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Original Article

Assessing the Effectiveness of Hospital Waste Management Practices Among Tertiary Care Hospitals and Primary Health Centres in KPK: A Comparative Cross-Sectional Study

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Abstract

Background: Healthcare waste, both biologic and non-biologic, poses environmental and public health risks if improperly managed. Developing countries like Pakistan often lack effective waste management systems, leading to potential hazards.

Objective: This study assessed the effectiveness of hospital waste management practices in tertiary care hospitals and primary health centers in Khyber Pakhtunkhwa (KPK), Pakistan, identifying strengths and weaknesses.

Methods: A cross-sectional study was conducted from August to December 2023, with 384 participants involved in waste management from various healthcare roles. Data were collected via interviews, observations, and questionnaires on demographics, knowledge, training, PPE use, and disposal methods. Statistical analyses were performed using SPSS version 25.

Results: Of the 384 participants, 72.49% were male, with a mean age of 35-40 years. Awareness of waste management practices was high among doctors (96.9%) and paramedics (93.4%). However, PPE usage was low, with only 36.9% consistently using face masks, 31.8% using aprons, and 28.4% using gloves. Most facilities had designated central storage (93.2%) and staff for disposal (96.6%). Incineration was available in 89.6% of facilities but faced operational issues.

Conclusion: While awareness of waste management is high, gaps exist in PPE usage and reliance on incineration. Improving training, developing alternative waste treatment methods, and implementing a national policy are recommended to enhance waste management practices in Pakistan.

1 Introduction

Healthcare waste encompasses a wide range of discarded materials, both biologic and non-biologic, which are no longer intended for further use. Improper management of this waste constitutes a significant environmental and public health concern (1).highlight the existence of multiple terms used interchangeably to describe healthcare waste, including hospital waste, medical waste, regulated medical waste, and infectious medical waste, without a universally accepted definition for each term According to the World Health Organization (WHO), healthcare waste includes all waste generated within healthcare facilities, research centers, and laboratories related to medical procedures. This also includes similar types of waste originating from minor and scattered sources, such as waste produced during home healthcare procedures like home dialysis, self-administration of insulin, and recuperative care (2, 3). Based on WHO findings, a significant portion of waste, ranging from 75% to 90%, generated by healthcare providers and facilities falls under the category of non-hazardous or general healthcare waste, which is comparable to domestic or general waste (4). Approximately 10-25% of healthcare waste is classified as hazardous, carrying various environmental and health risks (5).

In most developing countries, there is no proper waste management system in place (6). Waste management practices are often delegated to untrained personnel, who work without proper instructions and insufficient support (7). For instance, in India, improper handling practices for medical waste include a lack of proper segregation, collection, and on-site transportation procedures. Predominant methods for the final disposal of medical waste often involve incineration or open burning in secluded areas within hospital premises. Similarly, there is a lack of a national policy on medical waste management in Bangladesh, as seen in many other developing countries (8). Iran also lacks an effective system for managing hospital waste, with inadequate practices in waste segregation by hospital staff. The current waste collection process involves initially gathering waste within hospital premises and transferring it to a temporary storage area, followed by transportation from the temporary storage area to a permanent disposal site. Historically, Iran relied mainly on incinerators to manage

infectious hospital waste, but more recently, the Ministry of Health and Medical Education has advocated for the adoption of autoclaves for healthcare waste disinfection. This newer approach has led to the installation of autoclaves in hospitals across the nation (9-12).

According to Ghana Health Services (2006), color-coding of waste containers and plastic bags (black for general waste, yellow for infectious waste, and brown for hazardous waste) facilitates efficient segregation of healthcare wastes. However, none of the 120 healthcare centers visited, including a teaching hospital, specialist hospitals, general hospitals, clinics, and herbal hospitals, were using these color-coded containers or carrier bags (13, 14). Studies from Pakistan show that around 1.35 kg of waste is produced every day for each hospital bed occupied (15). An examination conducted in eighteen distinct hospitals revealed inadequate categorization and incomplete utilization of color-coded systems for various forms of waste. Incineration emerged as the primary method for managing infectious waste disposal, with burning being the secondary choice in terms of preference and utilization. In Quetta, the management at most hospitals exhibited a careless attitude, with the collection, handling, transfer, and transport to the final disposal site conducted in the most hazardous manner (16).

