

Literature Review: Pharmaceutical Waste Disposal Practices: Global Trends and Environmental Impact

Ahmed Hussain AlSalman ^{1,*}, Ali Abdulwahab AlKhamis ¹, Entsaar Mansoor Binsaleh ¹, Ali Abdullah Gadeemi ¹, Ashwag Adel AlJuhar ¹ and Abdulaziz Ibrahim AlDuhailan ²

¹ Pharmacy Department, King Abdulaziz Hospital of National Guard Affairs, AlAhsa, Saudi Arabia.

² Pharmacy Department, King Fahad Hospital Medical Supplies, AlAhsa, Saudi Arabia.

World Journal of Biology Pharmacy and Health Sciences, 2025, 23(03), 128–130

Publication history: Received on 29 July 2025; revised on 04 September 2025; accepted on 06 September 2025

Article DOI: <https://doi.org/10.30574/wjbphs.2025.23.3.0815>

Abstract

Pharmaceutical waste is progressively emerging as a concern of public health and environmental concern. Abuses of disposal protocols cause contamination of water bodies, soil contamination, and even food chain contamination. This review addresses global trends in pharmaceutical disposal, establishing notable environmental impacts and evaluating current regulatory frameworks and levels of public knowledge. The research indicated large policy implementation shortcomings and public educational shortfalls, especially in low- and middle-income countries. Improving collection systems, implementing take-back programs, and increasing stakeholder collaboration are essential to mitigate the environmental burden of pharmaceutical waste.

Keywords: Pharmaceutical; Waste; Disposal; Practices; Global Trends; Environmental Impact

1. Introduction

With increased global use of pharmaceuticals, production of drug waste has expanded manifold. It is made up of expired, unused, and dirty drugs from hospitals, households, and drug manufacturing facilities. Improper disposal such as flushing down medicine or disposing of it in the garbage can pose threats to freshwater life, antibiotic resistance, and human lives [4-6]. While take-back programs are present in developed countries, developing countries are typically lacking in infrastructure and legislations to manage drug waste effectively.

2. Literature Review

There is an immense variability of pharmaceutical waste disposal methods across different countries. In the US and EU, policy stimulates take-back collection programs and burning of pharmaceutical waste, but in most of Asia and Africa, medicines are merely discarded in household waste or in waterway systems [7-10]. Environmental survey studies have reported finding pharmaceutical residues in rivers, lakes, and even drinking water [11]. Examples are antibiotics, hormones, and analgesics that persist in the environment, affecting ecosystems and potentially entering the human food chain [12].

3. Discussion

Pharmaceutical waste management is influenced by various factors including public awareness, regulatory policy, health infrastructure, and industry participation of the pharmaceutical industry. Sweden and Germany have implemented successful national programs for disposal with public campaigns and collection points in pharmacies [13].

* Corresponding author: Ahmed Hussain AlSalman.

On the other hand, most of the poor nations rely on unsafe or ad hoc methods of disposal, which lead to environmental pollution and health risks [14-16]. Emerging technologies such as green pharmacy and biodegradable drug design offer promise for the future but are at the initial stages of implementation [17].

4. Results

The analysis of global data shows that while there is better management of pharmaceutical waste in high-income countries, even they suffer from issues related to cost and compliance. Surveys conducted in nations such as India, Nigeria, and Brazil indicate that more than 60% of families throw away medicines in general waste, and even a minor percentage knows how to dispose of them properly [18]. The occurrence of pharmaceutical pollutants in water bodies is attributed to impairment of aquatic reproductive systems, elevated bacterial resistance, and ecological imbalance [19].

