

Knowledge, Attitude and Practice of Disposal of Unused, Unwanted and Expired Medicines among Healthcare Professionals

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ABSTRACT

Background

Unused, unwanted and expired medicines stored at home pose threats to both health systems and environments. Healthcare professionals (HCPs) should be aware of the proper disposal methods of such medicines.

Objective

To assess the knowledge, attitude and practice of disposal of unused, unwanted and expired medicines among healthcare professionals.

Method

A web-based cross-sectional descriptive study was conducted among faculties and junior residents at B.P. Koirala Institute of Health Sciences, Dharan, Nepal using a semi-structured proforma. The data were collected through Google Form. Descriptive statistics were calculated. Chi-square test and Student's t test were used for analysis using statistical package for the social sciences at p value of 0.05.

Result

A total of 294 healthcare professionals with mean age 35.37 ± 6.630 years were participated out of which 231 (78.6%) were male and 151 (51.4%) were faculties. Mean knowledge score was higher in faculties (2.37 ± 1.111) than the Junior residents (2.33 ± 1.155) [$F(1,293)=0.102$, $p=0.750$]. Junior residents (140 out of 143, 97.9%) had a better attitude than faculties (141 out of 151, 93.3%) regarding the disposal of medicines [$\chi^2(1)=3.558$, $p=0.059$]. Junior residents (36 out of 143, 25.1%) also had a better practice than faculties (24 out of 151, 15.8%) regarding the disposal of medicines [$\chi^2(1)=3.895$, $p=0.048$].

Conclusion

Majority of the Healthcare professionals had positive attitude but poor knowledge and practice regarding disposal of expired and unused medicines. There was a high practice of keeping medicines at home by healthcare professionals. The findings would be useful for planning strategies to minimize unused medicines and foster the appropriate disposal practice.

KEY WORDS

Attitude, Faculties, Knowledge, Medical waste disposal, Practice

INTRODUCTION

Unused and unwanted medicines are the medications that are discontinued but remain with the consumer.¹ After the expiry date, the potency of the drug is no longer guaranteed.² Inappropriate prescription, self-medication, change of prescription, adverse effects of the drug, unclear instruction, resolution of symptoms, expired medicines and non-adherence to the prescription contribute to unnecessary storage of medicines at home.³⁻⁶

Unused, unwanted and expired medicines stored at home pose threats to both health systems and environments.⁷ Unsafe disposal of such drugs results in environmental pollution that had caused a decline in the number of vultures, sterility in frogs and feminization of male fishes.^{8,9} Dumping of antibiotics leads to exposure of sub-therapeutic concentrations to microbes that cause the emergence of drug-resistant soil bacteria. Such bacteria may then infect humans and other animals as well.¹⁰ Stocking unused, unwanted and expired medicines or donating these to friends or relatives can lead to accidental or inappropriate ingestion thereby increasing the risk of adverse effects and drug poisoning.

It is imperative that healthcare professionals (HCP) should be aware of the proper disposal methods of such medicines. Doctors, being HCP, can educate the patients and public regarding the safe disposal methods of such medicines. Most of the studies are limited to the general public.¹¹⁻¹³ To date, no study has investigated the knowledge, attitude, and practice (KAP) of HCPs in Nepal on disposal of unused, unwanted and expired medicines. The present study was conducted to assess the knowledge, attitude and practice of disposal of unused, unwanted and expired medicines among HCPs.

METHODS

A cross-sectional descriptive study was conducted among faculties and junior residents working at B.P. Koirala Institute of Health Sciences (BPKIHS), Dharan, Nepal from October to December 2021. Those faculties and junior residents who did not give consent to participate were excluded. The sample size was calculated using a single population proportion formula ($n = Z^2 \times P \times Q / L^2$), by using a confidence interval of 95%, a margin of error of 10% and a proportion of event occurrence of 65% in a similar study.¹⁴ Based on the above assumption and after adding a 10% non-response rate, the minimum sample size required for the study was 228. Population proportionate random sampling was used to select participants. Random selection was made from the list of faculties and junior residents using computer-generated randomization sequence.

