

Healthcare waste in primary care and hospital services: health impacts, gaps in environmental education and management challenges

Residuos sanitarios en la atención primaria y en los servicios hospitalarios: impactos sanitarios, brechas en la educación ambiental y desafíos en la gestión

Ilén M. Núñez Casañas¹  , Daimarelis Guerra del Valle¹  , Susana Solís Solís²  , Yanet Ortega Dugrot³  , Juan Alfonso Venerio Diezcabezas de Armada⁴  

¹Universidad Técnica de Ambato. Facultad de Ciencias de la Salud, Carrera de Licenciatura en Enfermería. Latacunga, Ecuador.

Cite as

Núñez Casañas IM, Guerra del Valle D, Solís Solís S, Ortega Dugrot Y, Diezcabezas de Armada JAV. Healthcare waste in primary care and hospital services: health impacts, gaps in environmental education and management challenges. SAP Primary Care. 2026; 2:95. <https://doi.org/10.62486/pc202695>

Publication History

Submitted: 20-08-2025

Revised: 22-11-2025

Accepted: 19-04-2026

Published: 20-04-2026

Corresponding Author

Ilén M. Núñez Casañas 

ABSTRACT

Introduction: healthcare waste management remains a persistent challenge across primary care and hospital services because failures in segregation, handling, and final disposal expose workers, patients, and surrounding communities to preventable biological and environmental risks. This review aimed to examine the health impacts of healthcare waste, the role of environmental education in risk prevention, and current management challenges, with attention to their relevance for first-contact care settings.

Method: a literature review was conducted following PRISMA guidelines. The search covered indexed journals, bibliographic portals, and databases using DeCS/MeSH-based terms combined with the Boolean operators “AND” and “OR”. Twenty-eight original studies published in Spanish and English during the last five years were selected.

Development: the reviewed evidence showed that inadequate management of healthcare waste is associated with occupational exposure, infectious risk, environmental contamination, and weak compliance with institutional protocols. Recurring gaps were identified in staff training, risk awareness, segregation practices, and operational supervision. Environmental education emerged as a central component for improving waste handling practices in both hospital and primary care services, where preventive action, safe routines, and community protection are closely connected.

Conclusions: proper healthcare waste management requires sustained training, protocol adherence, and continuous monitoring in all levels of care. In primary care settings, these measures are especially relevant because they strengthen prevention, protect frontline health workers, and reduce environmental and community-related harm.

Keywords: Healthcare Waste; Primary Care; Waste Management; Environmental Education; Occupational Health.

RESUMEN

Introducción: la gestión de los residuos de servicios de salud continúa siendo un desafío en la atención primaria y en los servicios hospitalarios, debido a que las fallas en la segregación, manipulación y disposición final exponen a trabajadores, pacientes y comunidades a riesgos biológicos y ambientales prevenibles. Esta revisión tuvo como objetivo analizar los impactos sanitarios de estos residuos, el papel de la educación ambiental en la prevención de riesgos y los desafíos actuales de su gestión, considerando su relevancia para los escenarios de primer contacto.

Método: se realizó una revisión bibliográfica siguiendo los lineamientos PRISMA. La búsqueda incluyó bases de datos, portales bibliográficos y revistas indexadas, con términos revisados en DeCS/MeSH y combinados mediante los operadores booleanos “AND” y “OR”. Se seleccionaron 28 estudios originales publicados en español e inglés durante los últimos cinco años.

Desarrollo: la evidencia revisada mostró que la gestión inadecuada de los residuos sanitarios se asocia con exposición ocupacional, riesgo infeccioso, contaminación ambiental y baja adherencia a los protocolos institucionales. Se identificaron vacíos recurrentes en la capacitación del personal, la percepción del riesgo, las prácticas de segregación y la supervisión operativa. La educación ambiental apareció como un componente central para mejorar el manejo de estos residuos tanto en el ámbito hospitalario como en la atención primaria, donde la prevención, la seguridad del personal y la protección comunitaria guardan una relación directa.

Conclusiones: el manejo adecuado de los residuos de servicios de salud requiere capacitación sostenida, cumplimiento de protocolos y monitoreo continuo en todos los niveles asistenciales. En la atención primaria, estas acciones adquieren especial valor por su vínculo con la prevención, la protección del personal de primera línea y la reducción de daños ambientales y comunitarios.

