



**KNOWLEDGE, ATTITUDE AND PRACTICES ABOUT BIOMEDICAL WASTE
MANAGEMENT AMONG HEALTHCARE PERSONNEL IN DAWADMI &
SHAQRA(RIYADH PROVINCES), KINGDOM OF SAUDI ARABIA: A CROSS
SECTIONAL STUDY**

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ABSTRACT

Introduction: Biomedical waste management (BWM) involves all individuals who play a role in generating, collecting, receiving, storing, transporting, treating, disposing, or handling biomedical waste in any form. The categorization of biomedical waste is crucial for proper handling and disposal. The majority of BMW, approximately 75% to 90%, falls into the non-hazardous or general health-care waste category. This includes items that do not pose direct risks to health or the environment. However, the remaining 10% to 25% of BMW is considered hazardous and can lead to various environmental and health risks. **Methods:** This was a prospective observational cohort study conducted at 4 Tertiary Care Hospitals in Dawadmi & Shaqra(Riyadh Provinces) Saudi Arabia from the year 2023 (Mar to Aug). Institutional Review Board/ Ethical Review Board was taken from each hospitals before commencing the study. All the House Job Officers, Residents, Consultants, Physicians were included in the study. **Results & Conclusion:** The study paints a positive picture of waste management practices in surveyed hospitals, with healthcare professionals demonstrating good knowledge of waste categorization and adherence to recommended practices. The findings provide valuable insights that can guide interventions aimed at enhancing the overall safety and efficiency of medical waste management in healthcare settings.

KEYWORDS: All the House Job Officers, Residents, Consultants, Physicians were included in the study.

INTRODUCTION

Biomedical waste management (BWM) involves all individuals who play a role in generating, collecting, receiving, storing, transporting, treating, disposing, or handling biomedical waste in any form. The categorization of biomedical waste is crucial for proper handling and disposal. The majority of BMW, approximately 75% to 90%, falls into the non-hazardous or general health-care waste category. This includes items that do not pose direct risks to health or the environment. However, the remaining 10% to 25% of BMW is considered hazardous and can lead to various environmental and health risks. This hazardous health-care waste includes specific types of waste such as sharp waste, infectious waste, pathological waste, pharmaceutical waste, cytotoxic waste, chemical waste, liquid infectious waste, and radioactive waste.^[1] Developed countries tend to generate more healthcare waste, including hazardous waste, per bed-day compared to developing countries. The World Health Organization (WHO) indicate that high-income countries generate on average up to 0.5 kg/bed-day of hazardous waste, while

low-income countries generate on average 0.2 kg/bed-day.^[3] The categorization of healthcare facilities into red, indicating the absence of a credible BWM system or the need for major improvement, is indicative of challenges in waste management practices. The statistics from the WHO studies in 22 developing countries further underscore the issue. The range of healthcare facilities (HCFs) not using proper waste disposal methods, which spans from 18% to 64%, emphasizes the need for improvement in waste management practices across various regions.^[4] Before the pandemic, a significant portion of the global population lacked access to proper waste collection and controlled waste disposal facilities. Approximately 2 billion without waste collection and 3 billion without controlled waste disposal, highlight pre-existing challenges in waste management infrastructure that may be exacerbated during health crises.^[5-6] New York City- the most developed city globally, experienced changes in waste generation patterns during the pandemic. Residential solid waste generation increased significantly (*from 5 to 30%*), possibly due to people spending more time at home and changing consumption

patterns. In contrast, the commercial and industrial sectors declined, likely reflecting reduced economic activities and business operations.^[7] The news of human-to-human transmission of the coronavirus led to a sudden increase in the global demand for medical masks, examination gloves, and goggles (*89 million medical masks per month, 76 million examination gloves, while international demand for goggles stands at 1.6 million per month*). The WHO estimated substantial monthly requirements to meet the needs of the COVID-19 response, indicating the unprecedented strain on the supply chain for these essential items.^[8-9] To find out what practice has been observed among the Health Care Personnel (HCP) in Riyadh provinces- Saudi Arabia, this study will cover all the possible aspects of knowledge, attitude and practice among the HCP while disposing of the BWM.

