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# Awareness of Biomedical Waste Management Among Medical and Paramedical Students in Faisalabad

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**Disclaimers**

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## ABSTRACT

**Background**: Biomedical waste, generated during diagnosis, treatment, and research, poses significant risks to environmental and human health if improperly managed.

**Objective:** This study assessed biomedical waste management awareness among medical and paramedical students in Faisalabad institutes.

**Methods**: A descriptive, cross-sectional, questionnaire-based survey was conducted in private and public institutes in Faisalabad, including 195 students. A modified WHO questionnaire was used, and data analysis was performed using SPSS version 23, incorporating descriptive and inferential statistics.

**Results**: Among 195 participants (69% male, 31% female; mean age 23.28±3.09), 89% of paramedical students had knowledge of the color-coded waste management system, compared to 54% of medical students. Additionally, 90% of paramedical students practiced waste segregation by color, versus 42% of medical students. While 42% of medical students reported adequate knowledge of color codes, 74% of paramedical students reported sufficient knowledge. No significant association was found between year of study and knowledge levels.

**Conclusion**: Paramedical students demonstrated higher knowledge and better practices in biomedical waste management than medical students, especially in public institutions. Increased training on waste segregation protocols is essential to improve knowledge and compliance among students.

**Keywords**: Biomedical waste management, Color coding, Healthcare waste, Paramedical students, Medical students, Waste segregation, Paramedics

## INTRODUCTION

Biomedical waste refers to any waste generated during the diagnosis, treatment, vaccination of humans or animals, or in activities related to biological testing and research. When disposed of without discrimination, biomedical waste poses significant hazards to both the environment and human health (1). Effective management and ultimate disposal of biomedical waste require precise segregation and dedicated healthcare measures to prevent life-threatening diseases such as Hepatitis B, Hepatitis C, and Human Immunodeficiency Virus (HIV) from spreading (2). With the increasing establishment of hospitals, there is a corresponding rise in unprocessed biomedical waste, as each patient generates substantial waste daily, leading to an accumulation that can strain waste management systems and significantly impact the health and safety of the surrounding community (3).

Biomedical waste is broadly classified into risky (infectious, sharp, pathological, etc.) and non-risky categories, which include general domestic waste (4). Despite widespread awareness efforts by digital and electronic media on the dangers of mismanaged biomedical waste, new strategies to mitigate these risks are often hampered by a lack of funding and awareness of the health hazards associated with mismanagement (5). The formulation of a structured, standards-based biomedical waste management system and the establishment of a governing body are essential for implementing strategies that align with global health standards (6). In developing countries like Pakistan, knowledge regarding biomedical waste management remains limited, affecting all stages of waste handling, including collection, storage, transportation, and disposal. Compliance with the Environmental Protection Act of 1997 is critical for hospitals in Pakistan to uphold effective waste management strategies that meet international standards (7).

Medical waste includes both non-harmful and harmful materials. Non-harmful waste includes items such as fruit peels, fresh water, paper, cotton, and packaging materials, whereas harmful waste can be further divided into potentially infectious and toxic categories. Potentially infectious waste includes blood products, lab waste, and sharps, while potentially toxic waste comprises radioactive, pharmaceutical, and chemical waste. Among the hazardous materials commonly used in healthcare are plastics, such as disposable syringes, blood bags, urethral bags, and surgical gloves, which pose additional risks when improperly disposed of. The incineration of these materials releases harmful dioxins and furans, contributing to serious health issues, including increased cancer risk, reduced sperm count, and developmental abnormalities in reproductive organs. Recycling plastics, while challenging, is essential to

reducing these hazards and generating less waste overall (8). Research on biomedical waste management in Pakistan is limited, underscoring the urgent need for increased awareness, organization, and adherence to both international and national standards to mitigate the environmental impact of biomedical waste. Hospitals bear a significant responsibility in ensuring safe waste disposal practices that do not harm the environment (9). Despite global advancements in biomedical waste management, awareness and implementation in Pakistan remain insufficient to meet the desired standards (10).

