

Global Scenario of Drug Disposal: A Review of Literature

Darshana Ramesh*, Sandhrima Sudhakaran and Shabaraya AR

Department of Pharmacy Practice, Srinivas College of Pharmacy, Valachil, Post Farangipete, Mangalore, Karnataka 574743, India

ABSTRACT

Thousands of drugs are introduced to the market every day in order to treat various diseases and to improve the health of growing population of India. But when they are expired or when the disease is cured, the drug is no longer needed and their disposal become necessary because drug is a chemical and once it expires it will become a toxic agent. The people may have unused, unwanted or expired medicines which may occur as a result of non-adherence, unnecessary storage of OTC medication or unused drugs. The USFDA initiated 'drug take back programme' to prevent the exposure of these drugs into environment. But in India this programme is not functional. Our country is now facing various problems as a result of improper drug disposal methods such as flushing into toilet, burning and throwing outside or into waste-basket which may lead to environmental contamination and pollution, contamination of water supplies and other local sources used by community and wildlife which will result in serious environmental and health hazards like toxicity, accidental poisoning and drug abuse, development of drug resistance problems and even death.

INTRODUCTION

Safe use of medicine also includes safe storage and disposal. It is crucial that we organize and keep track of the drugs that we use. After all, you want to know where a particular medicine is when you or someone else needs it. Always keep your drugs secure so that a curious toddler, a meddling teenager, a beloved pet or even houseguest, does not have access to the drugs easily. [2] Drug disposal is the discarding of drugs. People generally dispose of unused drugs that remain after the end of medical treatment. Health care organizations dispose of drugs on a larger scale for a various reasons, including having leftover drugs after treating patients and discarding of expired drugs. Failure to proper disposal of drugs creates opportunities for others (of whom the drug is unintended) to take them inappropriately. Inappropriate disposal of drugs can also cause drug pollution. People dispose of drugs in numerous ways. Even though organizations have expertise on drugs, they give inconsistent information about drug disposal to the consumers. [3] Expired drugs should be disposed off safely, without causing harm to the people and the environment. Pharmaceutical products may lose their potency in the deterioration process. Physical changes may also lead to decreased absorption, which results the products to be less effective. Pharmaceutical product manufactures are responsible for the harmful effects of their products within its shelf life and only if the product was transported and stored under the conditions recommended by the manufacturer.

LITERATURE REVIEW

Drug disposal practices in different geographies

Canada: Different types of pharmaceutical disposal methods shown in Table 1. Patients and their caretakers may need to dispose of prescription and non-prescription medications for numerous reasons, for example, failure to complete a course of therapy; alteration in treatment, dose, or clinical condition; or product expiry. The ideal method of medication disposal should be convenient to perform, should reduce the risk for diversion, should not impose a financial burden, and should not harm the environment. It is recommended to take unused medications to a community pharmacy for proper disposal so that these guidelines are met. [4,5] Disposing of medications in the trash is not adequate, because home garbage containers are often exposed to children and pets, as well as to drug diversion. Even though flushing medications down the toilet has often been used as an alternative for drug disposal, there are compelling arguments against widespread use of this practice, given that the potential environmental and health impact of most medications is not known. The US Food and Drug Administration has published a

Since the drug take back programme is not functional in the developing countries like India several cases of toxicity and accidental exposure are seen day by day. [1]

Keywords: Drug; Catalyze

Correspondence:

Dr. Darshana Ramesh,
Department of Pharmacy Practice,
Srinivas College of Pharmacy,
Valachil, Post Farangipete,
Mangalore,
Karnataka-574743.
E-mail: drdarshanaprakash@gmail.com

Access this article online

Website: www.jbclinpharm.org

Quick Response Code:



list of medicines, notably potent opioids, for which disposal by flushing may be acceptable when more responsible, take-back options are not easily available. [6] Topical patches containing opioids, such as Fentanyl and Buprenorphine, have unique disposal risks. The Patch-for-Patch Fentanyl Return Policy is an Ontario legislative initiative that aims to reduce the risk of harm; evaluation of this program will be of interest. The website of the Health Products Stewardship Association (HPSA) provides information about locations and processes for safe drug disposal in every Canadian province. The HPSA also administers medication return programs for participating pharmacies in British Columbia, Manitoba, Ontario, and Prince Edward Island; through these programs, patients can take unwanted or unused drugs to participating pharmacies. In addition, HPSA, its partners, and participating pharmacies conduct an annual campaign in order to encourage families to declutter their medicine cabinets and to return unwanted and expired medicines to the pharmacy. [7]