METHOD

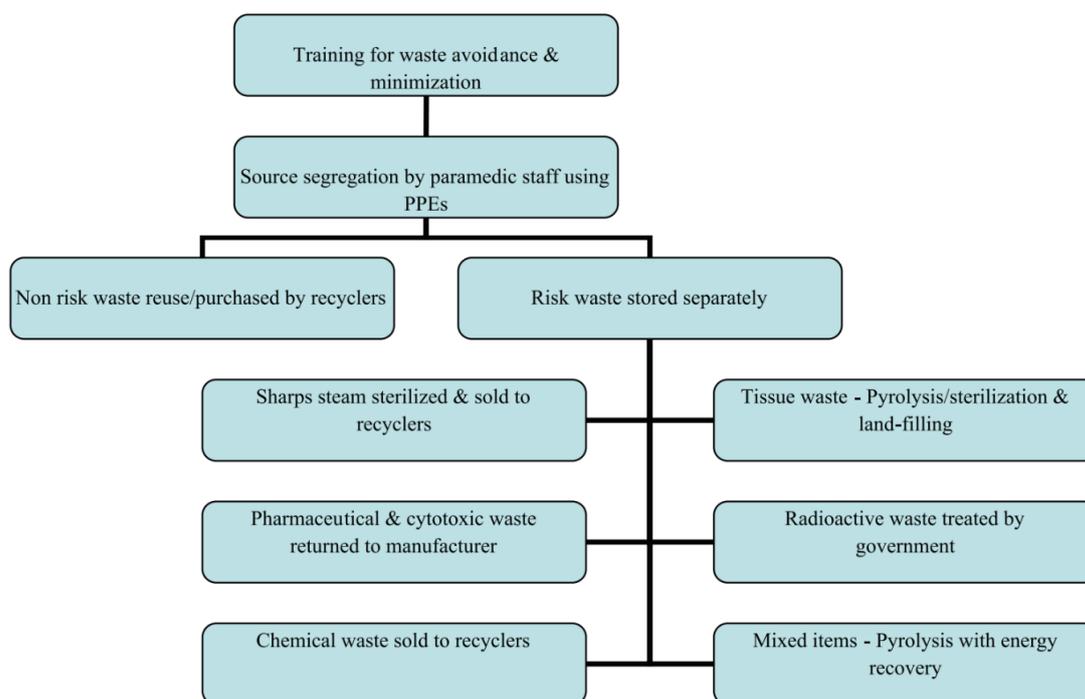


Figure 1: Outline of Hospital Waste Management. Source: Ali M, et al.^[8]

We divided the KAP Study questionnaire for the survey into 3 sections i.e., Knowledge about segregation, Attitude about the Non-Risk and Risk Waste Material, and Practice about the Disposing of the BWM. The questionnaire had started with an extensive demographic information such as age, gender, duration of working and prior source of BWM.

BWM Knowledge

- Understanding of biomedical waste: Knowledge about what constitutes biomedical waste, including infectious waste, sharps, pharmaceutical waste, and other hazardous materials.

This was a prospective observational cohort study conducted at 4 Tertiary Care Hospitals in Dawadmi & Shaqra(Riyadh Provinces)from the year 2023 (Mar to Aug). Institutional Review Board/ Ethical Review Board was taken from each hospitals before commencing the study. All the House Job Officers, Residents, Consultants, Physicians were included in the study. For those who were marked as Non Health Care Professionals were excluded from the study. Proper biomedical waste management is crucial to mitigate the environmental and health risks associated with hazardous waste generated in healthcare facilities. According to Ali M et al, the implementation of effective BMW systems involves proper segregation, handling, transportation, treatment, and disposal of healthcare waste, ensuring that infectious, toxic, and other hazardous materials are managed in a way that minimizes their impact on both human health and the environment [Fig 01].

