

Secret of Salutary Environment: A Review Touching on Pharmaceutical Waste Materials

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Abstract- *Pharmaceuticals are essential to human health, but when they enter the environment through various routes such as emissions after consumption or improper disposal of waste and unused drugs, they can pose significant environmental concerns. Detection methods were not developed for all pharmaceuticals entering the ecosystem. These pharmaceuticals can have adverse effects on ecosystems and the various organisms within them.*

Various policies are recommended to prevent generation of household pharmaceutical waste and ensure environmentally friendly methods of pharmaceutical household waste disposal, prescribing greener medicines, or designing pharmaceuticals that are benign and easily biodegradable, and ensuring market space for redistribution of unused pharmaceuticals.

Preventing the inevitable collection and disposal of waste and unused pharmaceuticals is an important step in preventing them from entering the environment and causing harm. Pharmaceutical industries play an important role in this process by implementing various strategies to dispose of and reduce waste and unused pharmaceutical products.

Reducing the levels of pharmaceuticals in the environment is essential to protect human health, maintain ecosystem integrity, and promote environmental sustainability. Efforts to address this issue require collaboration and coordination among various stakeholders, including pharmaceutical industries, regulatory agencies, health care professionals, environmental scientists, and the public.

Keywords- Unused pharmaceutical products, Ecosystem, Pharmaceutical preventive measures.

I. PHARMACEUTICAL WASTE: IS IT A COMMON KIND?

Pharmaceutical waste refers to drugs in various dosage forms that cannot be used, reused or even returned for

use, meaning; Medicines that are damaged, unused, contaminated, or expired medical products, including prescription drugs, over-the-counter drugs, vaccines, biologics, and drugs that are not fit for their intended use. Empty containers like vials, bottles, ampoules or partially filled containers, used syringes, PPE kits, IV bags also fall in this category. This pharmaceutical waste is generated from a variety of health care settings from pharmacies, hospitals, clinics, and homes. These pharmaceutical waste products are chemically potent even in low concentrations and even after expiration. Active pharmaceutical ingredients can contaminate water and soil, causing ecological damage resulting in antibiotic resistance. Destruction of this pharmaceutical waste often requires very high temperature ignition at licensed facilities to chemically destroy the drug components rather than simply dumping and landfilling. Therefore, pharmaceutical waste is not a general type of waste, but a special category that requires strict management and disposal protocols that differ from general or municipal solid waste.

Types of Pharmaceutical Wastes:

Pharmaceutical waste is potentially generated through a variety of activities in different areas of the health care system. Therefore, identifying and sorting the various types of pharmaceutical wastes is important for their proper management and safe disposal. Basically, this pharmaceutical waste products are majorly classified into different categories:

- i) Controlled substance
- ii) Hazardous waste
- iii) Non-Hazardous Waste
- iv) Chemotherapy waste
- v) Biomedical waste

- **Controlled substances:** Drugs or medicines or chemicals that have the potential for abuse or addiction, i.e.; Some sedatives and opioids etc. are controlled by the government. These substances include both prescription drugs and illegal drugs. Prescription drugs are again

classified into different schedules based on their therapeutic use, potential for safety or abuse.

- The primary methods of disposing of controlled substances are:
 - i) **Medication pick-up locations:** Medication drop-off at pick-up location, pharmacy, or law enforcement agency site. This is the most preferred method.
 - ii) **Mail-back program:** This is an option to use pre-paid mail-back envelopes to send expired or unused medications back to the disposal facility.
- It is necessary to check the FDA's flush list and take measures to dispose of them. Since these are potentially hazardous substances, they should be flushed or discarded following proper protocols to avoid misuse. Therefore, their disposal is strictly controlled by regulatory bodies to prevent diversion.
- **Hazardous waste:** Wastes that can be solid or liquid that can potentially harm the environment or pose a threat to people's health. These could also be gases or sludge. These hazardous wastes have extremely powerful activity.
 - **Secure Landfills:** Many are specially designed landfills with impermeable liners and leachate collection systems that are built with significant separation between waste and groundwater.
 - **Deep Wall Injection:** Method in which liquid waste is injected into porous rock formations located deep underground.
 - **Surface impoundment:** Shallow pits are created which are covered with plastic where the liquid waste will evaporate, leaving the solid residue for further management.
- **Non-hazardous waste:** These are drugs that do not exhibit hazardous characteristics but still require proper management to prevent misuse and contamination. Non-hazardous wastes are pharmaceutically inert products that have no pharmaceutical properties but are still monitored and managed by medical standards. These products, such as sodium chloride or dextrose solutions, may be contaminated or mixed with other compounds and therefore require evaluation of hazardous properties prior to disposal.
 - Non-hazardous drug disposal includes recycling, reusing, composting, and disposal in a controlled landfill for paper, non-toxic plastics or food scraps.

- There are many other options such as bulk energy recovery and professional disposal services.
- Many communities have local regulations and waste management policies that must be followed and disposed of.

How badly can pharmaceutical waste affect the ecosystem?

Improper disposal poses a serious threat to the entire system.

- **Environmental contamination:** Medicines and drugs containing APIs enter water and soil because most municipal sewage treatment plants are not designed to completely eliminate them.
- **Ecological effects:** The aquatic environment is affected and can potentially cause a number of abnormalities in the reproductive system or changes in behaviour.
- **Public health at risk:** Contamination of consumed water is a very long-term problem. Antibiotics leach into the environment and may contribute to the development of antibiotic-resistant bacteria. This may also lead to the risk of accidental poisoning or misuse of the drug. The chemical exposure in workers handling such drugs is highly potent and genotoxic – causing DNA damage.

Pharmaceutical Waste Management: A Visionary Plan.

- **Reduction/Waste Minimization:** An important method of medical waste management is the prevention of material being produced, also known as waste minimization.
- **Reuse:** Creating ways to reuse drugs/medicines and containers without any side effects or toxicity, whenever possible.
- **Recycle:** The process that involves reprocessing or treating a discarded waste material to make it suitable for reuse in its original form or for some other purpose.
- Strict segregation and compliance of pharmaceutical waste.
- **Separation, labelling and packaging:** Separating pharmaceutical waste from other types of waste to prevent contamination and ensure proper disposal. Labelling the separated waste helps in implementing relevant management instructions and appropriate disposal method. Packing waste material in leak-proof, puncture-resistant containers helps prevent leaks and spills and reduce environmental pollution and exposure to hazardous substances.
- **Training for individual:** Individual handling the waste should be trained on safe management and transportation of pharmaceutical waste. Trained staff may be able to manage waste safely and also comply with regulatory requirements.

II. CONCLUSION

All pharmaceutical waste, especially hazardous drugs, is incinerated to balance the potential risks. Waste are unwanted materials that are no longer used, that either have to be disposed of or have already been discarded. Pharmaceutical waste management is a challenging task in recycling industries, government administration, policy planning, quality assurance for effective waste management. There is a need to continuously develop new classification and effective technologies for easy disposal of medical wastes and ensure reduction in the cost of waste management. By adopting a systems approach all communities can effectively manage pharmaceutical waste and protect the environment from chemical risks and protect human health for future generations.

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