USA: The occurrence of trace levels of prescription and over-the-counter pharmaceuticals in the environment began to receive concerted attention nearly two decades ago. The public's growing concern and awareness over the presence of these chemicals in drinking water and environment has served to catalyze considerable discussion and debate regarding the best practices for disposal of unused or unwanted medications. In 2007, the first federal guidance for consumers was issued in the United States. It recommends disposing of unused pharmaceuticals to household trash, after taking precautions to mix the pharmaceuticals with an inert substance and conceal the contents from view. Providing the consumer with additional options for conscientious drug disposal are various community, city, and state collection events, on-going programs, and government-funded pilot projects. These approaches consist of the opportunity to mail or bring unused medications to various collection points, such as pharmacies, for eventual destruction. All of these approaches to medication disposal play roles in reducing the introduction of pharmaceuticals to the environment. [8]

This is an open access article distributed under the terms of the Creative Commons Attribution Noncommercial Share Alike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

For reprints contact: invoice@jbclinpharm.org

Cite this article as: Prakash D, Sudhakaran S and Shabaraya AR. Global Scenario of Drug Disposal: A Review of Literature. J Basic Clin Pharma. 2020;11:01-04.

Table 1: Different types of pharmaceutical disposal methods.

Disposal Methods	Types of Pharmaceutical	Comments
1. Return to donor or manufacturer (Transfrontier transfer for disposal)	All bulk waste pharmaceuticals, particularly antineoplastics	Usually not practical—transfrontier procedures may be time consuming
2. Landfill	Limited quantities of untreated solids, semi-solids and powders. PVC plastics	Disposal of waste pharmaceuticals preferable after immobilization
a. Highly engineered sanitary landfill	Waste solids, semi-solids and powders, preferably after immobilization. PVC plastics.	Immobilization of solids, semi-solids, powders is preferable
b. Engineered landfill		As last resort. Not for untreated controlled substances. Must be covered immediately with municipal waste
c. Open uncontrolled non engineered dump	Untreated solids, semisolids, powders	
3. Waste Immobilization: encapsulation	Solids, semi-solids, powders, liquids, antineoplastics, controlled substances	
4. Waste Immobilization: inertization	Solids, semi-solids, powders, antineoplastics, controlled substances.	
5. Sewer (Fast-flowing watercourse)	Diluted liquids, syrups, intravenous fluids, small quantities of diluted disinfectants (supervised).	Not recommended for antineoplastics, and Un-diluted disinfectants and antiseptics.
6. Burning in open containers	Packaging, paper, cardboard	As last resort. Not acceptable for PVC plastics or pharmaceuticals
7. Medium temperature incineration with two-chamber incinerator with minimum temperature of 850°C. Cement kiln incineration in the absence of high temperature incinerators	Solids, semi-solids, powders, controlled substances.	Antineoplastics best incinerated at high temperature.
8. High temperature incineration with temperatures greatly in excess of 1200°C	Solids, semi-solids, powders, antineoplastics, controlled substances	Expensive
9. Chemical decomposition		Not recommended unless special chemical expertise and materials available. Not practical for quantities over 50 kg

Kuwait: People face a problem of unused medicines in households in Kuwait. Official guidelines do not prevail in Kuwait regarding proper disposal of healthcare and domestic waste, with which to encourage them to continue in this manner. Introduction of these guidelines and the development of a reverse distribution mechanism should be considered to support the efforts of the public and to reduce the environmental harm that is the result of continuing landfill of unwanted medicines and their packaging. The disposal of potentially mutagenic anti-cancer medication and biologicals also needs to be investigated as these can lead to serious adverse outcomes if discarded into household garbage. The study shows that the need for appropriate methods for disposal of unwanted medication in the home is an issue in Kuwait. Hence, guidelines on safe disposal of unwanted medicines are required and an organized method of collecting unused medication needs to be introduced.^[9]