- Segregation and categorization: Knowledge about the proper segregation and categorization of different types of biomedical waste.
- Regulations and guidelines: Awareness of local, national, and international regulations and guidelines related to biomedical waste management.

BWM Attitude

- Perceived importance: Attitudes towards the importance of proper biomedical waste management for public health and environmental protection.
- Responsibility: Attitudes towards individual and collective responsibility for biomedical waste disposal.

- Compliance: Willingness to adhere to guidelines and regulations regarding biomedical waste management.

BWM Practice

- Segregation and collection: Actual practices in segregating biomedical waste at the source and collecting it in designated containers.
- Storage and transportation: Practices related to the safe storage and transportation of biomedical waste within healthcare facilities.
- Disposal methods: Adherence to recommended methods of disposal, such as incineration, autoclaving, or landfilling, depending on the type of waste.

The first portion, knowledge questions, had 17 questions that were structured and closed-ended, with maximum and minimum scores of "yes" and "no," respectively. The second element was an attitude questionnaire. It consisted of 26 structured and closed-ended questions placed in a Likert scale with a maximum score of 3 (agree) and 1 (disagree) for positive statements and vice versa. The third section was a practice questionnaire with 20 questions. They were structured and closed-ended, and interpreted on the bases of maximum score a responder achieved in each sections. In Knowledge 17 to 15 consider as higher knowledge, and below or equal to

9 as poor knowledge. Score 26 to 21 consider as Positive Attitude of BWM while score below or equal to 10 consider as negative attitude towards BWM. Responders received the score 20 to 14, considered as had a good practice of BWM while below 8 score marked as poor practice of BWM. All of the questions were assessed for reliability using a pilot study with 50 respondents in an area similar to the research region. KR20 was used to assess the reliability of knowledge questions, and the result was 0.60. The Cronbach's α for attitude and practice were 0.63 and 0.82, respectively. These values were declared acceptable by the standard scale. BWM Knowledge, Attitude and Practice among the HCP was assessed on following basis (through structured questionnaire).

RESULTS

The questionnaire was distributed among 887 respondents of 04 different tertiary care hospitals of Riyadh province. Out of 887, 711 revert back response of fully completed information was received. The highest number of population responded to the questionnaire were Allied Health Care Professionals (Physiologist, Occupational Therapist, Speech Therapists, Clinical Psychologists, Medical Technologists, Physiotherapists), and Nurses i.e. 162 out of 180 and 136 out of 160 [Fig 02].