A semi-structured proforma was prepared based on the objectives of the study and in accordance with the relevant literature.^{13,15-18} It consisted of three sections:

(A) socio-demographic data, (B) knowledge (5 items), (C) attitude (5 items), and (D) practice (9 items) related to the disposal of unused, unwanted and expired medicines. The questionnaire items comprised of open, closed and Likert scales. Most of the questions had multiple choices with one or more correct options and some were subjective type. For knowledge domain, score 1 was assigned for 'correct answer', 0 for both 'incorrect answer' and 'I don't know' response; the score values for the attitude domain were 3 for 'agree', 2 for 'neutral' and 1 for 'disagree'; score values for practice domain were as follows: 1 for both 'Yes' and 'correct answer', 0 for 'No', 4 for 'always', 3 for 'often', 2 for 'sometimes', and 1 for 'rarely'. Total knowledge score, total attitude score and total practice score were 5, 15 and 9 respectively.¹⁹ The questionnaire was pretested in 30 respondents and the questions were modified accordingly to ensure simplicity and ease of understanding. The subject experts also checked the questionnaire design and verified its validity and reliability. The sample used for the pilot test was not used for the final data analysis.

A Google Form (docs.google.com/forms) was prepared after agreement among all researchers and the link to the Google Form was sent by the principal investigator to the randomly selected faculties and junior residents via email. Clicking the next tab and submitting the questionnaire were considered as confirmation of informed consent. Participation in the study was purely voluntary. No incentive was given to the participants. Personal identifications (phone number, name, etc.) were not recorded to maintain the confidentiality of the participants. Multiple responses from a single participant were disabled. Ethical clearance was obtained from the Institutional Review Committee, BPKIHS (IRC/2152/021).

The responses were extracted from Google Forms and exported to Microsoft Excel 2010. Descriptive statistics such as mean, frequency, percentage and standard deviation (SD) were calculated. The knowledge was categorized as 'good knowledge' (score 3 and above) and 'poor knowledge' (score less than 3).¹⁹ The attitude was categorized as positive (score 12 to 15) and negative (score less than 12).²⁰ Similarly, the practice was categorized as 'Good practice' (score 5 to 9) and 'Poor practice' (score less than 5).²¹ Chi-square test was used to determine any associations between categorical variables and outcomes and Student's t test for continuous variables and outcomes. Statistical Package for Social Sciences (Version 21.0., IBM, Armonk, NY) was used for statistical analysis at P-value less than 0.05. The standard guidelines were followed for reporting results of internet E-Surveys.²²

RESULTS

A total of 294 HCPs with mean age 35.37 ± 6.630 years were participated. Two hundred and thirty one (78.6%) were males and 151 (51.4%) were faculties (Table 1).

Table 1. Sociodemographic characteristics of the healthcare professionals (n=294)

Variables	Frequency	Percentage	
Age category	27-45 years	268	91.2
	46-60 years	25	8.5
	More than 60 years	1	0.3
Gender	Male	231	78.6
	Female	63	21.4
Designation	Faculties	151	51.4
	Junior residents	143	48.6

Table 2. Knowledge of healthcare professionals towards disposal of unused, unwanted and expired medicines (n=294)

Variables	Correct response		Incorrect response	
	Frequency	%	Frequency	%
Medicines lose their effect after the expiry date.	250	85.0	44	15.0
We should put unused, unwanted and expired medicines in the red container.	89	30.3	205	69.7
The best recommended method for safe disposal of unused, unwanted and expired medicines is returning them back to the hospital, pharmacies or manufacturer.	158	53.7	136	46.3
Wastewater treatment removes most of the medicines from the sewer before they reach the river or lake.	61	20.7	233	79.3
The method of incineration for disposal is restricted for metered-dose inhalers (aerosol).	133	45.2	161	54.8

A total of 250 (85%) HCPs knew that medicines lose their efficacy after the expiry date (Table 2). Mean knowledge score of all participants was 2.35±1.131 and was higher in faculties (2.37±1.111) than the JRs (2.33±1.155) [F(1,293)=0.102, p=0.750]. Further, 120 (40.8%) and 174 (59.2%) HCPs had good and poor knowledge respectively towards the disposal of unused, unwanted and expired medicines.

Out of 294, 277 (94.2%) HCPs agreed that improper disposal of unused, unwanted and expired medicines adversely affects the environment and our health. Further, 281 (95.6%) and 13 (4.4%) HCPs had positive and negative attitudes respectively towards the disposal of unused, unwanted and expired medicines. Junior residents (140 out of 143, 97.9%) had a better attitude than faculties (141 out of 151, 93.3%) regarding the disposal of medicines [$\chi^2(1)=3.558, P=0.059$] (Table 3).