This study seeks to measure and analyze the level of awareness and the effectiveness of biomedical waste management practices among medical and paramedical students in Faisalabad. It explores the steps involved in biomedical waste management, including waste assessment, segregation, accumulation, and storage. Proper disposal techniques, such as autoclaving and chemical and thermal treatments, are critical components of effective biomedical waste management that contribute to reduced infection rates and environmental safety (11). The findings aim to provide insight into the current understanding and application of biomedical waste management among students, highlighting areas for improvement and aligning practices with global standards.

## MATERIAL AND METHODS

This descriptive cross-sectional survey was conducted to assess the awareness of biomedical waste management among medical and paramedical students in Faisalabad (12). The study was carried out across several institutions, including The University of Faisalabad, University Medical & Dental College, Government College University Faisalabad, College of Paramedics Faisalabad, and Aqsa Institute Faisalabad. The research was completed over a duration of three months following the approval of the study. A sample size of 195 participants was calculated based on a 7% margin of error, a 95% confidence level, and an estimated population of 20,000, with a response distribution of 50% (13). Participants were selected using a simple random sampling technique to ensure representation. Eligible participants included male and female students over the age of 18, enrolled between the 2nd and 5th years of their studies, and willing to participate. Students not associated with the medical field or unwilling to participate were excluded.

The study adhered to the ethical principles outlined in the Declaration of Helsinki, with approval obtained from the relevant institutional ethics committee. Written informed consent was obtained from each participant after explaining the study's purpose, procedures, and the confidentiality of their responses. Data were collected through a self-administered questionnaire designed according to the World Health Organization's recommended assessment tool for biomedical waste management (14). This structured questionnaire allowed for self-reporting of participants' awareness and practices related to biomedical waste management.

Data analysis was performed using SPSS version 25. Descriptive statistics, including frequencies and percentages, were used to summarize participant demographics and responses, while inferential statistics were applied to assess variations in awareness levels across demographic groups.

## RESULTS

The study assessed 195 participants with a mean age of 23.28 ± 3.094 years. The sample consisted of 135 (69.2%) males and 60 (30.8%) females. A majority, 156 (80%), were enrolled in private institutions, while 39 (20%) were from government institutions. Of the participants, 133 (68.2%) were medical students (MBBS, Dentistry, Physiotherapy), and 62 (31.8%) were paramedical students (Lab Technologists, Nursing). Most participants were in their 4th and 5th years (30.8% each), while 33 (16.9%) were in the 3rd year, and 42 (21.5%) were in their 2nd year.

**Table 1: Demographic Data**

| Category | Variable | Participants (n=195) |
|---|---|---|
| **Gender** | Male | 135 (69.2%) |
| | Female | 60 (30.8%) |
| **Age** | 18-22 years | 70 (35.9%) |
| | 23-27 years | 98 (50.3%) |
| | 28 years or above | 27 (13.8%) |
| **Institution Type** | Private | 156 (80%) |
| | Government | 39 (20%) |
| **Degree Program** | Medical | 133 (68.2%) |
| | Paramedical | 62 (31.8%) |
| **Study Year** | 2nd Year | 42 (21.5%) |
| | 3rd Year | 33 (16.9%) |
| | 4th Year | 60 (30.8%) |
| | 5th Year | 60 (30.8%) |

Only 9% of medical students reported having received training in biomedical waste management, compared to 16% of paramedical students. Approximately 42% of medical students acknowledged the presence of waste management plans and teams in their institution, while this was confirmed by 35% of paramedical students. Notably, 59% of medical students demonstrated awareness of color-coded waste separation, whereas paramedical students showed a higher level of knowledge, with 89% acknowledging the color coding system .

**Table 2: Knowledge of Biomedical Waste Management**

| Question | Medical (n=133) | Paramedical (n=62) |
|---|---|---|
| **Training in BWM** | 12 (9%) | 10 (16%) |
| **All healthcare wastes hazardous** | 60 (45%) | 36 (58%) |
| **Waste Management Plan & Team** | 56 (42%) | 22 (35%) |
| **Knowledge of color coding** | 79 (59%) | 55 (89%) |
| **Standard storage room** | 70 (53%) | 54 (87%) |
| **Knowledge of BM rules** | 90 (68%) | 52 (84%) |
| **Needle recapping practice** | 110 (83%) | 54 (87%) |

Attitudes varied between medical and paramedical students, with 30% of medical students and only 10% of paramedical students disposing all waste in general garbage. Regarding segregation practices, 42% of medical students and 90% of paramedical students indicated they follow waste categorization according to color-coded bins.