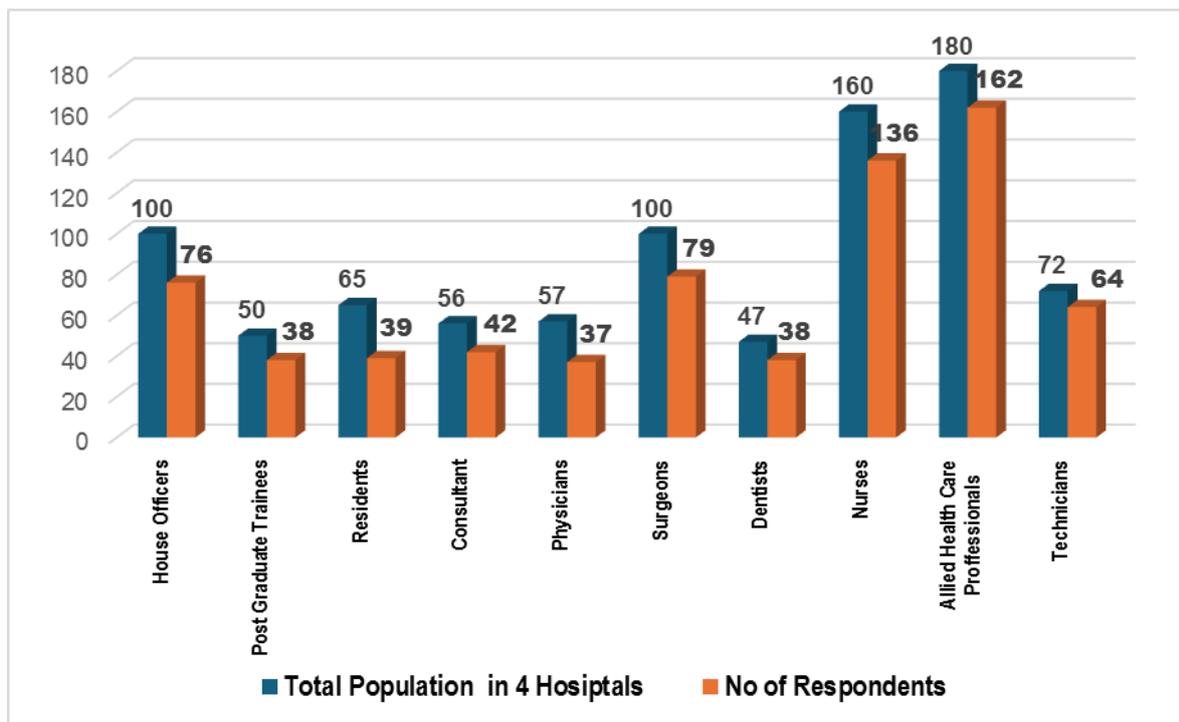


Figure 2: Proportion of Respondents from 04 Tertiary Care Hospitals in Dawadmi & Shaqra (Riyadh provinces) Saudi Arabia.

Most of the responder were male from the age of 20 to 40 years having maximum range of working experience ≤ 5 years. The prior information

respondents about the BWM was the hospital practices they are working with or previously they are employed [Table 01].

Table 1: Demographic Characteristics of Study Respondents (711) among the 4 Tertiary Care Hospitals in Dawadmi & Shaqra(Riyadh provinces)- Saudia Arabia from the year 2022 (Mar to Aug)

	Frequency (Percentage)
Age of Respondents	
≤20 years	67(9.423%)
20-40 years	436(61.322%)
41-59 years	143(20.112%)
>60 years	65(9.142%)
Gender of Respondents	
Male	512(72.011%)
Female	199(27.988%)
Duration of Working	
≤5 years	316(44.444%)
≤10 years	207(29.113%)
≤15 years	96(13.502%)
≥20 years	92(12.939%)
Prior Source of Biological Waste Management Information	
Do not receive any	112(15.752%)
Have receive but not from the hospital working	137(19.268%)
Hospital notice board	32(04.500%)
Hospital daily awareness emails	29(04.078%)
From the hospital/departmental practice (with or without knowledge)	401(56.399%)

For the BWM knowledge, in high knowledge group of BWM Post Graduate Trainees had higher knowledge of BWM, in moderate group Consultant had moderate knowledge of BWN, while in Low Knowledge BWM most of the Residents had minimum knowledge of BWM. In Positive Practice group of BWM Post Graduate Trainees had Positive Attitude towards BWM, in

moderate group Physician had Neutral Attitude of BWN, while in Negative Attitude of BWM Technician had very low attitude toward BWM. Surgeon follows the highest practice among the Good Practice BWM group, Consultant had highest Moderate practice group in terms while Technician among the poor practice score the highest among all the responder. [Table 02]

Table 2: Frequency of the Knowledge, Attitude, and Practice of BWM among the different Health Care Professionals with respect to their background/profession/designation among the 4 Tertiary Care Hospitals in Riyadh Provinces- Saudia Arabia from the year 2022 (Mar to Aug)