A total of 283 (96.3%) HCPs used to check the expiry date of the medicines at the time of buying and 62.6% HCPs always check the expiry date of medicines available at their

Table 3. Attitude of healthcare professionals towards disposal of unused, unwanted and expired medicines (n=294)

Variables	Frequency	%	
Improper disposal of unused, unwanted and expired medicines adversely affects the environment and health.	Agree	277	94.2
	Neutral	9	3.1
	Disagree	8	2.7
I am willing to donate my unused and unwanted medicines before expiry to reduce wastage.	Agree	269	91.5
	Neutral	23	7.8
	Disagree	2	0.7
If there is a monetary incentive for me to return unused, unwanted and expired medicines, I am more likely to do so.	Agree	183	62.2
	Neutral	62	21.1
	Disagree	49	16.7
There is a need for a program like "Drug take-back system" to collect unused, unwanted and expired medicines from home.	Agree	275	93.5
	Neutral	14	4.8
	Disagree	5	1.7
I wish to attend a seminar or workshop on how to dispose of unused, unwanted and expired medicine safely.	Agree	269	91.5
	Neutral	19	6.5
	Disagree	6	2.0

home. Only 59 (20.1%) HCPs ever sought advices from others during disposing of unused, unwanted and expired medicines (Table 4). Only 60 (20.4%) HCPs had good practice and 234 (79.6%) HCPs had poor practice of disposal of unused, unwanted and expired medicines. Junior residents (36 out of 143, 25.1%) had a better practice than faculties (24 out of 151, 15.8%) regarding the disposal of medicines [$\chi^2(1)=3.895, p=0.048$].

Table 4. Practice of healthcare professionals towards disposal of unused, unwanted and expired medicines (n=294)

Variables	Frequency	%	
Do you check the expiry date of the medicines at the time of buying?	Yes	283	96.3
	No	11	3.7
How often do you check the expiry date of medicines you have at your home?	Always	184	62.6
	Often	73	24.8
	Sometimes	31	10.5
	Rarely	6	2.0
Do you have unused or expired medicines with you at your home?	Yes	165	56.1
	No	129	43.9
What do you usually do with the unused, unwanted and expired medicines present at your home?	I keep them for future use.	41	13.9
	I give them back to the pharmacy.	12	4.1
	I donate to hospitals or other organizations.	12	4.1
I give them to friends or relatives.		15	5.1
	I dispose of them.	214	72.8

Out of 294, 165 (56.1%) HCPs had unused, unwanted and/or expired medicines at their home. Most common medicines stored by them included non-steroidal anti-inflammatory drugs (84.2%), antibiotics (60.6%), proton pump inhibitors (55.2%), vitamins (53.3%), anti-allergics (5.5%), probiotics (3%) and muscle relaxants (1.8%) and miscellaneous (21.9%). The miscellaneous drugs consisted of antidiabetics, steroids, antihypertensives, antidepressants, hypnotics, anti-diarrheal, antihistaminics (H_2 blockers), anthelmintics, antiviral drugs, thyroid hormone preparations and immunosuppressants. Leftover from the previous over-the-counter drugs (70.4%) was the most common cause of the availability of unwanted, unused and expired medicines at their home (Fig. 1).

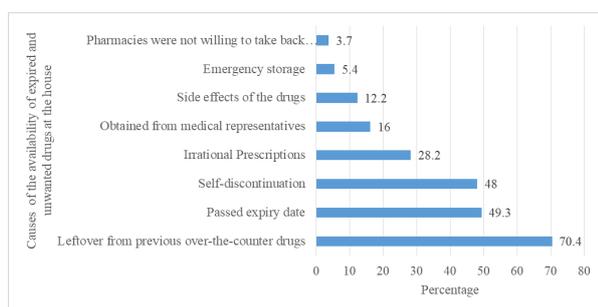


Figure 1. Causes of the availability of unused, unwanted and expired drugs at the house (n=165)

Most of the HCPs threw the unused, unwanted and expired solid (68.7%) and liquid (53.7%) drugs in household garbage respectively (Table 5).

Table 5. Methods of disposal of unused, unwanted and expired drugs among the healthcare professionals (n=294)

Practice of disposal methods among participants	Solid dosage forms		Liquid dosage forms	
	n	%	n	%
I dispose of them in the sink or flush down the toilet.	24	8.2	64	21.8
I incinerate/burn them.	57	19.4	42	14.3
I throw them in household garbage.	202	68.7	158	53.7
I throw them in river or lake.	13	4.4	12	4.1
I dump them in the ground.	71	24.1	64	21.8
I throw them in household garbage after inertization and encapsulation.	18	6.1	19	6.5

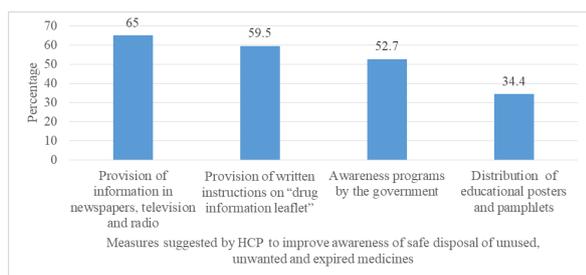


Figure 2. Measures suggested by healthcare professionals to improve awareness of safe disposal of unused, unwanted and expired medicines (n=294)

One hundred and ninety one HCPs (65%) suggested provision of information of the disposal of unwanted, unused and expired medicines in newspapers, television and radio (Fig. 2).