Thailand: Thai villagers stored some kind of medicines in their houses and often they did not finish them all. Drug for neuromuscular disorders was the most common stored item. The leftover medicines were thrown away into garbage when unwanted no matter which dosage form it was. This can potentially do harm to the environment. There were no significant differences of storage and disposal practices between genders. Neither was any significant differences found with regarding to education, career and income versus practice of storage and disposal.^[10]

Nigeria: The average number of unused medications found in households is unsurprising because in Nigeria, self-medication is common. They store unused drugs at home either for re-use or to give it to someone else who has similar problem. Furthermore, these medications may be a result of non-adherence to therapy. The most common classes of medicines found in households were analgesics, antibiotics, and nutrition/blood preparations. In Nigeria, analgesics are the most commonly procured medicines and self-medication with them is high. They are usually the primary class of medicines

used by people in an event of illness. This is because most illnesses present with pain and fever are treated with analgesics and households keep it in their medicine cabinet to use in an event of illness. High amount of antibiotics are present in households and this indicates the improper use of antibiotics and this can lead to resistance which is a major challenge in the treatment of infectious diseases in developing countries. Nutrition and immunity boosting medicines are common in households because people take them as supplements for preventing illness, promoting health, prevention of stress, boosting the immune system, and to supplement regular nutrition. Therefore, their use is usually seen as part of a healthy lifestyle. It is common in Nigeria, to dispense medicines without appropriate labelling. People identify these medicines only with certain symptoms and diseases. This can lead to the administration of wrong medicines for a disease condition. This leads to appropriate labelling of medicines during dispensing.^[11] Nigeria lacks basic education on appropriate disposal of medicines. As in developed countries, unused/expired medications are not returned to pharmacies for appropriate disposal. Dumping of pharmaceuticals in the soil, ground water, and drinking water have been reported. However, no such studies have been done in Nigeria, but it is likely that these compounds are accumulating in the environment, since they are mostly disposed in refuse dump. Therefore, public awareness is required on appropriate drug disposal. Government should also encourage reverse distribution network in which community members are encouraged to return unwanted medications to pharmacies which then arrange for approved agents/bodies to collect and destroy them.^[12]

New Zealand: In New Zealand people have leftover medications since their medical condition improved or resolved. Depending on dosage type, unused or unwanted drugs were returned to pharmacies with tablets and capsules being most likely to be returned and liquids most likely to be added to water systems. A significant percentage of unwanted medications are disposed of through different routes that have the potential to adversely affect the environment. Decreasing

excess medications and wastage as well as education of appropriate disposal techniques may minimize their potential impact on the environment.^[13]

Australia: The National Return and Disposal of Unwanted Medicines Program provide safe and free method for the disposal of expired/unwanted medicines. This will reduce dumping of drugs in landfill and waterways. An audit showed that over 600 tonnes of medicines are returned through the program. Out of which, substantial proportion of these medicines were still within their expiry dates. *Salbutamol*, *insulin* and *frusemide* are the most commonly discarded medicines. More than \$2 million of public money is wasted each year. Hoarding and no adherence to treatment contribute to drug waste. Health professionals should educate their patients about the importance of completing prescribed courses of treatment, and they should discourage them from hoarding medicines after reaching the safety net threshold on the Pharmaceutical Benefits Scheme. Prescribe no more than the required quantity of medicines. When starting a new therapy, a minimal quantity should be prescribed in case the drug is unsuitable for the patient. Advise patients to return all unwanted medicines to a pharmacy for disposal.^[14] In Australia, the National Return and Disposal of Unwanted Medicines programme offers the only safe method for disposal of unwanted and expired medicines and is a fundamental component of the quality use of medicines strategy. Periodic audits of the Return Unwanted Medicines bins to collect data on medicine wastage will assist with decision making about medicines supply and use at a national level, and in the design of campaigns to facilitate quality use. On-going research on the reasons why consumers return or otherwise dispose of medicines is also needed to promote medicine adherence and rational prescribing of medicines, and to minimise wastage.^[15]

Yogyakarta: Out of a survey majority of respondents (85%) reported storing unused medications in their home and only 3% reported returning medication to a pharmacy. Antibiotics were commonly medicine kept in home (37%). Predominant reason for discontinuing medication was disease or symptoms felt improved (97%). Less than half of respondents (41%) checked the expiry date of their medicine before use. Most respondents (80%) did not get any advice from health professionals. Gaps exist in practices of medicine disposal. An effective unused drug disposal system supported by community pharmacists should be provided along with extensive media campaign to educate customers on safe medicine disposal practices.^[16]

