HAZARDOUS WASTE MANAGEMENT AND ONE HEALTH APPROACH

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INTRODUCTION

Landfilling is one of the most widely used waste management methods across all countries, regardless of their level of development. The main types of landfills include (a) municipal solid waste landfills, (b) industrial waste landfills, and (c) hazardous waste landfills. In most cases, these facilities are designed and regulated to ensure that waste disposal complies with specific quality and quantity standards. However, in many developing countries, illegal and uncontrolled "open dumps" remain a common issue, leading to the release of gases such as CO2, H2S, CH4, and NOx into the atmosphere. These emissions have been linked to respiratory diseases and certain forms of cancer, posing a higher risk to children living in nearby areas. To mitigate these risks, it is crucial to implement advanced waste management technologies, enforce stricter landfill regulations, and establish greater minimum distance requirements between landfills and residential areas (Siddiqua et al., 2022).

` The One Health approach, which acknowledges the interconnectedness of human, animal, and environmental health, provides a holistic solution to these challenges. By promoting interdisciplinary collaboration, community engagement, policy enhancement, institutional capacity building, and public-private partnerships, this approach plays a key role in ensuring environmental sustainability. The successful implementation of One Health strategies requires coordinated efforts from governments, local communities, private sector stakeholders, and international organizations to create a cleaner and healthier environment. (Gebrekidan et al., 2024;Lee et al., 2024)

AIM -METHODOLOGY

The purpose of this study is to highlight the public health risk from the incorrect management of hazardous waste by the community and the state, while suggesting ways to effectively manage it. A narrative review was conducted according to the PRISMA method, in the PubMed and EBSCO databases. 35 and 65 results were found respectively according to the search terms and were included in the study 21, according to the study selection criteria.

RESULTS

Despite a 90% reduction in average lead exposure among children in the United States since the 1970s, certain neighborhoods remain significantly affected, with children still experiencing harmful levels of lead exposure and animals also suffering from poisoning. These areas are often characterized by lower-income and minority populations. Urban wildlife and domesticated animals are particularly vulnerable to lead contamination. In cities, lead accumulates in soil, buildings, dust, and even trees, and this issue will persist unless targeted actions are taken to eliminate these contamination sources. (Levin et al., 2021)

Advancements in technology and economic growth have influenced the volume of post-production waste. Among the different categories, post-industrial waste—particularly from mining, metallurgy, and energy sectors—accounts for the largest proportion. Certain hazardous and non-hazardous waste materials can be repurposed for construction through "solidification/stabilization" processes, either as raw materials or as additives. However, the practice of integrating these waste materials into construction remains limited. (Olejarczyk et al., 2022)

Clinical waste (CW) poses serious environmental and public health concerns. Proper waste management systems are essential for the safe disposal of hazardous medical waste. While incineration effectively eliminates pathogens and reduces waste volume, it produces clinical waste ash (CWA), a byproduct that increases environmental concentrations of heavy metals, inorganic salts, and organic compounds. The generation of CWIFA is expected to rise both nationally and globally. To address this issue, further research is needed to assess the impact of ash leachate, improve disposal methods, and explore innovative ways to recycle and repurpose ash in construction and other industries. (Ghazali et al., 2022)

The number of people exposed to hazardous substances due to unsafe and improper e-waste management practices continues to rise. This exposure has been linked to various health issues, including thyroid dysfunction, cellular damage, adverse neonatal outcomes, behavioral changes, and impaired lung function.

Studies indicate an increased prevalence of spontaneous abortions, stillbirths, premature births, and lower birth weights associated with e-waste exposure. Additionally, individuals living in or working within e-waste recycling areas show signs of significant DNA damage. (Grant et al., 2013)

Globally, activities related to the nuclear fuel cycle—including the operation and decommissioning of nuclear facilities—generate high-level radioactive waste, posing severe risks to human health and the environment. One widely adopted method for managing this waste is cementation, which facilitates its encapsulation, solidification, and eventual disposal. However, further large-scale research and refinement are required to enhance its effectiveness and integration. (Luhar et al., 2023)

In many regions, particularly in the global South, waste management practices often involve mixing domestic and commercial waste with hazardous materials during storage and handling. Additionally, waste is frequently stored in outdated or poorly maintained facilities. Raising awareness through print, digital, and social media campaigns is essential to encourage individuals to adopt proper waste disposal practices. (Abubakar et al., 2022)

Current cancer treatments often incorporate a combination of surgical procedures, radiotherapy, and chemotherapy. While chemotherapy drugs effectively target cancer cells, they also possess cytotoxic and mutagenic properties, classifying them as hazardous substances. Consequently, the waste generated during their preparation and administration poses significant health and environmental risks. Proper handling requires well-defined protocols, including clear categorization of cytostatic and cytotoxic drugs as hazardous waste. Additionally, training medical personnel and educating cancer patients and their families on appropriate disposal methods—both in hospitals and at home—is crucial. (Furtak-Niczyporuk et al., 2019)

Biomedical waste, which encompasses industrial, hospital, and healthcare facility waste, presents a heightened risk of contamination and injury compared to other waste types. Promoting a culture of responsibility and sustainability can contribute to safer waste management practices, ultimately protecting both the environment and future generations. (Dhole et al., 2024)

Human biomonitoring plays a key role in assessing exposure to harmful substances and predicting associated health risks. By analyzing biomarkers of susceptibility, exposure, and effect, researchers can determine not only whether exposure has occurred but also its toxic pathways and health implications. (Kim et al., 2021; Germolec et al., 2022)

Health concerns related to industrially contaminated sites (ICS) remain a significant public issue. Risk assessments typically focus on individual pollutants, although epidemiological studies provide substantial evidence of health risks among workers in industrial activities and local residents. Vulnerable groups—such as children, elderly women, and individuals with lifestyles that increase their exposure—may experience heightened risks despite not being directly employed in these industries. (Hoek et al., 2018; Zelinski et al., 2022)

Cement production is a major contributor to greenhouse gas emissions worldwide, accounting for a substantial share of global CO_2 emissions. This has heightened the urgency to develop alternative sustainable cementitious materials to reduce the construction industry's environmental footprint. (Tang et al., 2021; Mottese et al., 2021)

Polycyclic aromatic hydrocarbons (PAHs) were among the first substances identified as carcinogenic and remain a primary concern at hazardous waste sites. Given their frequent detection, it is crucial to establish feasible and effective remediation strategies to mitigate their impact. (Cannon, 2025; Khezri et al., 2023)

Government-funded environmental protection initiatives may gradually be overtaken by community-driven programs. The recurring environmental and economic benefits of such grassroots efforts can serve as a foundation for fostering long-term waste reduction and sustainability practices at the local level. (Meegoda et al., 2021)

CONCLUSIONS

Minimizing hazardous waste presents several key advantages: 1) incorporating environmental health and safety concerns through an integrated risk assessment framework, 2) evaluating risks under both normal conditions and emergency situations, 3) identifying the most pressing threats that require immediate intervention through corrective actions, 4) gradually implementing a comprehensive risk management approach in sectors facing environmental and safety challenges, such as waste collection, while fostering new skills and innovative solutions to improve waste management systems. (Mazzi, 2023)