	Knowledge			Attitude			Practice		
	High (=15-17) n(%)	Moderate (=10-14) n(%)	Low (≤9) n(%)	Positive (=21-26) n(%)	Neutral (11-20) n(%)	Negative (≤10) n(%)	Good(14-20) n(%)	Moderate (9-13) n(%)	Poor (≤8) n(%)
	House Officers n=76	30(39.473%)	37(48.684%)	09(11.842%)	43(56.578%)	29(38.157%)	04(05.263%)	31(40.789%)	42(55.263%)
Post Graduate Trainees n=38	29(76.315%)	06(15.789%)	03(7.894%)	29(76.315%)	08(21.052%)	01(02.631%)	13(34.210%)	21(55.263%)	01(02.631%)
Residents n=39	17(43.589%)	13(33.333%)	09(23.076%)	23(58.974%)	11(28.205%)	05(12.820%)	18(46.153%)	16(41.025%)	05(12.820%)
Consultant n=42	11(26.190%)	26(61.904%)	05(11.904%)	20(47.619%)	19(45.238%)	03(07.142%)	11(26.190%)	26(61.904%)	05(11.904%)
Physicians n=37	17(45.945%)	17(45.945%)	03(08.108%)	14(37.837%)	20(54.054%)	03(08.108%)	14(37.837%)	20(54.054%)	03(08.108%)
Surgeons n=79	38(48.101%)	41(51.898%)	0(0)	53(67.088%)	26(32.911%)	0(0)	46(58.227%)	33(41.772%)	0(0)
Dentists n=38	11(28.947%)	12(31.578%)	15(39.473%)	07(18.421%)	25(65.789%)	06(15.789%)	16(42.105%)	17(44.736%)	05(13.157%)
Nurses n=136	68(50.000%)	57(41.911%)	11(08.088%)	68(50.000%)	61(44.852%)	07(05.147%)	68(50.000%)	61(44.852%)	07(05.147%)
Allied Health Care Professionals* n=162	97(59.876%)	43(26.5432%)	22(13.580%)	85(52.469%)	65(40.123%)	12(07.407%)	83(51.23%)	71(43.827%)	08(04.938%)
Technicians n=64	31(48.437%)	21(32.812%)	12(18.750%)	24(37.500%)	21(32.812%)	19(29.687%)	18(28.125%)	37(57.812%)	09(14.0625%)

*Physiologist, Occupational Therapist, Speech Therapists, Clinical Psychologists, Medical Technologists, Physiotherapists

DISCUSSION

The findings of an observational descriptive study conducted among 241 professional and non-professional staff at a district hospital in the KwaZulu-Natal province. The result demonstrated Nurses had better knowledge of HCW management compared to other healthcare professionals. About 63% of nurses scored 'good' (47.7%) or 'excellent' (15.3%) on the knowledge score. Other professional participants scored lower, particularly in understanding the purpose of different colored bags used for sorting medical waste. Nearly half of the participants (48.3%) reported never receiving formal training in HCW management. Among those who did receive in-service training (50.7% of participants), the majority (38.7%) were nurses. The majority of professional participants (89.6%), 68.8% of nurses, and 33% of non-professionals recognized that containing sharp objects helps safely manage hospital waste. However, 33.3% of non-professionals did not answer this question. Only 51.2% of other professionals and 52.8% of nurses reported sorting HCW when depositing it into collection bins. In contrast, over 80% of non-professionals reported sorting HCW during collection.^[11] From the results of a descriptive cross-sectional survey method to evaluate the knowledge and practices of healthcare professionals regarding medical waste management in seven hospitals in Lagos, Nigeria. A significant majority (69.5%) of the respondents demonstrated adequate knowledge of waste categorization. The study found a significant association ($p < 0.05$) between the profession of the respondents and their ability to categorize paper, bottles, food, and plastic wastes correctly. A majority (61.0%) of the respondents indicated that waste segregation should be done at the source. A high percentage (88.6%) of respondents indicated the use of safety boxes for sharp collection. The majority (81.9%) of all respondents reported using a color code system for easy identification of the different types of wastes generated in their facilities.^[12] In Debre Markos town healthcare facilities in northwest Ethiopia included 55 medical waste handlers from 12 healthcare facilities to assess the knowledge, attitude, and practices of waste handlers regarding medical waste management. About 45.5% of the study participants had adequate knowledge scores regarding medical waste management. The majority of participant's demonstrated awareness of segregation practices, with 72.7%, 69.1%, and 90.9% identifying that general, infectious, and sharp wastes should be disposed of in black bag, yellow bag, and a safety box, respectively. A significant proportion, 78.2%, of the participants had a favorable attitude toward medical waste management. Around 80.0% of the participants had adequate practice scores.^[13] The majority of respondents (89%) demonstrated knowledge about hazards in healthcare facilities among healthcare workers (HCWs) in a typical healthcare facility (HCF) in Nigeria. Specifically, 70% recognized recapping used needles as a risky practice, and 100% acknowledged the importance of effective handwashing before and after clinical procedures in preventing cross-infection. A

