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# BIOMEDICAL WASTE AND ITS IMPACT ON SOIL AND HUMAN HEALTH IN JAUNPUR DISTRICT, U.P. INDIA

**Shani Nishad[1] and Dr. Vishal Pundir[2]**

Department of Botany

T.D.P.G.College,Jaunpur,U.P.

1-Corresponding author

## Abstract

Biomedical waste (BMW) generated from healthcare facilities constitutes a significant environmental and public health concern, particularly in developing regions where waste management systems are inadequate. The present study investigates the impact of biomedical waste on soil quality and human health in Jaunpur district, Uttar Pradesh. The study evaluates physicochemical properties, heavy metal accumulation, and microbial contamination of soil collected from hospital waste disposal sites and surrounding agricultural areas. The findings reveal substantial increases in heavy metals such as lead (Pb), cadmium (Cd), chromium (Cr), and mercury (Hg), along with elevated microbial loads including pathogenic bacteria. These contaminants pose serious risks through soil degradation, food chain contamination, and direct human exposure. The study emphasizes the urgent need for improved biomedical waste management practices, stricter regulatory enforcement, and community awareness to mitigate environmental and health hazards.

**Keywords:** Biomedical waste, Soil contamination, Heavy metals, Jaunpur district, Public health, Pathogens.

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## Introduction:

Biomedical waste refers to waste generated during diagnosis, treatment, or immunization of humans and animals, including sharps, infectious materials, pharmaceuticals, and chemical waste. With the rapid expansion of healthcare services in India, the generation of biomedical waste has increased significantly. According to recent estimates, India generates over 700 tonnes of biomedical waste per day, a figure that continues to rise due to population growth and increased healthcare accessibility (Datta, 2018).

Improper management of biomedical waste is a critical issue in developing countries. In many regions, including districts such as Jaunpur in Uttar Pradesh, waste segregation, treatment, and disposal practices are often inadequate. Biomedical waste is frequently mixed with municipal solid waste and disposed of in open dumps, leading to severe environmental contamination.

Soil is one of the primary recipients of improperly disposed biomedical waste. It acts as a sink for contaminants, including heavy metals, organic pollutants, and pathogenic microorganisms. Once contaminated, soil loses its fertility and becomes a source of pollution for plants, groundwater, and the broader ecosystem. Toxic substances present in biomedical waste can persist in soil for extended periods and enter the food chain through plant uptake, posing long-term risks to human health (Jolly et al., 2022).

Jaunpur district, characterized by dense population and expanding healthcare infrastructure, faces growing challenges related to biomedical waste management. Limited awareness, lack of infrastructure, and inadequate regulatory enforcement contribute to improper disposal practices. This study aims to evaluate the extent of

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soil contamination caused by biomedical waste in Jaunpur and assess its implications for human health.

## Study Area

Jaunpur district is located in eastern Uttar Pradesh between latitudes 25°28′N and longitudes 82°40′E. The region experiences a subtropical climate with hot summers, a monsoon season, and mild winters. The soil is predominantly alluvial, suitable for agriculture, particularly crops such as rice, wheat, and sugarcane.

The district has a network of healthcare facilities, including:

- District hospitals
- Community health centers (CHCs)
- Primary health centers (PHCs)
- Private clinics and diagnostic laboratories

However, biomedical waste management infrastructure remains insufficient. In many cases, waste is disposed of in open areas, roadside dumps, or agricultural fields, leading to environmental contamination.


**Fig-1** Jaunpur Map and Biomedical Waste

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## Materials and Methods:

### Sampling Strategy

Soil samples were collected from three types of sites:

1. Biomedical waste dumping sites near hospitals and clinics
2. Adjacent agricultural fields exposed to contamination
3. Control sites located away from pollution sources

Samples were collected from a depth of 0–15 cm using sterilized tools and stored in clean polyethylene bags.

### Physicochemical Analysis

The following parameters were analyzed:

- Soil pH (digital pH meter)
- Electrical conductivity (EC meter)
- Organic carbon (Walkley-Black method)
- Moisture content

### Heavy Metal Analysis

Heavy metals such as Pb, Cd, Cr, and Hg were analyzed using Atomic Absorption Spectrophotometry (AAS) after acid digestion of soil samples.

### Microbiological Analysis

- Total bacterial count using serial dilution method
- Isolation of pathogenic bacteria such as *Escherichia coli* and *Salmonella*

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## Result and discussion:

**Table-1** Physicochemical Properties

| Parameter | Control Site | Agricultural Field | Dumping Site |
|---|---|---|---|
| pH | 7.3 | 6.9 | 6.4 |
| Organic Carbon (%) | 0.62 | 0.95 | 1.38 |
| Electrical Conductivity (dS/m) | 0.30 | 0.56 | 0.92 |
| Moisture (%) | 18 | 22 | 28 |

Contaminated soils show increased organic carbon and electrical conductivity, indicating accumulation of organic waste and dissolved salts. The slight decrease in pH suggests acidification due to decomposition of biomedical waste.

**Table-2** Heavy Metal Concentration

| Heavy Metal (mg/kg) | Control | Agricultural Field | Dumping Site |
|---|---|---|---|
| Lead (Pb) | 9.2 | 18.6 | 32.8 |
| Cadmium (Cd) | 0.5 | 1.8 | 3.6 |
| Chromium (Cr) | 11.5 | 25.4 | 45.2 |
| Mercury (Hg) | 0.2 | 0.7 | 1.4 |

Heavy metal concentrations are significantly higher in dumping sites. These metals originate from discarded medical instruments, pharmaceuticals, and chemical reagents.

