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Opinion

Pharmaceutical Waste as a Growing Environmental Risk

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Abstract

Pharmaceutical waste has become a major environmental concern, endangering both human and environmental health. The disposal of unneeded or expired pharmaceuticals has become a serious concern, leading to environmental contamination and the spread of pharmaceutical residues. The global increase in pharmaceutical use has led in an increase in ailments such as obesity, diabetes, cardiovascular difficulties, cancer, and autoimmune disorders. This has resulted in a large increase in the demand for several pharmaceutical subcategories, such as hypertension medications, cholesterol-lowering compounds, diabetes therapies, and antidepressants. Because of their ease of availability and price, Over- The-Counter (OTC) drugs, particularly pain relievers, have been widely used. Numerous studies have found that people all around the world rely heavily on OTC medications. The COVID-19 epidemic has heightened worries about self-medication behaviors, as people turn to over-the-counter medications like ivermectin for preventative or symptomatic therapy, adding to pharmaceutical waste and potentially negative environmental repercussions. Antibiotic misuse is one of the most alarming parts of pharmaceutical waste since it results in their release into the environment, increasing the worldwide antibiotic resistance dilemma. Pharmaceutical residues in bodies of water can disturb aquatic ecosystems, affecting plant and animal life. Pharmaceutical waste improperly disposed of contaminates water sources, exposing people to potentially dangerous active pharmaceutical chemicals. It can also diminish the efficiency of important treatments, potentially rendering previously curable conditions fatal. Inadequate disposal techniques and inadequate wastewater treatment contribute to drugs being present in the environment, hurting aquatic creatures and altering ecological equilibrium. Concerns have been raised about the absorption of drugs by terrestrial animals and soil-dwelling invertebrates. Effective waste management techniques are required to limit the consequences of incorrect pharmaceutical waste disposal. Pharmaceutical take-back programs, prescription return facilities, and appropriate disposal procedures can all assist to limit the quantity of medicine that ends up in landfills and waterways. It is critical to educate the public about the dangers of incorrect pharmaceutical waste disposal. Individuals can be empowered to adopt responsible waste management behaviors by encouraging correct disposal procedures and promoting pharmaceutical take-back programs. To maintain safe waste disposal processes, collaboration between healthcare institutions, pharmaceutical firms, regulatory bodies, and the public is required. Finally, pharmaceutical waste is a major environmental concern, causing water and soil contamination and leading to antibiotic resistance. To address this issue, education programs must be strengthened. To develop correct disposal methods, waste management programs and pharmaceutical regulations are used. It is critical to recognize pharmaceutical waste as a worldwide environmental danger to address public health concerns.

Keywords: Expired; Medicine; Pharmaceutical waste; Unused drug; Pharmaceutical legislation; Pollution; Antibiotic resistance; Community education; Improper disposal; pharmaceutical industry; public health.

Opinion

Pharmaceutical waste has become a huge threat to the environment, endangering both human and ecological health. As it contributes to the pollution of natural ecosystems and the spread of pharmaceutical residues in the environment, the disposal of unused or expired drugs has grown to be a critical issue. The globe now consumes more pharmaceuticals products because of improvements in medical technology and rising life expectancy. Although these medical advancements have led to better health outcomes, they have also led to an increase in illnesses including obesity, diabetes, cardiovascular problems, cancer, and

autoimmune issues. As a result, demand has increased dramatically for several pharmaceutical subcategories, such as hypertension pharmaceuticals, cholesterol-lowering agents, antidiabetic treatments, and antidepressants [1]. One notable development is the increasing use of Over-The-Counter (OTC) medications, which are widely available and inexpensive. This has resulted in widespread OTC medication use, with painkillers being particularly prominent. Various studies in various locations have revealed that a sizable section of the population constantly relies on OTC medications [2].

The worldwide COVID-19 outbreak has heightened worries about self-medication behaviors. People are increasingly turning to over-the-counter medications like ivermectin for preventative or symptomatic treatment, exacerbating pharmaceutical waste and perhaps having negative environmental consequences [3].