DISCUSSION

Pharmaceutical waste is a growing problem in different parts of the world in terms of its negative impact on the environment and human health including governmental expenditures.²³ Ecopharmacovigilance emphasizes the source control of pharmaceutical waste to the environment. Improper disposal of medicines can contaminate the environment and pollute the nature, alter the food chain and harm the living beings including the microorganisms.²⁴ In the present study, faculties had better knowledge over JRs regarding the methods of disposal of unused, unwanted and expired drugs; however, it was statistically not significant ($p=0.750$). Good knowledge of disposal of unused, unwanted and expired medicines was found in only in 40.8% of HCPs and this finding was lower than the finding of a study conducted in Ethiopia.²⁰ These differences might be due to unawareness of the guidelines, poor national and local policy regarding the proper disposal of the unused, unwanted and expired medicines. It is also not in undergraduate and postgraduate medical curriculum.

In the present study, more than three-fourth (85%) of the HCPs knew that medicines lose their effect after the expiry date. This was comparable to the finding of other studies.^{15,25} In contrast to this, a lower percentage of the participants (62.2%) said that it loses its therapeutic effect in a similar study.¹⁴ The potency of the medicines begin to diminish at the expiry date. Most of the medicines if stored under optimal conditions retain 90% of their potency for at least five years after the labeled expiry date.² Many medicines retain a significant amount of their original potency even ten years after the expiry date.² There is not any other scientific evidence to suggest that expired medications can be toxic except the case of degraded oxytetracycline.^{26,27}

A large proportion (69.7%) of the HCPs did not know that unused, unwanted and expired medicines should be kept in the red container in hospital. The color-coding for containers for pharmaceutical waste management is different in different countries. As per the national guidelines in Nepal, all pharmaceutical waste should be kept in red container.²⁸ In India, pharmaceutical waste is kept in yellow-colored non-chlorinated containers.²⁹ Half of the HCPs (53.7%) agreed that the best recommended method for safe disposal of unused, unwanted and expired medicines is returning them back to the hospital, pharmacies or manufacturer. This findings was higher than a study conducted in China (46%).³⁰ If a drug take-back policy is not there, then incineration is the second-best method for drug disposal.³¹ The World Health Organization,

US-Food and Drug Administration (FDA) and Nepalese Guidelines for Safe Disposal of Unwanted Pharmaceuticals medicines recommend high-temperature incineration with temperatures more than 1200°C.^{28,32,33}

A large proportion of HCPs (95.6%) had a positive attitude towards the disposal of unused, unwanted and expired medicines. JRs (97.9%) had a better attitude than faculties (93.3%) regarding the disposal of medicines; however, it was statistically not significant ($p=0.059$). JRs might be more concerned regarding safe disposal of such medicines. A total of 94.2% participants opined that improper disposal of unused, unwanted and expired medicines adversely affects the environment and health. Similar finding was reported in other study (75%).¹⁴ A large proportion of HCPs (93.5%) opined that there is a need for a program like "Drug take-back system" to collect unused, unwanted and expired medicines from home. This might be due to lack of a drug-take-back-system in Nepal. In a study by Sapkota et al. most participants supported need of drug take-back system in the country. Take-back concept could be initiated and implemented on government funding or other sources.³⁴

Only one-fifth (20.4%) of HCPs had a good practice of disposal of unused, unwanted and expired medicines in the present study. JRs (25.1%) had a better practice than faculties (15.8%) and it was statistically significant ($p=0.048$). JRs may be more aware of the guidelines on pharmaceutical waste disposal and less ignorant. Majority (96.3%) of HCPs used to check the expiry date of the medicines at the time of buying. This finding was comparable with a similar study conducted in India (74.3%).¹⁴ It is critical to be alert with the expiry date of medicines to ensure its full potency and safety. The present study found that slightly less than two-thirds (62.6%) of the HCPs always check the expiry date of medicines available at their home. This result was consistent with a similar study conducted in India.¹⁴ HCPs might be more concerned regarding safety of the medicines they are using. HCPs as well as general public should cultivate a good habit of checking the expiry date of medicines at the time of purchase from pharmacies. The medicines available at home should also be reviewed every 6-12 months for its expiry date.