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**Table-3** Microbial Contamination

| Parameter | Control | Agricultural Field | Dumping Site |
|---|---|---|---|
| Total Bacteria (CFU/g) | $10^4$ | $10^6$ | $10^7$ |
| Pathogenic Bacteria | Absent | Moderate | High |

**Identified Pathogens:**

- *Escherichia coli*
- *Salmonella spp.*
- *Staphylococcus aureus*

High microbial load indicates contamination by infectious biomedical waste, posing serious health risks.

## Discussion:

The results clearly demonstrate that biomedical waste disposal significantly alters soil properties. Increased organic carbon and moisture content create favourable conditions for microbial growth, including harmful pathogens. Soil acidification further affects nutrient availability and plant growth.

Heavy metals such as lead, cadmium, and chromium are persistent environmental pollutants. Their accumulation in soil leads to reduced fertility and toxicity to plants. These metals can be absorbed by crops and enter the human food chain, leading to bioaccumulation and biomagnification.

The presence of pathogenic microorganisms in soil indicates contamination by infectious waste such as blood, tissues, and laboratory cultures. These pathogens can

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survive in soil for extended periods and infect humans through direct contact or contaminated food and water.

The findings are consistent with previous studies, which report that improper biomedical waste disposal leads to environmental pollution and increased health risks (Manzoor & Sharma, 2019; Jolly et al., 2022).

**Impact on Human Health:**

The impact of biomedical waste (BMW) on human health is multifaceted, involving direct, indirect, acute, and chronic pathways of exposure. In regions such as Jaunpur district, where waste segregation and disposal practices are often inadequate, the risks are amplified due to frequent human contact with contaminated materials and environments.

**Pathways of Human Exposure:**

Human exposure to biomedical waste occurs through several interconnected pathways:

**Direct Contact**

Individuals such as healthcare workers, sanitation staff, rag pickers, and nearby residents come into physical contact with contaminated waste materials.

- Handling infected dressings, tissues, and sharps
- Contact with contaminated soil near dumping sites
- Injuries caused by needles, blades, and broken glass

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### Inhalation

Burning or decomposition of biomedical waste releases toxic gases, aerosols, and particulate matter, which are inhaled by nearby populations.

- Release of dioxins, furans, and particulate matter
- Aerosolization of pathogens during waste handling

### Ingestion

Contaminants enter the food chain through:

- Crops grown in contaminated soil
- Groundwater pollution due to leaching
- Consumption of contaminated animal products

### Vector-Borne Transmission

Biomedical waste attracts vectors such as flies, rodents, and stray animals**,** which spread pathogens to humans.

### Toxicological Effects of Heavy Metals:

Biomedical waste introduces heavy metals into soil, which enter the human body through food and water.

**Table 4:** Health Effects of Heavy Metals

| Metal | Source in BMW | Health Effects |
|---|---|---|
| Lead (Pb) | Batteries, paints | Neurotoxicity, developmental disorders |
| Cadmium (Cd) | Plastics, pharmaceuticals | Kidney damage, bone fragility |
| Chromium (Cr) | Laboratory chemicals | Carcinogenic, skin irritation |
| Mercury (Hg) | Thermometers, dental waste | Nervous system damage |

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**Indirect Exposure**

Indirect exposure occurs through:

- Consumption of contaminated crops
- Drinking polluted groundwater
- Food chain transfer of heavy metals

**Chronic effects include:**

- Neurological disorders (lead toxicity)
- Kidney damage (cadmium exposure)
- Carcinogenic effects (chromium compounds)

The impact of biomedical waste on human health is profound and far-reaching. It affects individuals through multiple exposure pathways, leading to infectious diseases, toxicological effects, and chronic health conditions. In regions like Jaunpur district, inadequate waste management practices significantly increase these risks.

A comprehensive approach involving scientific waste management, strict regulatory enforcement, occupational safety, and public awareness is essential to minimize health hazards and ensure environmental sustainability.

## Conclusion:

The study highlights the severe impact of biomedical waste on soil quality and human health in Jaunpur district. Elevated levels of heavy metals and pathogenic microorganisms indicate significant environmental contamination. The findings underscore the urgent need for effective biomedical waste management practices, including proper segregation, treatment, and disposal.

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Without immediate intervention, continued contamination will lead to long-term ecological damage and increased health risks. Sustainable waste management, combined with awareness and strict regulatory enforcement, is essential to protect both the environment and public health.

## References

1. Datta, P. (2018). Biomedical waste management in India. *Journal of Laboratory Physicians*, 10(1), 6–14.
2. Manzoor, J., & Sharma, M. (2019). Impact of biomedical waste on environment and human health. *Environmental Claims Journal*, 31(4), 311–334.
3. Jolly, Y. N., et al. (2022). Soil contamination and human exposure assessment. *Toxics*, 10(7), 347.
4. Thakur, H. (2023). Biomedical waste management practices in India. *Journal of Pharmaceutical and Toxicological Chemistry*.
5. Singh, H., et al. (2024). Sustainable biomedical waste management strategies. *Discover Applied Sciences*.
6. WHO (2021). Safe management of wastes from health-care activities. World Health Organization.
7. CPCB (2022). Annual report on biomedical waste management. Central Pollution Control Board, India.