Palabras clave: Residuos de Servicios de Salud; Atención Primaria; Gestión de Residuos; Educación Ambiental; Salud Ocupacional.

INTRODUCTION

Over the past decade, environmental pollution has increased, leading to socioenvironmental conflicts that fundamentally disrupt daily life, particularly for vulnerable individuals.⁽¹⁾

Globally, the generation of solid waste represents a problem that negatively impacts biodiversity; public health; and productive, recreational, and tourism activities. In this regard, although it accounts for the smallest portion of the total solid waste generated by the community, it is considered potentially hazardous because of its impact on public health and environmental quality.⁽²⁾

The solid waste generated in healthcare institutions contains significant amounts of bacteria, viruses, and other pathogens that can cause various infections and diseases in humans. Given this reality, it is necessary to address its management through various measures to mitigate the harmful impact it causes.⁽³⁾

To prevent various workplace-related risks, workers in healthcare institutions must receive appropriate health education. However, knowledge gaps still exist that must be addressed through continuous staff training.⁽⁴⁾

Proper management of solid waste in healthcare facilities is considered necessary for the prevention of harm to human health and the environment, compliance with established regulations on the subject, and improvement of process quality within institutions.

Given the importance of proper management of waste generated in healthcare services, this literature review was conducted to analyze its effects on health, the role of environmental education in preventing associated risks, and the main management challenges in primary care and hospital services.

METHOD

A literature review of original articles, theses, and other reference sources published in databases, bibliographic portals, and indexed journals, including CUMED, DOAJ, Web of Science, LILACS, Latindex, PubMed, SciELO, Medigraphic, Scopus, Dialnet, and Google Scholar, was conducted. The search aimed to identify research related to the impact of hospital solid waste on health, environmental education associated with its management, and the challenges linked to its management.

Prior to the search, the keywords were reviewed in accordance with the DeCS/MeSH thesaurus. Different combinations of terms were used: healthcare waste, hospital waste, environmental health education, and hospital waste management, along with the Boolean operators “AND” and “OR.”

Publications in Spanish and English related to the study topic, including original research, theses, and other reference works, were considered inclusion criteria. The searches were conducted between February 26 and March 13, 2026, with an initial total of 215 records identified. The selection process followed the PRISMA guidelines, and a flowchart summarizing the stages of identification, screening, and selection of the studies was developed.

Letters to the editor, opinion pieces, and publications for which the full text was not available—even after requesting it from the authors—were excluded. The titles and abstracts were subsequently reviewed, duplicates were removed, and the final documents were selected on the basis of their thematic relevance, timeliness, methodological clarity, and consistency in the presentation and discussion of the results. Finally, 28 publications were included, 27 of which were in Spanish and 1 in English. All the selected studies were published within the past five years. The information was organized into thematic areas for analysis and subsequent manuscript drafting.

Table 1. Information search process	
Stage	Result
Records identified in databases, bibliographic portals, and indexed journals	n = 215
Records excluded due to duplication or after critical review	n = 142
Publications included in the review	n = 28
Topics of the included publications	Hospital solid waste and its impact on health (n=11) Environmental education on hospital solid waste management (n=8) Management of hospital solid waste (n=9)

DEVELOPMENT

To achieve the proposed objective, a literature review was conducted, during which studies related to the topic under analysis were selected. A total of 28 articles were included, all published between 2022 and 2026, comprising original studies with various methodological designs, as well as undergraduate and graduate theses. Geographically, the majority of the studies originated from Peru, followed by those from Ecuador.

The article is structured into three sections: The first section describes hospital solid waste and its impact on health; the second section addresses the importance of environmental education in the management of this waste; and the third section discusses the management of hospital solid waste.

Hospital Solid Waste and Its Impact on Health

Hospital solid waste is defined as solid waste generated in healthcare facilities during the provision of services such as hospitalization, surgeries, morgue operations, and laboratory work.⁽⁵⁾

According to authors Cajachagua et al.⁽⁶⁾, solid waste generated in healthcare institutions is a byproduct of the care provided to patients. Improper management of this waste increases the risk of infections caused by viruses, parasites, fungi, and bacteria, as well as injuries from sharp objects.