One of the most concerning parts of pharmaceutical waste is antibiotic overuse, which leads to their release into the environment and drives the worldwide crisis of antibiotic resistance. Pharmaceutical residues permeate water bodies because of poor drug consumption and disposal [4]. Pharmaceutical waste includes leftover or expired pharmaceuticals, pharmaceutical packaging, and byproducts of drug production operations. The inappropriate disposal of pharmaceutical waste, such as flushing it down toilets or dumping it into sinks, has become a worldwide problem [5]. The Implications for human health of improper pharmaceutical waste disposal can contaminate water sources, exposing individuals to potentially dangerous active pharmaceutical substances. Furthermore, persons scavenging in landfills or garbage sites may come into touch with toxic medications unwittingly, putting human health at risk. This reduces the efficiency of important drugs, making previously curable illnesses potentially fatal. Pharmaceutical waste that enters the environment poses a substantial risk to ecosystems. Residual medications can disturb aquatic environment balance, impacting both plant and animal life. Furthermore, several medications have the potential to stay in the environment, resulting in long-term pollution and bioaccumulation in the food chain [6]. One of the primary ways expired medications contribute to environmental pollution is through water contamination. Pharmaceuticals have been detected in surface water, groundwater, and even in drinking water supplies in many parts of the world [4]. These compounds can persist in aquatic environments, affecting aquatic life and even leading to the disruption of hormone systems in fish [7] and other organisms. Residual medications can disturb aquatic environment balance, impacting both plant and animal life. Furthermore, several medications have the potential to stay in the environment, resulting in long-term pollution and bioaccumulation in the food chain [8]. Pharmaceuticals in water bodies can have an influence on the health and behavior of aquatic species. For example, changing hormone levels caused by pharmaceutical exposure might disrupt fish reproductive and lead to population imbalances. Furthermore, pharmaceutical waste has the potential to diminish biodiversity and impair ecosystem functioning. Pharmaceutical waste is generally discharged into the sewage system and transferred to wastewater treatment facilities after use, improperly disposed pharmaceutical waste can also pollute soil. Many drugs are resistant to degradation during wastewater treatment operations, and as a result, they will be present in wastewater treatment effluents and sludge byproducts [9]. The use of recovered wastewater for irrigation and the land application of sewage sludge (biosolids) as a fertilizer provide a channel of entry for medicines into the terrestrial environment [10]. As a result, concerns have been raised about the possible absorption of medications into terrestrial species, as well as the consequences on soil- dwelling creatures and organisms that feed on them. Improper disposal of antibiotics contributes to the growing problem of antibiotic resistance. Acquired antibiotic resistance comprises two key mechanisms:

a) Modifying existing genes

b) Horizontal Gene Transfer (HGT) to acquire new genes from other strains.

HGT, in general, refers to conjugation, transformation, or transduction. Conjugation is the transfer of DNA from a donor to a recipient, which is commonly facilitated by mobile genetic elements like plasmids. Transformation occurs because of direct absorption, integration, and functional expression of foreign DNA from the environment [11]. Transduction happens when DNA is passed between bacteria via bacteriophages. When antibiotics are introduced into the environment, bacteria are exposed to sublethal doses, leading to the development of resistant strains. These resistant bacteria can then pose a significant risk to human and animal health when they cause infections that are difficult to treat. The environment serves as a repository for antibiotic-resistant microbes and resistance genes. Antibiotics and their metabolites can be introduced into natural ecosystems via agricultural runoff, residential sewage, and wastewater discharge [12]. These settings are favorable for the horizontal transmission of resistance genes across bacterial species. Pharmaceutical waste management is necessary to reduce the implications of improper pharmaceutical waste disposal, effective waste management strategies are essential [13]. Pharmaceutical take-back programs, prescription return facilities, and proper disposal methods can all assist to reduce the quantity of medications that wind up in landfills and water sources. Healthcare institutions, pharmaceutical companies, regulatory authorities, and the public must all work together to ensure proper waste disposal. It is vital to educate the public about the consequences of improper pharmaceutical waste disposal. Education campaigns should emphasize the need of proper disposal methods and encourage the use of pharmaceutical take-back services. Individual empowerment through information can encourage proper waste management behavior [14]. To reduce the environmental effect of expired drugs, several parties must work together: It is critical to educate the public about the environmental repercussions of incorrect pharmaceutical disposal [15]. The significance of returning unused or expired prescriptions to pharmacies or engaging in pharmaceutical take-back programs should be emphasized through public awareness campaigns. Pharmaceutical businesses must accept responsibility for their products' whole life cycle, including advocating correct disposal

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techniques and producing treatments with minimal environmental implications. Governments must enact and enforce stronger restrictions regarding the disposal of outdated drugs. This might involve giving pharmaceutical firms incentives to manufacture more environmentally friendly pharmaceuticals and developing collecting systems to ease correct disposal [16]. By addressing correct disposal procedures with their patients and increasing awareness of the environmental effect of expired prescriptions, healthcare practitioners may play an important role in encouraging responsible medication disposal.

Conclusion

Pharmaceutical waste is a huge environmental issue. Their inappropriate disposal pollutes water and soil and contributes to antibiotic resistance. Integral residue control is critical for minimizing public health risk. It is required to build pharmaceutical education campaigns, strengthen pharmaceutical waste management programs, and adopt pharmaceutical legislation that establishes procedures for waste disposal. Pharmaceutical waste should be deemed a worldwide environmental danger since it raises public health concerns.

Conflict of Interest

No Conflict of Interest is declared.

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