as answered Antipyretics; 20 (13.8%) of them answered as Antacids; 19 (13.1%) of them answered as Vitamin supplementation; 12 (8.2%) of them answered as Topical drugs; 11 (7.5%) of them answered as Antacids. For Question 6 (Most common leftover dosage form at home), of 145 study participants, 70 (48.2%) of them answered as Tablets; 6 (4.3%) of them answered as Capsules; 1 (0.6%) of them answered as Syrups and Respules.

The responses of the study participants for the options of Question 7 were as follows: For Question 7. I (Methods of drug disposal adopted for Solids), of 145 study participants, 137 (94.5%) of them answered as Garbage; 5 (3.4%) of them answered as Toilet; 3 (2.1%) of them answered as Sink. For Question 7. II (Methods of drug disposal adopted for Semisolids), of 145 study participants, 131 (90.3%) of them answered as Garbage; 9 (6.2%) of them answered as Sink; 5 (3.4%) of them answered as Toilet. For Question 7. III (Methods of drug disposal adopted for liquids), of 145 study participants, 128 (88.3%) of them answered as Garbage; 12 (8.3%) of them answered as Sink; 5 (3.4%) of them answered as Toilet.

On summarizing the total responses of all individuals, 66 participants (45.5%) stated that 1-5 drugs were leftover at home. 76.6% participants were unaware of the consequences of the improper drug disposal. The reasons for possession of unused medicines at home was stated by majority (45.5%) as self-discontinuation after the condition was resolved and then by 30.3% participants as passed expiry date. Majority (65.5%) stated that the acceptable method to dispose medicines was collection of unused drug from home by the Municipality. Analgesics were the drugs left unused at home by majority of participants (31%) and 80% participants stated tablets as the common dosage form of the leftover drugs and this was followed by syrups. Majority (88%) stated that they disposed the unused or expired medicines either as tablets, liquids or semi solids in the garbage.

Table 3 explains the impact of educational, occupational and socio economic status of the study participants on the ways of purchase of drugs. Majority of participants with graduation and diploma as level of education purchased drugs based on prescription followed by purchase over the counter where as participants with primary and middle school education and illiterates purchased drugs mostly over the counter. Likewise professionals and semi-skilled workers purchased drugs based on prescription and those skilled workers, unemployed participants purchased drugs over the counter. Similarly participants belonging to lower and lower middle class purchased drugs mostly over the counter than with prescription. There was a statistically significant association between the educational status (P=0.02), occupational status (P=0.014) and socioeconomic status (P=0.036) and the ways of purchase of drugs by the study population.

The impact of educational, occupational and socioeconomic status of the study participants on the awareness of the consequences of improper disposal of drugs (Q 2) is expressed in Table 4. Majority of participants who stated that they were aware of the consequences of improper drug disposal were graduates and diploma holders. Participants with level of education at primary and middle school level and the illiterates were not aware of the consequences of improper drug disposal. Similarly participants who were semi-professionals and semi-skilled workers had better awareness than the unemployed and unskilled workers. Participants in the lower, lower middle and upper lower socioeconomic class stated

Table 2: Responses of the study participants for Questions 1 to 6.

QUESTIONS	Responses	No. of Responses (N=145)	%
Q1 Number of unused/leftover drugs at your home	0	2	15.2
	1-5	66	37.9
	6-10	42	26.9
	11-25	28	15.9
	>25	6	4.1
Q2 Awareness regarding consequences of improper drug disposal?	Aware	34	23.4
	Unaware	111	76.6
Q3 Reasons for possession of unused medications at home	Doctor changed treatment	14	9.7
	Prescribed more than needed	13	9
	Self-discontinuation after condition resolved	66	45.5
	Leftover from previous over-the-counter drug purchase	20	13.8
	Passed expiry date	44	30.3
	Adverse effect to prescribed drug	17	11.7
	Others	2	1.3
Q 4 Acceptable method to dispose medication	Rinsing down a sink	10	6.8
	flushing down a toilet	14	9.6
	Returning to pharmacist	21	14.4
	Municipality collection at home	95	65.5
	Giving away to friends, relatives, etc.	2	1.3
	Others	8	5.5
Q5 Classes of unused/expired drugs present at your home	Antibiotics	38	26.2
	Antipyretics	26	17.9
	Analgesics	45	31
	Antacids	20	13.8
	Antihistamines	11	7.5
	Vitamin supplementation	19	13.1
	Topical drugs (eye drops, creams, ointments, sprays, etc.)	12	8.2
Q6 Most common leftover dosage form at home	Tablets	116	80
	Capsules	39	26.8
	Syrups	41	28.27
	Respules	0	0
	Lozenges	0	0
	Creams/ ointments/ lotions	13	8.9
	Other	1	0.6