According to the World Health Organization (WHO)⁽⁷⁾, of all the waste generated in healthcare facilities, 15 % consists of infectious, chemical, or radioactive material, while the remaining 85 % is classified as general or nonhazardous. Improperly managed hazardous healthcare waste is considered a risk factor that, globally, increases exposure to pathogens, primarily among cleaning staff in healthcare facilities.⁽⁸⁾

Furthermore, sharps are considered the most hazardous waste for staff and the general public because of the risk of injury, which has a high potential for infection and communicable diseases such as human immunodeficiency virus (HIV), hepatitis B, and C. They are also associated with dermatological and respiratory conditions, as well as poisonings that influence the environmental determinants of health.⁽⁹⁾

It is believed that much of this waste may even contain bodily fluids, and it is typically disposed of in landfills or dumped indiscriminately, leading to water, air, and soil contamination. Poor management increases the likelihood of the spread of infections and diseases.⁽¹⁰⁾

Similarly, the Pan American Health Organization (PAHO) identifies the management of solid waste from healthcare services in Latin America and the Caribbean as a serious problem. It is estimated that the risk of people being exposed to biological agents becoming ill or dying is high because of improper handling.^(11,12)

Poor management of hospital waste can lead to the contamination of water and food and can contribute to epidemics. The presence of improperly handled sharps waste increases the risk of accidents and the transmission of infectious diseases. Additionally, other potential risks have been identified, such as the spread of drug-resistant microorganisms that are released into the environment from healthcare facilities.⁽¹³⁾

There are significant environmental considerations and occupational health challenges stemming from a lack of information and knowledge about the environment among healthcare professionals, cleaning staff, and patients, as well as increased administrative costs. Given the above, it is necessary to promote immediate actions that propose innovative solutions to improve health and environmental sustainability. Educating exposed workers about the occupational risks associated with integrated solid waste management is considered one of the fundamental measures for preventing such risks.⁽¹⁴⁾

Environmental education on solid waste management in healthcare

Inadequate management of hospital solid waste can lead to workplace accidents, infections, and even diseases. Insufficient knowledge among healthcare personnel is considered one of the causes of the high rate of infectious diseases in healthcare facilities in Latin America.⁽¹⁵⁾

For this reason, it is important to carry out educational campaigns to improve the situation. In this context, an educational program on waste management practices was implemented in Peru. The results show that knowledge improved across the various stages evaluated. According to the author Arzamendia⁽¹⁶⁾, initiatives should be aimed not only at knowledge but also at attitudes and practices. It is essential that training includes not only occupational health aspects but also environmental ones.

Furthermore, Lino Parrales⁽¹⁷⁾ argued that environmental education within healthcare facilities provides the necessary tools to understand environmental issues and the proper management of hospital-generated solid waste. A study conducted at the Basic Hospital of Jipijapa Canton, Ecuador, revealed that 64 % of workers have received environmental education programs concerning the proper management of hospital solid waste, whereas 36 % have not received training. However, 100 % indicated that it is important to receive education on proper management, since in the past year, they had not received training on the environment, hospital waste management, infections, safety, or occupational hazards.

A study conducted at the Señor de los Milagros Health Center in Peru⁽¹⁸⁾ investigated the relationship between environmental education and the management of hospital solid waste, revealing a lack of training among staff and, consequently, inadequate waste management. Despite this, following this assessment, health promotion activities on the topic were carried out, resulting in a 51 % increase in knowledge levels compared to the baseline test after environmental education was provided.

According to Cali Ligua et al.⁽¹⁹⁾, the implementation of educational tools promotes advances in teaching proper waste management, which contributes to sustainable practices that benefit both the environment and healthcare personnel. Examples of these tools include participatory games, audiovisual media, and practical scenarios.

A study conducted by Bernable Nicolás⁽²⁰⁾ investigated the relationship between environmental education and the management of hospital solid waste among health sciences students. The findings revealed a significant connection between environmental education and the management of solid waste in hospitals, underscoring the need to strengthen environmental training to optimize sustainable practices in the healthcare sector.

In this regard, the research conducted by Pérez Chombi⁽²¹⁾ at the Copani-Yunguyo Health Center highlights the need for ongoing

training, as it demonstrates how educational programs influence the management of solid waste generated in healthcare settings.