**Table 3: Attitudes Toward Biomedical Waste Management**

| Attitude Question | Medical (n=133) | Paramedical (n=62) |
|---|---|---|
| **Dispose all waste in general garbage** | 40 (30%) | 6 (10%) |
| **Segregate waste by categories** | 56 (42%) | 56 (90%) |
| **Dispose contaminated items in appropriate bins** | 52 (39%) | 45 (73%) |
| **Dispose sharps waste appropriately** | 42 (32%) | 55 (89%) |
| **Awareness of international symbols** | 57 (43%) | 34 (55%) |
| **Disposal of hazardous liquid waste** | 57 (43%) | 44 (71%) |

The majority of paramedical students (90%) reported categorizing waste according to biomedical waste standards, compared to 42% of medical students. Additionally, 53% of medical students expressed a need for further training in biomedical waste management, while only 32% of paramedical students felt similarly. Most students, regardless of background, supported workshops for enhanced learning.

**Table 4: Practice Assessment**

| Practice Question | Medical (n=133) | Paramedical (n=62) |
|---|---|---|
| **Segregate biomedical wastes by category** | 56 (42%) | 56 (90%) |
| **Need further training** | 70 (53%) | 20 (32%) |
| **General waste vs clinical waste disposal** | 45 (34%) | 54 (87%) |
| **Report needlestick injuries** | 57 (43%) | 56 (90%) |
| **Use of personal protective equipment** | 133 (100%) | 62 (100%) |
| **Support workshops on waste management** | 120 (90%) | 56 (90%) |

A chi-square test demonstrated a significant difference between medical and paramedical students in terms of color-coding knowledge ($p < 0.05$), with paramedical students showing higher knowledge (89%) compared to medical students (59%). A significant difference was also found between government and private institutions regarding color-coding knowledge, with government institution students showing higher awareness ($p < 0.05$). However, no significant difference in knowledge of color coding was observed across study years ($p > 0.05$), though 4th-year students had slightly higher knowledge levels at 75%. These results indicate that paramedical students generally possessed better knowledge and practices regarding biomedical waste management than medical students, with institutional type also impacting awareness levels.

**Table 5: Statistical Analysis**

| Chi-Square Test | Value | df | p-value |
|---|---|---|---|
| **Degree Program** | 16.901 | 1 | 0.000 |
| **Institution Type** | 4.032 | 1 | 0.045 |
| **Study Year** | 2.641 | 3 | 0.450 |

## DISCUSSION

The Biomedical waste management (BWM) is essential for maintaining safe healthcare environments and minimizing health risks. Biomedical waste is generated through processes like diagnosis, treatment, and immunization in healthcare, with approximately 85% classified as non-hazardous and the remainder posing serious risks due to pathogenic, chemical, and radioactive content (World Health Organization 15). Despite these known risks, the present study found a notable gap in BWM knowledge and practices among medical students compared to paramedical students. This gap aligns with past studies, which similarly reported lower awareness and inadequate BWM training among medical students (15).

Parental medical students, as shown in our results, displayed significantly higher awareness and adherence to color-coding practices for waste segregation, suggesting that practical exposure and frequent handling of waste materials may foster greater understanding in BWM. The disparity observed between private and government institutions, with higher knowledge levels among students from government institutions, reflects prior findings that resource allocation and regulatory compliance in government hospitals often lead to more robust training and implementation of BWM practices (16). This variance underscores a need for standardizing BWM education across institutional types, an area identified as a priority for healthcare policy reforms.