that they were unaware of the consequences of improper drug disposal. There was a statistically significant association between the educational status (P=0.026), occupational status (P=0.032) and socio economic status (P=0.021) and the awareness of the study participants on the consequences of improper drug disposal.

DISCUSSION

Medicine waste management and disposal is grabbing attention in the recent years because it has been realized that improper disposal can contaminate the environment and pollute the nature, alter the food chain and harm the living beings.[22] A questionnaire based study was conducted in 145 consumers of medicines to assess their knowledge, attitude and practice on the disposal of unused medicines. Majority of the participants were males (54%) with a mean age of 36.76 $\pm$ 13.60 years. The younger mean age in the study was attributed to younger male patients being more forthcoming in their providing consent to participate in the study.

In the present study, educational, occupational and socio economic status had a significant impact on the ways in which the participants purchased drugs and their awareness on the consequences of improper drug disposal. Better the level of education, occupation and those with a better socio economic status had better awareness and purchased drug mostly with the prescription as they were aware of the potential health

Table 3: Educational/occupational and socioeconomic status Vs Ways of purchasing medicine.

Characteristics	Purchase on prescription	Purchase over the counter	Receive from friend/ colleague	Purchase based upon the advice of a relative or friend	*P* Significance
Educational status					
Diploma	3	4	1	2	
Graduate	13	6	2	2	0.02*
High school	8	4	3	2	
Intermediate	2	6	1	1	
Middle School	9	7	3	2	
Primary School	3	17	5	2	
Illiterate	5	21	5	6	
Occupational status					
Semi Profession	15	5	1	0	
Semi-Skilled	11	22	6	4	0.014*
Shop	2	6	1	2	
Skilled workers	3	12	1	2	
Unemployed	4	33	6	4	
Unskilled workers	1	4	0	0	
Socioeconomic status					
Upper lower	22	28	7	9	
Lower middle	12	18	4	5	0.036*
Upper middle	5	7	3	3	
Lower	2	11	3	6	

*P value of < 0.05 was considered statistically significant

Table 4: Educational, occupational and socioeconomic status Vs Awareness of consequences of improper Drug disposal.

Characteristics	Q. 2: Awareness regarding consequences of improper drug disposal (N=145)		*P* Significance
	Aware (*n*=34)	Unaware(*n*=111)	
Educational status			
Diploma	4	6	
Graduate	21	2	
High school	7	10	0.026*
Intermediate	1	9	
Middle school	1	20	
Primary school	0	27	
Illiterate	0	37	
Occupational status			
Semi Profession	17	4	
Semi-Skilled	13	30	
Shop	2	9	0.032*
Skilled Workers	2	16	
Unemployed	0	47	
Unskilled workers	0	5	
Socioeconomic status			
Upper lower	18	48	0.021*
Lower middle	4	35	
Upper middle	12	6	
Lower	0	22	

risks associated with purchase of drugs Over the Counter (OTC) and using the drugs from their friends and family. Their better economic status also enabled them to visit the clinicians for ailments. Participants belonging to lower class, with low level of education or with illiteracy were not much aware of the risks of taking drugs over the counter and also their economic status hindered in consulting a physician for minor ailments. These findings are in concordance with those reported in the literature.[23,24]

The common leftover drugs in most of the participants' home were analgesics and antibiotics. This could be attributed to the over the counter purchase of these drugs for minor ailments. This was followed by cough suppressants which is a common phenomenon among the public with all levels of education. Antibiotics being leftover in a household should be considered as a significant threat to antimicrobial resistance.