All the authors agree that environmental education aimed at healthcare workers who handle hospital solid waste helps strengthen the knowledge necessary to prevent accidents and the onset of diseases. Furthermore, it enables the modification of risk-generating behaviors, promoting positive changes and adhering to the established requirements for the management of this waste.

Solid Waste Management in Healthcare

Owing to growing concern about the environmental impact of solid waste in healthcare institutions, among other issues, the United Nations has established seventeen Sustainable Development Goals to be achieved by 2030. This has prompted the formulation of various regulations, standards, and strategies by each signatory country to minimize ecological impact. Of the 17 proposed goals, four are related to environmental health and healthcare solid waste: good health and well-being, sustainable cities and communities, responsible consumption and production, and climate action.⁽²²⁾

A joint assessment by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF)⁽²³⁾ revealed that 48 % of the facilities sampled across 24 countries lack adequate systems for the safe disposal of solid hospital waste. In recent years, 30 % of health facilities lack temporary storage facilities or do not comply with final disposal requirements for hospital waste, a problem considered more severe in less developed countries.⁽²⁴⁾

Furthermore, approximately 70 % of the waste generated by health facilities in Latin America and the Caribbean is estimated to be not managed properly, posing a risk to public health and the environment.⁽¹²⁾

Given the need to promote healthy environments in healthcare facilities, the International Labor Organization (ILO) has recommended that institutions establish guidance on occupational safety and health, clarify the importance of protecting workers' rights, and promote a safe and secure work environment for all workers.⁽²⁵⁾

A study conducted by Romero Arce⁽²⁶⁾ revealed that the implementation of a structured plan addressing conditioning, segregation, storage, transportation, and final disposal is essential for the health center studied. In his work, the author designs a program that seeks to optimize each phase of waste management through training, infrastructure improvements, procedures, and monitoring.

Furthermore, the research conducted by the authors of Rosales Iches *et al.*⁽²⁷⁾ recognizes the recyclable potential of waste through an innovative approach. To this end, segregation from the moment waste is generated is essential, as it minimizes environmental impact and enables compliance with biosafety protocols.

In this regard, the author Villón Bonifacio⁽²⁸⁾ argued that there is a significant relationship between sustainable management and waste segregation; therefore, the circular economy must be promoted, where proper classification of waste types is the first step toward transforming them into other materials.

The issue of healthcare waste is not limited to high-complexity hospitals. In primary care, clinics, polyclinics, vaccination centers, wound care services, and other first-contact facilities also generate biological waste, sharps, and potentially hazardous materials. In these settings, proper waste management is integral to patient safety, occupational health, and community protection. Regular staff training, segregation at the point of generation, the availability of appropriate supplies, and local supervision are necessary measures to reduce preventable risks and strengthen the quality of care.

CONCLUSIONS

Improperly managed hospital solid waste can cause accidents involving sharp objects that can lead to the transmission of irreversible diseases such as HIV/AIDS, hepatitis B, and hepatitis C, which represent global public health problems. Various infectious diseases and ecological damage can be prevented through environmental education for exposed workers on proper waste management. Similarly, ensuring compliance with management protocols, implementing periodic training, and promoting continuous improvement are necessary to reduce environmental impact and protect the health of workers, patients, and the community at large.

FINANCING

The authors did not receive funding for the conduct of this research.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

AUTHORSHIP CONTRIBUTIONS

Conceptualization: Daimarelis Guerra del Valle, Yanet Ortega Dugrot.

Data curation: Ilén M. Núñez Casañas, Daimarelis Guerra del Valle.

Formal analysis: Yanet Ortega Dugrot, Ilén M. Núñez Casañas.

Research: Ilén M. Núñez Casañas, Susana Solís Solís.

Methodology: Juan Alfonso Venerio Diezcabezas de Armada, Ilén M. Núñez Casañas.

Project administration: Juan Alfonso Venerio Diezcabezas de Armada, Susana Solís Solís.

Supervision: Yanet Ortega Dugrot, Daimarelis Guerra del Valle.

Visualization: Susana Solís Solís, Juan Alfonso Venerio Diezcabezas de Armada.

Writing – original draft: Ilén M. Núñez Casañas.

Writing–review and editing: Daimarelis Guerra del Valle, Yanet Ortega Dugrot.

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