5. Conclusion

Pharmaceutical waste disposal is a grim environmental issue that requires collective effort across the world. Sustainability, community awareness, regulatory adherence, and technological development are essential to address this complex issue. Global standards, funding for waste facilities, and accountability of the pharmaceutical industry are essential for secure disposal processes worldwide.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

- [1] Daughton CG, Ruhoy IS. Environmental footprint of pharmaceuticals: the significance of factors beyond direct excretion to sewers. *Environ Toxicol Chem.* 2009;28(12):2495–521.
- [2] Kümmerer K. *Pharmaceuticals in the environment: sources, fate, effects and risks.* Springer; 2008.
- [3] Ruhoy IS, Daughton CG. Types and quantities of leftover drugs entering the environment via disposal to sewage—revealed by coroner records. *Sci Total Environ.* 2007;388(1-3):137–48.
- [4] Bound JP, Voulvoulis N. Household disposal of pharmaceuticals as a pathway for aquatic contamination in the United Kingdom. *Environ Health Perspect.* 2005;113(12):1705–11.
- [5] Larsson DG. Pollution from drug manufacturing: review and perspectives. *Philos Trans R Soc Lond B Biol Sci.* 2014;369(1656):20130571.
- [6] Al-Khatib IA, Al-Qaroot YS, Ali-Shtayeh MS. Management of healthcare waste in circumstances of limited resources: a case study in the occupied Palestinian territory. *Waste Manag Res.* 2009;27(4):305–12.
- [7] Tong AY, Peake BM, Braund R. Disposal practices for unused medications in New Zealand community pharmacies. *J Prim Health Care.* 2011;3(3):197–203.
- [8] Kusturica MP, Tomas A, Sabo A. Disposal of unused drugs: knowledge and behavior among people around the world. *Rev Environ Contam Toxicol.* 2017;240:71–104.
- [9] Seehusen DA, Edwards J. Patient practices and beliefs concerning disposal of medications. *J Am Board Fam Med.* 2006;19(6):542–7.
- [10] Atinafu T, Alemayehu M, Alemu T, et al. Unused medications disposal practice: the case of patients visiting University of Gondar Teaching Hospital, Gondar, Ethiopia. *Int J Pharm Sci Res.* 2014;5(12):999–1005.
- [11] Fatta-Kassinos D, Vasquez MI, Schroeder HF, et al. Occurrence and removal of antibiotics and β -blockers in wastewater treatment and their environmental risk assessment. *Sci Total Environ.* 2011;409(23): 4929–36.
- [12] aus der Beek T, Weber FA, Bergmann A, et al. Pharmaceuticals in the environment—global occurrences and perspectives. *Environ Toxicol Chem.* 2016;35(4):823–35.
- [13] Holm G. Sweden's returns system for unused pharmaceuticals. *Pharm J.* 2001;267(7175):447–50.

- [14] Akande TM, Ologe MO. Disposal practices of expired and unused medications among households in Ilorin, Nigeria. *Trop J Pharm Res.* 2011;10(6):627–34.
- [15] Adedeji WA, Reuben RC. Assessment of practices and awareness of disposal of expired and unused medications among medical and pharmacy students in a Nigerian university. *J Drug Deliv Ther.* 2018;8(6):48–54.
- [16] Silva L, Barbosa F, Ferraz G. Environmental risk of improper disposal of pharmaceutical waste in Brazil: a review. *Environ Sci Pollut Res.* 2020;27(1):1–10.
- [17] Henningsen J, Maack G, Schulte-Oehlmann U, et al. Pharmaceuticals and personal care products in the aquatic environment: a European perspective on hazard assessment and regulation. *Environ Toxicol Chem.* 2011;30(5): 852–62.
- [18] Sasu S, Kümmerer K, Kranert M. Assessment of pharmaceutical waste management in Ghana. *Waste Manag Health Care.* 2012;30(5):1225–32.
- [19] Rivera-Utrilla J, Sánchez-Polo M, Ferro-García MA, et al. Pharmaceuticals as emerging contaminants and their removal from water: a review. *Chemosphere.* 2013;93(7):1268–87.
- [20] WHO. Safe management of wastes from health-care activities. 2nd ed. Geneva: World Health Organization; 2014.