In the present study, 53.7% participants purchased around 1-5 drugs and 45.5% stated that they had 1-5 drugs let unused at home. This is in accordance with the report given by Shivaraju, *et al.*[21] which stated that 43.37% participants had 1-5 drugs left over at home and self -discontinuation as the most common reason for this leftover of drugs at home. The present study also identified self-discontinuation as the major cause of having leftover medicines at home. Similar reports are also stated by Maharana, *et al.*[25] The reason for self-discontinuation is stopping of the drug intake following the improvement in illness.

In the present study, when asked about their opinion on the acceptable method of disposal of unused medicines, 65.5% stated that the municipality should collect the unused/ expired drugs from home. Around 14% said that it is better to return to the pharmacist. Some participants stated the acceptable methods were rinsing the medicines in the sink or flushing them in the toilet. A study done by Akici, *et al.*[19] stated that some saved the medicines that were leftover following completion or discontinuation of therapy for their friends and family with the intention of not wanting to waste them. Tablet was the most common dosage form identified as leftovers in the present study which was followed by the syrups. But a study done by Sirisha, *et al.*[26] identified topicals and syrups as the most common leftovers.

In the present study, most of the participants (>89%) adopted disposal of unused medicines by throwing them in the garbage irrespective of their dosage forms. Studies done in USA, UK and Kuwait identified the practice of flushing of medicines which was acceptable previously. However flushing in the toilet/sink also poses a major hazard to the environment and life. In countries like Sweden, Korea, Canada etc. there are Medication return or Take-back programs of unused drugs by the pharmacy which is the correct and eco-friendly way of drug disposal.[27]

In the present study, majority of the participants were unaware of the potential consequences of leftover drugs and improper disposal of drug. Therefore proper education on safe drug disposal is the need of the hour as ecovigilance is being talked about in larger proportion. This can be implemented by the governing bodies in collaboration with the professional bodies through media, awareness camps, rallies regarding safe disposal of drug.

CONCLUSION

The present study was conducted to assess the knowledge and practice of the medicine consumers on the methods of disposal of unused or expired medicines. The study identified that most of the participants had more number of unused or expired drugs leftover in their households and there was lack of awareness among the medicine consumers on safe disposal of medicines and most of them opined that disposal in garbage as the acceptable method. Hence there is a dire need to develop guidelines on safe disposal of un used medicines and reduce the risk of health hazards. It is imperative for the drug regulating bodies and government authorities should prioritize to implement educational programs that would create an awareness among the common man on safe disposal of medicines.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

ABBREVIATIONS

WHO: World Health Organization; **OTC:** Over the Counter.