Ethiopia: Improper discarding of medications seems to be practiced in Adigrat city. A large portion of the respondents are unaware about drug-take-back systems. On the other hand, most of the respondents had a positive attitude towards the risks of expired and unused drugs. Almost half of the respondents suggested that awareness regarding disposal of unused and expired pharmaceuticals should be improved. There is a need for increasing awareness about proper disposal of unused and expired medicines among the public. Community pharmacists can play a significant role in encouraging proper disposal practices in Adigrat city.^[17]

India: In order to treat various diseases thousands of drugs are releasing into the market every day to promote the health of growing population of India. But when they are no longer needed, their disposal become necessary because drug is a chemical and once it expires it will become a toxic agent. Expired medicines, unused or unwanted drugs are seen in the household which occur as a result of non-adherence, excessive storage of OTC medication or disuse of drugs. The USFDA initiated 'drug take back programme' to prevent the entry of these medication into environment. But in India drug take back programmer is un functional. The country is now facing numerous problems due to improper drug disposal methods such as flushing into toilet, burning and throwing somewhere or into waste-basket which may lead to contamination of

water supplies, environmental contamination and pollution and other local sources used by community and wildlife which will results in accidental poisoning and drug abuse, serious environmental and health hazards like toxicity, development of drug resistance problems and even death. Since the drug take back programme is UN functional in the developing countries like India several cases of toxicity and accidental exposure are seen every day. So an online survey was conducted in general population in order to check the knowledge of people regarding safe drug disposal system.^[18]

DISCUSSION

Based on the review of studies the overall status of medication waste management is not satisfactory worldwide except in few developed countries. Lack of established programmes may have largely contributed to the substandard nature of medication waste management in developing countries. Classes of medicines found in medication waste seem to correlate with common disease patterns in the community. Amount of medicines discarded as waste can be minimised by consumer education and prescribing and/or issuing the minimum required amount of medicines per person during a clinic visit. However, in some developing countries, over the counter medicines represented the major proportion of medication waste. This shows the unique nature of issues present in developing countries and the need of preliminary surveys to understand and quantify them. Although our review does not represent all countries under equal conditions, it will provide a good insight to understand the background of medication. The most popular methods for medication disposal were in the garbage, toilet or sink. Liquid medications were more likely to be rinsed down the sink, as opposed to solid tablets and capsules which were more likely deposited in the rubbish bin. The most common method for disposal of unused medications practiced are throwing in dust bin, this practice of disposal are followed by people all over. Not only in India but also in various countries of the world it is followed the same, majority of the population throw it in garbage in countries like UK and Saudi Arabia while New Zealand, USA flushing in toilet predominates. Only in countries like Germany and Sweden they follow the practice of returning it to the pharmacy. It was recommended in the FDA guidelines for drug disposal that unused/expired medicines should not be flushed in toilet or drain. Before throwing the unused /expired medicines in the dustbin it was suggested to mix the solid medications with the substance like coffee grounds and put into a disposable container and the liquid medications with salt, turmeric. Inappropriate 7 medication disposal were associated with accidental exposure to human, livestock and aquatic organisms. USFDA have initiated the drug take back programme on 25th September 2010, for preventing and controlling these problems. 18 Pharmacies interested in program would be identified wherein patients visiting these pharmacies would be encouraged to return the unused/expired medications to the pharmacy. The disposal of unused/expired medications from the pharmaceutical industries are given to Bio Medical Waste Management and disposed as per the rules (Biomedical waste Management).¹⁹ However, no provisions for disposal of drugs from each home and lack of awareness regarding safe disposal. So a proper awareness programme is the need of the hour to tackle the issues arising from improper drug disposal. Unused medicines can be divided into two categories as expired and non-expired. Expired medicines need to be sorted out separately and incinerated by municipal authorities. But the rural population may not be able to access municipals and therefore other local authorities may need to take the responsibility. Although lack of man power will be an issue, defining the role for each stakeholder group will minimise negative consequences. Offering the consumers with discounts for their purchases based on returned medicines as well as initiatives such as 'National take back day for medicines' will encourage general public to engage more and more with these programmes. Periodic feedback via

surveys and quality assurance audits will help to understand emerging problems and to improve systems on a regular basis.