National legislation on medical waste regulations is crucial for countries as it establishes legal controls for proper handling, transportation, and disposal of medical waste, promoting environmental protection and public health (17). The responsibility of enforcing the implementation of such a national policy lies with the Ministry of Health. The Ministry of Environment may also play a role in this matter, and it is essential to establish a clear division of duties between these two departments (11). In the late 1970s, the United States officially recognized medical waste as a distinct category within municipal waste after discovering medical-related items such as syringes and bandages washing up on the eastern coast beaches of the country (18). The WHO published the inaugural comprehensive handbook on the subject, "Safe Management of Wastes from Healthcare Activities," in 1999, following extensive years of work and dedication (19). The Government of Pakistan took measures to enhance the management of hazardous waste by introducing the Hazardous Waste Management (HWM) 2005 rules, formulated in accordance with the Pakistan Environmental Protection Act (PEPA) of 1997 (20). These rules aimed to improve the handling, storage, transportation, and disposal of hazardous waste in the country, aligning with the objectives set forth in the PEPA of 1997. The HWM 2005 rules marked a significant milestone as the initial comprehensive legislation striving to attain sustainable enhancements in hazardous waste management practices. It aimed to address various aspects of hazardous waste handling and disposal, promoting environmentally responsible and sustainable practices in Pakistan. The HWM 2005 rules reflected WHO guidelines from the establishment of a facility-based waste management plan to effective regulation of onsite collection, segregation, handling, labeling, storage, transportation, and disposal of healthcare waste (21).

Inadequate hospital waste management can lead to the spread of infectious diseases among healthcare workers, patients, and the public. It also poses environmental risks, as improper disposal can contaminate soil, water, and air. Tertiary care hospitals typically generate a larger volume and variety of medical waste compared to primary health centers. Understanding the differences in waste generation, handling, and disposal between these two types of facilities can help optimize resource allocation and reduce unnecessary expenses. Tertiary care hospitals usually have more resources and expertise, potentially leading to better adherence to waste management regulations and guidelines. Comparing their practices with those of primary health centers can shed light on the effectiveness of different approaches and aid in spreading best practices. The findings of this study can contribute to the development or refinement of policies, regulations, and guidelines related to hospital waste management. It can provide evidence-based insights to authorities for implementing more effective waste management practices.

2 Material and Methods

The study was a cross-sectional design, funded by Khyber Medical University under grant number DIR/ORIC/Ref/24/00063, and conducted from August 2023 to December 2023. A total of 384 participants from both genders were included. The inclusion criteria required participants to be involved in various stages of waste management, including generation, processing, storage, transportation, and disposal of healthcare waste. Ethical approval was obtained from the institutional review boards of the respective healthcare centers, and all procedures adhered to the ethical standards set forth in the Declaration of Helsinki.

Data collection was conducted through a combination of interviews, direct observations, and structured questionnaires filled out by the participants. The collected data encompassed demographic information, knowledge of waste management practices, training details, use of personal protective equipment (PPE), and information regarding the disposal of waste. Key variables included age, gender, educational background, awareness regarding waste management practices, use of specific bins for waste disposal, and the status of final waste disposal.

Participants' knowledge and practices related to waste management were thoroughly assessed. The primary outcome measures focused on the level of knowledge regarding waste management practices, educational background, adherence to the use of PPE, vaccination status, and compliance with hospital policies. Statistical analyses were performed using SPSS version 25. Descriptive statistics were utilized to

express variables in terms of frequency, percentage, and cumulative percentage. Comparisons between groups were conducted using the chi-square test for categorical variables and the one-sample t-test for continuous variables, with confidence levels of 95% and 99% considered statistically significant.

Throughout the study, ethical considerations were rigorously adhered to. The research protocol received approval from the institutional review boards of various tertiary care hospitals in Peshawar, ensuring compliance with ethical standards. Participant confidentiality was strictly maintained, and all data were anonymized to protect their identities. Informed consent was obtained from all participants prior to their inclusion in the study.

The study's comprehensive methodology facilitated a detailed evaluation of the effectiveness of hospital waste management practices among tertiary care hospitals and primary health centers. This approach provided valuable insights into the potential benefits and challenges associated with current practices, thereby guiding future improvements in clinical waste management strategies.

3 Results

Data were collected from 384 participants according to the study criteria. Of these, 72.49% of the participants were male, while 27.51% were female, with a mean age of 35-40 years. The analyzed data provided insights into various aspects of hospital waste management practices among tertiary care hospitals and primary health centers.

Table 1: Demographic Characteristics of Participants (N=384)

Characteristic	n	%
Gender		
Male	278	72.49
Female	106	27.51
Profession		
Doctors	129	33.59
Nurses	64	16.67
Technicians	122	31.77
Other Staff	74	19.27
Training Status		
Yes	291	75.78
No	93	24.22
Vaccination Status		
Yes	360	93.75
No	24	6.25

Table 2: Awareness of Hospital Waste Management Practices by Occupation

Occupation	Yes	No	Total
Doctors	125	4	129
Nurses	63	1	64
Paramedics	114	8	122
Other Staff	42	32	74

The results indicated that doctors exhibited the highest level of awareness regarding hospital waste management practices, with 96.9% of them being aware. Paramedics followed, with 93.4% demonstrating awareness. Nurses also showed high awareness levels at 98.4%, while other staff had the lowest awareness at 56.8%.