REFERENCES

1. Derksen JG, Rijs GB, Jongbloed RH. Diffuse pollution of surface water by pharmaceutical products. Water Sci Technol. 2004;49(3):213-21.
2. World Health Organization. The world medicines situation 2011-Rational use of medicines. (WHO/EMP/MIE/2011.2.2). 3rd Edition. Geneva: WHO. 2011;1-22.
3. Atinafu T, Takele A, Kassie A, Yehualaw A, Tesfaw G, Desseno T, *et al.* Unused medications disposal practice: The case of Patients visiting university of Gondar specialized teaching Hospital, Gondar, Ethiopia. Int J Pharm Sci Res. 2014;5(12):995-1005.
4. Abou AHS. An economic assessment of the extent of medication use and wastage among families in Saudi Arabia and Arabian Gulf countries. Clin Therap. 2003;25 (4):1276-92.
5. Garey KW, Johle ML, Behrman K, Neuhauser MM. Economic consequences of unused medications in Houston, Texas. Ann Pharmacother. 2004;38(7-8):1165-8.
6. Daughton CG. Cradle-to-cradle stewardship of drugs for minimizing their environmental disposition while promoting human health. II. Drug disposal, waste reduction and future directions. Environ Health Perspect. 2003;111(5):775-85.
7. Beirens TM, Beeck EFV, Dekker R, Brug J, Raat H. Unsafe storage of poisons in homes with toddlers. Accid Anal Prev. 2006;38(4):772-6.
8. Angi'enda SA, Bukachi SA. Household knowledge and perceptions on disposal practices of unused medicines in Kenya. J Anthropol Archaeol. 2016;4(2):1-20.
9. Auta A, Omale S, Shalkur D, Abiodun AH. Unused medicines in Nigerian households: Types and disposal practices. J Pharmacol Pharmacother. 2011;2(3):195-6.
10. Osei-Djarbeng SN, Larbi GO, Abdul-Rahman R, Osei-Asante S, Owusu-Antwi R. Household acquisition of medicines and disposal of expired and unused medicines at two suburbs (Bohyen and Kaase) in Kumasi – Ghana. Pharma Innov J. 2015;4(8):85-8.
11. Bashaar M, Thawani V, Hassali MA, Saleem F. Disposal practices of unused and expired pharmaceuticals among general public in Kabul. BMC Public Health. 2017;17(1):45.
12. Tong AY, Peake BM, Braund R. Disposal practices for unused medications around the world. Environ Int. 2011;37(1):292-8.
13. Persson M, Sabelstrom E, Gunnarsson B. Handling of unused prescription drugs--knowledge, behaviour and attitude among Swedish people. Environ Int. 2009;35(5):771-4.
14. World Health Organization (WHO). Guidelines for Medicine Donations - Revised 2010, 1996, 1st edition 1996, 2nd edition 1999 and 3rd edition 2011. 2010;1-20.
15. West LM, Diack L, Cordina M, Stewart D. A systematic review of the literature on 'medication wastage': an exploration of causative factors and effect of interventions. Int J Clin Pharm. 2014;36(5):873-81.
16. Seehusen DA, Edwards J. Patient practices and beliefs concerning disposal of medications. Journal of the American Board of Family Medicine. 2006;19(6):542-7.
17. Aditya S, Singh H. Safe medication disposal: Need to sensitize undergraduate students. Int J of Pharm and Life Sci. 2013;4(3):2475-80.
18. Ayele Y, Mamu M. Assessment of knowledge, attitude and practice towards disposal of unused and expired pharmaceuticals among community in Harar city, Eastern Ethiopia. J Pharm Policy Pract. 2018;11(1):27.
19. Akici A, Aydin V, Kiroglu A. Assessment of the association between drug disposal practices and drug use and storage behaviors. Saudi Pharm J. 2018;26(1):7-13.
20. Saleem S. Modified Kuppuswamy Scale Updated For Year 2018. Paripex-Indian J Research. 2018;7(3):217-8.
21. Shivaraju PT, Gangadhar M. Knowledge and awareness of disposal of unused and expired medications among medical undergraduates of a tertiary care

teaching hospital at BG Nagar: A cross-sectional observational study. Natl J Physiol Pharm Pharmacol. 2017;7(11):1268-73.

22. Sonowal S, Desai C, Kapadia JD, Desai MK. A Survey of Knowledge, Attitude and Practice of Consumers at a Tertiary Care Hospital Regarding the Disposal of Unused Medicines. J Basic Clin Pharmacol. 2017;8(1):4-7.
23. Zorpas AA, Dimitriou M, Voukkali I. Disposal of household pharmaceuticals in insular communities: social attitude, behaviour evaluation and prevention activities. Environ Sci Pollut Res Int. 2018;25(27):26725-35.
24. Abahussain EA, Ball DE, Matowe WC. Practice and opinion towards disposal of unused medication in Kuwait. Med Prin Pract. 2006;15(5):352-7.
25. Maharana SP, Paul B, Dasgupta A, Garg S. Storage, reuse and disposal of unused medications: A cross-sectional study among rural households of Singur, West Bengal. Int J Med Sci Public Health. 2017;6(7):1185-90.
26. Sirisha A, Janardhan M, Sree PK, Rao YV, Raikar SR, Patil S, *et al*. Knowledge, attitude and practice on safe disposal of medicines among medical and dental undergraduates. J Basic Clin Res. 2016;3(1):5-9.
27. Al-Shareef F, El-Asrar SA, Al-Bakr L, Al-Amro M, Alqahtani F, Aleanizy F, *et al*. Investigating the disposal of expired and unused medication in Riyadh, Saudi Arabia: A cross-sectional study. Int J Clin Pharm. 2016;38(4):822-8.

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