CONCLUSION

Monitoring and detection of pharmaceutical impact on environment has to be done on priority. India is facing multidrug-resistant bacterial infections which are only the visual impact of our doing-undoing. Environmental impact of other medicines has not been well studied as their disposal is not regulated. Currently, no methods exist to assess the negative environmental impact in the long- and short-term exposure to synthetic medicines. Since there are not many medical activist pressure groups in the country, such issues do not find much space in the media. The ignorant populations continue to suffer the exposure because the monitoring agencies are not vigilant. None wants any additional work to control the medicine disposal. Concern for public health is at low ebb, and the medicine disposal in the country certainly needs a re-think.

REFERENCES

1. Shwetha N, Jha A. Knowledge and awareness regarding safe drug disposal system among general population of India. *J Pharmacovigil.* 2018;6(256):2-8.
2. Plant EA, Norris PT, Tordoff JM. Workforce and service delivery analysis across New Zealand hospital pharmacy departments. *J Pharm Pract.* 2006;36(4):271-4.
3. Stergachis A. Promoting the proper disposal of unused, unwanted, or expired medications: Andy Stergachis. *J Am Pharm.* 2014;54(3):226-28.
4. Konings F, Barakat A, Hutin Y, Hajjeh R. COVID-19 highlights the need for a strong health laboratories foundation for infectious disease surveillance and control in the Eastern Mediterranean Region. *East Mediterr Health J.* 2020;26(6):633-5.
5. Strike C, Watson TM. Losing the uphill battle? Emergent harm reduction interventions and barriers during the opioid overdose crisis in Canada. *Int J Drug Policy.* 2019;71:178-82.
6. Silver D, Taylor Z, Calderón-Figueroa F. Populism in the city: The case of Ford Nation. *Int J Polit Cult Soc.* 2020;33(1):1-21.
7. Wiederholt JB, Schommer JC, Mount JK, McGregor TD, Braatz PD. The Wisconsin pharmacy self-inspection project: An application of Berwick's theory of continuous improvement. *Am J Pharm.* 2002;66(1):27-36.
8. Glassmeyer ST, Hinchey EK, Boehme SE, Daughton CG, Ruhoy IS, Conerly O, et al. Disposal practices for unwanted residential medications in the United States. *Environ Int.* 2009;35(3):566-72.
9. Abahussain EA, Ball DE, Matowe WC. Practice and opinion towards disposal of unused medication in Kuwait. *Med Prin Pract.* 2006;15(5):352-7.
10. Arkaravichien W, Ruchipiyarak T, Thawinwan W, Benjawilaikul S. A threat to the environment from practice of drug disposal in Thailand. *Environ A.* 2014;7(1):25-29.
11. Linden K. A pharmaco-epidemiological study of medicine use among Finnish conscripts. Helsinki: University of Helsinki; 2005.
12. Auta A, Omale S, Shalkur D, Abiodun AH. Unused medicines in Nigerian households: types and disposal practices. *J Pharm Pharmacol.* 2011;2(3):195-98.
13. Braund R, Peake BM, Shieffelbien L. Disposal practices for unused medications in New Zealand. *Environ Int* 2009;35(6):952-5.
14. Kirkpatrick C, Dooley M, Charman B. The National Return and Disposal of Unwanted Medicines (NatRUM) Project Audit.
15. Bettington E, Spinks J, Kelly F, Wheeler AJ. Returning unwanted medicines to pharmacies: prescribing to reduce waste. *Australian prescriber.* 2018;41(3):78-82.
16. Kristina SA. A survey on medicine disposal practice among households in Yogyakarta. *Asian J Pharm.* 2018;12(03)74-76.
17. Kabsay H, Ahmedin M, Kebede B, Gebrezihar K, Araaya H, Tesfay D. Assessment of knowledge, attitude, and disposal practice of unused and expired pharmaceuticals in community of adigrat city, northern Ethiopia. *J Environ Res.* 2020;12(1):34-40.
18. Nasim F. How to Dispose off Expired, Unused drugs- Indian Pharmaceutical Association asks Nadda [Internet].