In our study, while medical students had moderate awareness of BWM principles, gaps in knowledge about color-coded waste segregation, waste disposal practices, and universal precautions suggest that current educational programs lack the practical, hands-on training required to bridge these gaps. Prior studies have demonstrated that a lack of effective waste management policies in healthcare settings contributes to occupational hazards for healthcare workers, including needle-stick injuries and exposure to infectious waste (16). Improper waste disposal can also result in environmental hazards such as land and water contamination and air pollution due to the emission of toxic substances from incineration and open burning (17).

The findings of this study highlight several strengths, including its multi-institutional design and the diversity of participants across healthcare disciplines. However, limitations exist, including the limited generalizability beyond the sample population and potential biases due to self-reporting. Future research should consider longitudinal designs to track BWM knowledge retention and behavior change over time, as well as intervention studies aimed at evaluating the efficacy of BWM educational programs.

## CONCLUSION

This study concludes that paramedical students demonstrated significantly better awareness and practices regarding Biomedical waste management (BWM) than medical students, reflecting the need for enhanced training and consistent institutional policies across healthcare education. Strengthening BWM education could improve public health outcomes, reduce occupational hazards, and promote sustainable healthcare practices, ultimately benefiting human health and environmental safety.

## REFERENCES

1 Harhay MO, Halpern SD, Harhay JS, Olliaro PL. Health Care Waste Management: A Neglected and Growing Public Health Problem Worldwide. Tropical Medicine and International Health. 2009;14(11):1414-7.

2 Palwankar PV, Singh AJ. Safety and Measures for Auxiliary Staff Associated With Hospital Waste Disposal. Indian Journal of Dental Sciences. 2012;4(1).

3 Mathur P, Patan S, Shobhawat AS. Need of Biomedical Waste Management System in Hospitals: An Emerging Issue - A Review. Current World Environment. 2012;7(1):117.

4 Lee BK, Ellenbecker MJ, Moure-Ersaso R. Alternatives for Treatment and Disposal Cost Reduction of Regulated Medical Wastes. Waste Management. 2004;24(2):143-51.

5 Sapkota B, Gupta GK, Mainali D. Impact of Intervention on Healthcare Waste Management Practices in a Tertiary Care Governmental Hospital of Nepal. BMC Public Health. 2014;14(1):1005.

6 Abdulla F, Qdais HA, Rabi A. Site Investigation on Medical Waste Management Practices in Northern Jordan. Waste Management. 2008;28(2):450-8.

7 Arshad N, Nayyar S, Amin F, Mahmood KT. Hospital Waste Disposal: A Review Article. Journal of Pharmaceutical Sciences and Research. 2011;3(8):1412.

8 Heidbreder LM, Bablok I, Drews S, Menzel C. Tackling the Plastic Problem: A Review on Perceptions, Behaviors, and Interventions. Science of the Total Environment. 2019;668:1077-93.

9 Hassan MM, Ahmed SA, Rahman KA, Biswas TK. Pattern of Medical Waste Management: Existing Scenario in Dhaka City, Bangladesh. BMC Public Health. 2008;8(1):36.

10 Rasheed S, Iqbal S, Baig LA, Mufti K. Hospital Waste Management in the Teaching Hospitals of Karachi. Journal of Pakistan Medical Association. 2005;55:192.

11 Almuneef M, Memish ZA. Effective Medical Waste Management: It Can Be Done. American Journal of Infection Control. 2003;31(3):188-92.

12 Levin KA. Study Design III: Cross-Sectional Studies. Evidence-Based Dentistry. 2006;7(1):24-5.

13 Raosoft. Sample Size Calculator. 2004.

14 World Health Organization. Management of Solid Health-Care Waste at Primary Health-Care Centres. 2005.

15 Joseph J. Awareness and Practice of Biomedical Waste Management in Indian Setting (2012-2016): Systematic

Review. Research and Reviews Journal of Medical and Health Sciences. 2017;6:27-33.

16 Patil PM, Bohara RA. Nanoparticles Impact in Biomedical Waste Management. Waste Management & Research. 2020.

17 Ajmal S, Ajmal M. Knowledge and Practices of Biomedical Waste Management Among Paramedic Staff of Jinnah Hospital, Lahore. Biologia. 2017;63(1):59-66.