Table 3: Waste Management Practices in Different Clinical Settings

Variable	Frequency	Percent	Cumulative Percent
Central Storage Area			
No	26	6.8	6.8
Yes	358	93.2	100.0
Waste Transport Means			
By Hand	168	43.8	43.8
By Trolley	216	56.2	100.0

Variable	Frequency	Percent	Cumulative Percent
Use of PPE			
Apron	123	31.8	31.8
Face Mask	143	36.9	68.7
Gloves	110	28.4	97.1
Plastic Shoes	13	2.9	100.0
Dedicated Staff			
No	14	3.4	3.4
Yes	370	96.6	100.0
Availability of Incinerator			
No	40	10.4	10.4
Yes	344	89.6	100.0

The study revealed that a significant majority of healthcare facilities (93.2%) had designated central storage areas for temporary hospital waste containment. Waste was primarily transported from generation to disposal via trolleys (56.2%), with a smaller proportion using manual methods (43.8%). Face masks were the most commonly used PPE (36.9%), followed by aprons (31.8%) and gloves (28.4%), with plastic shoes being the least used (2.9%). Most facilities (96.6%) had dedicated staff for waste disposal, and 89.6% had incinerators for final waste treatment.

These results underscore the importance of enhancing training and awareness programs to ensure effective waste management practices across all healthcare facilities. The findings suggest a need for further improvements in the use of PPE and the consistent availability of functional incinerators to ensure safe and environmentally sound waste disposal.

4 Discussion

The study provided a comprehensive assessment of hospital waste management practices among tertiary care hospitals and primary health centers in the Khyber Pakhtunkhwa (KPK) region. The findings indicated a high level of awareness among healthcare professionals, particularly doctors and paramedics, regarding waste management practices. This awareness aligns with previous studies, which emphasized the critical role of healthcare professionals' knowledge in effective waste management (1).

Despite the high level of awareness, the study identified significant gaps in the practical implementation of waste management practices. The use of personal protective equipment (PPE) was suboptimal, with only 36.9% of participants consistently using face masks, 31.8% using aprons, and 28.4% using gloves. These findings are consistent with a study conducted in Iran, where inadequate PPE usage was reported among healthcare workers (6). This gap highlights the need for ongoing training and reinforcement of safety protocols to ensure the protection of healthcare workers and the broader community.

The availability of central storage areas and dedicated staff for waste management was a strength noted in the study, with 93.2% of facilities having designated storage areas and 96.6% having dedicated staff. These practices are essential for maintaining an organized and efficient waste management system, as highlighted by the World Health Organization guidelines (2). However, the reliance on incineration, despite its availability in 89.6% of facilities, raised environmental concerns, especially given the inefficiencies and potential hazards associated with non-functional or improperly used incinerators. This finding corroborates similar issues reported in studies from Bangladesh and Ghana, where incineration practices were found to be problematic (5-7).

A notable limitation of the study was the uneven distribution of training among participants, with 24.22% reporting no formal training in waste management. This discrepancy underscores the need for standardized and continuous training programs across all healthcare facilities. The study's reliance on self-reported data could also introduce bias, as participants might overestimate their compliance with best practices. Additionally, the study did not assess the long-term sustainability of waste management practices, an aspect critical for ensuring ongoing compliance and environmental safety.

The study's strength lies in its large and diverse sample size, which included participants from various healthcare roles and facilities. This diversity provided a comprehensive overview of the waste management landscape in the region. However, the cross-sectional design limited the ability to infer causality or observe changes over time.

Recommendations from the study include enhancing training programs focused on practical aspects of waste management, such as proper PPE usage and safe disposal techniques. Regular audits and monitoring can help ensure compliance with established protocols. The study also highlighted the need for alternative waste treatment methods, such as autoclaving, to reduce reliance on incineration and its

associated risks. Developing a national policy on healthcare waste management, with clear guidelines and enforcement mechanisms, could further strengthen waste management practices in Pakistan.

5 Conclusion

In conclusion, while the study revealed a high level of awareness and certain strengths in waste management practices, significant gaps and areas for improvement were identified. Addressing these issues through targeted training, better resource allocation, and policy development will be crucial for enhancing the effectiveness of hospital waste management and safeguarding public health and the environment.

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