significant portion of respondents (96.2%) believed they were at risk of occupational hazards, and about two-thirds perceived the risk as high. Just over half of the respondents (52.1%) reported "always" complying with standard procedures. The composite Knowledge, Attitude, and Perception (KAP) of respondents revealed that 38% had a positive rating, while 20% had poor knowledge, good attitude, and perception. The study found that occupation was not significantly associated with respondents' perception of occupational hazards ($P = 0.68$) and handwashing practices ($P = 0.295$).^[14] In 2021 Alhumaid S et al generated a comprehensive Systematic Reviews and Meta-Analysis (PRISMA) aimed at evaluating the knowledge of infection prevention and control (IPC) among healthcare personnel and the variables affecting their adherence to it. High-income nations, low-income nations, and lower-middle-income nations were taken into consideration. The assessment found that in several studies, particularly those carried out in Italy and Nigeria, healthcare workers' (HCWs') understanding of routes of transmission was lacking. Knowledge of HCWs was shown to be associated with a number of factors, including experience, training, working overseas, having access to IPC guidelines, serving on an IPC committee, and reading scientific publications. Three primary drivers of health care workers' compliance with IPC standards were found to be knowledge, education, and training, in addition to experience. HCWs who said they had received enough IPC instruction and training were more compliant.^[15]

CONCLUSION

The study reveals disparities in knowledge and training among various healthcare professional groups, with Post Graduate Trainees have High Knowledge with Good Attitude of BWM displaying better understanding and training in HCW management compared to other professionals. Although underscores among Technician and Resident somewhat significance of ongoing education and training programs to enhance HCW management across all staff categories in healthcare settings. Overall, the study paints a positive picture of waste management practices in surveyed hospitals, with healthcare professionals demonstrating good knowledge of waste categorization and adherence to recommended practices. The findings provide valuable insights that can guide interventions aimed at enhancing the overall safety and efficiency of medical waste management in healthcare settings.

STUDY LIMITATION AND RECOMMENDATION

Because of the many associated risk factor of thyroid disorder and heart disease, in our study we include the questionnaire about the awareness sessions and campaign which must be intervene among the Saudi population and many of the respondents affirm the questionnaire which is one of the study strength. However, thyroid and cardiac awareness associated study was not conducted in previous literature at in depth level of knowledge, attitude and practice therefore actual stats

of the public or patient understanding was difficult to compute which was one of the limitation of the study. In order to find the real numbers of inadequate knowledge and understating among the Saudi population large number of study sample size and Qausi-experimental study would be recommended to conduct.

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CONSENT TO PARTICIPATE STATEMENT

This study has been granted an exemption from requiring written informed consent by of Research Ethics in Shaqra University as it is a questionnaires-based study.

CONFLICTS OF INTEREST STATEMENT

The authors have no conflict of interest

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DATA AVAILABILITY STATEMENT

All data generated or analyzed during this study are included in this article. Further enquires can be directed to the corresponding authors.

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