There is a natural inclination in human to keep something that might be useful later on, particularly if future procurement involves inconvenience or expense. The present study found that more than half (56.1%) of the HCPs had unused, unwanted and/or expired medicines at their home and this was slightly higher than a study conducted among Serbian households (44.4%).³⁵ This result, however, was lower than the study conducted in Ethiopia (66%).¹⁶ This difference might be due to the presence of drug take-back system, controlled drug-prescription and educational programs available in these countries. The stakeholders and policymakers should emphasize this problem through proper guidelines and awareness programs as storing

medicines at home can lead to irrational drug use and accidental poisonings. Nonsteroidal anti-inflammatory drugs, antibiotics and proton pump inhibitors were the most common medicines stored by HCPs. These results were comparable with other similar studies conducted in other countries which reported that most household medications were analgesic drugs.^{16,36-38} People are often inclined to treat pain and infections themselves as soon as they arise and hence they might keep analgesics and antibiotics at home for future use. Further, most of the faculties may have free medicines given by medical representatives as physician's sample and the surplus medicines may get expired and can accumulate over a period of time leading to a need for safe disposal. It would be better if these drugs are distributed to the needy patients as the unused home medicines might serve as a known source for poisonings, abuse and misuse. Time has come to explore the medicines reuse and the idea of re-dispensing the piled-up medicines to others following its quality control.

Around two-thirds (72.8%) of HCPs dispose of the unused, unwanted and expired medicines present at their home which was similar to findings of Ayele et al.¹⁶ Majority of HCPs threw the unused, unwanted and expired drugs in household garbage which is not a safe and recommended method. This finding was consistent with other studies.^{14,25,36,39} Around one-fifth (21.8%) of the HCPs also dispose the liquid drugs in the sink or flush down the toilet which is again not a recommended method. An environmentally unsafe disposal method was used by majority of the HCPs indicating a very poor practice of the pharmaceutical waste management. The findings of the present study is worrying since the unsafe practice of the disposal of unused, unwanted and expired medicines by the HCPs was not environmental friendly. This result emphasizes the involvement of the government in creating awareness and guiding the consumers on proper disposal practice. In this study, none of the HCPs considered returning medicines to the pharmacy or hospital as an appropriate way of disposing of unused, unwanted and expired medicine. In contrast, just under half of participants returned unwanted medication back to the pharmacy in Sweden.⁴⁰ This might be due to lack of a take-back system in our country whereas the USA, Canada and European countries have a well-established drug take-back system that encourages people for proper disposal of left-over medicines.^{41,42} One should return back the drugs by following the drug take-back program if it is available and this is the best method. In case if drug take program is not available then, one should follow specific disposal instructions on the medication label or in the patient information sheet that accompanies the medicines. Medicines can be disposed of in the household trash by removing them from their original containers, mixing them with an unpalatable substance, such as kitty litter or used coffee grounds, placing the mixture in a sealed plastic container and disposing it with the household trash.^{43,44}

Worldwide about 600 pharmaceutical compounds and transformation products from pharmaceuticals have been traced in the aquatic environment.⁴⁵ Therefore, it would be better to follow the FDA guidelines for flushing the drugs. FDA has recommended a flush list of certain drugs for their disposal. Medicines on the flush list are those (1) sought-after for their misuse and/or abuse potential and (2) that can result in death from one dose if inappropriately taken.⁴⁶

Around two-thirds of the HCPs (65%) suggested to disseminate the information of the disposal of unwanted, unused and expired medicines in newspapers, television and radio. This report implies need for proper education to improve consumers' awareness and practice through various ways by policymakers, stake-holders, mass-media and environmental agencies. HCPs have a captive audience at the point of prescribing and may be able to effectively educate patients regarding both the use and eventual disposal of any excess medicines. The present study has some limitations. Being a cross-sectional and single center study, the study finding may not be generalized to whole country; thus the external validity of the study may be compromised.

CONCLUSION

Majority of the HCPs had positive attitude but poor knowledge and practice regarding disposal of expired and unused medicines. There was a high practice of keeping medicines at home by HCPs. Non-steroidal anti-inflammatory drugs are among the most frequently found medicines at their home. Most disposal methods practiced by HCPs were not recommended methods. The findings would be useful for planning strategies to minimize unused medicines and foster the appropriate disposal practice. The existing national guidelines should be implemented and disseminated to preserve the ecosystem. An organized method of collecting unused, unwanted and expired pharmaceuticals through 'drug take-back system' needs to be introduced. There is a need of workshops, seminars or continued medical education on this topic to sensitize the HCPs so that they can follow the proper guidelines for the disposal of leftover medicines and can further educate the patients and public.

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