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Barriers and facilitators of biomedical waste management among healthcare professionals in Saudi Arabia: a qualitative study

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Abstract

Background Biomedical waste is a significant byproduct of healthcare systems, and it includes a diverse mixture of hazardous and non-hazardous waste. There is increasing concern among governments and healthcare organizations regarding the generation, handling, and disposal of healthcare or clinical waste. This study seeks to utilize a qualitative methodology to examine the barriers and facilitators faced by healthcare professionals (HCPs) in effectively managing biomedical waste (BMW) at several hospitals in Riyadh, Saudi Arabia.

Method We adopted an interview qualitative study with semi-structured individual interviews to gain a comprehensive understanding of the various factors that impact adherence to hand hygiene among HCPs. The content analysis method was used to examine the interviews allowing for the identification of codes and themes through a systematic categorization procedure.

Results A group of 32 HCPs with diverse specializations, who had an average age of 38 years, were interviewed. The participants included 14 males and 18 females. The interviews included a total of 8 physicians, 4 anesthesiologists, 6 lab technicians, and 14 nurses. We found that the participants focused on five primary themes that pertain to the challenges and problems related to BMWM among HCPs.

Conclusion Based on these findings, it is highly recommended to implement a comprehensive national strategy for integrating biomedical waste management (BMWM) into all healthcare programs. To maintain a high level of expertise in the field of BMWM principles, it is important for hospitals to provide regular training sessions to their staff.

Keywords Infection control, Healthcare workers, Qualitative study, Hospital waste management, Waste control

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Introduction

An effective and efficient healthcare system is an essential objective for any country [1]. If the guidelines, procedures, and byproducts of the healthcare system are not managed appropriately, they can pose significant risks to the general population and the environment [2]. One of the important byproducts of healthcare systems is biomedical waste, which encompasses a wide array of hazardous and non-hazardous waste [3]. The definition of medical waste includes any solid or liquid waste that is produced during the treatment of patients in healthcare facilities, as well as from diagnostic procedures, pathology testing, and medical research [4]. The waste generated by healthcare facilities can contain various hazardous substances, such as genotoxic or radioactive compounds, infectious microorganisms, toxic chemicals, and heavy metals [5]. The contents of this collection include sharp objects, non-sharp objects, blood, bodily fluids, dressings, surgically excised tissues, chemicals, medications, medical equipment, and radioactive substances [6]. In addition to inhalation and ingestion, these wastes include pathogenic bacteria that may enter human bodies via several access sites. These entry points include punctures, abrasions, or wounds in the skin, as well as other conceivable entry locations [7].

There is increasing concern among governments and healthcare organizations regarding the generation, handling, and disposal of healthcare or clinical waste [8]. According to a report from the World Health Organization (WHO), the waste generated by hospitals can be categorized into two types: "general" waste, which makes up about 75 to 90% of the amount of waste generated by healthcare activities, and infectious and toxic waste, which accounts for approximately 10 to 25%. The latter type of waste could pose several serious healthcare risks [1].

Currently, there is a growing global recognition that healthcare waste requires effective management and control [9]. Nevertheless, the effectiveness of biomedical waste management (BMWM) is diminishing due to several reasons such as insufficient technical and economic capabilities, social issues, and poor training of personnel in charge of managing and processing healthcare waste. Furthermore, there is a lack of facilities and action plans for managing waste, particularly hazardous waste, to reduce the costs of disposing of healthcare waste and to properly handle liquid chemical waste. Additionally, there is an insufficient organizational structure in place to effectively manage clinical waste, inadequate procedures for assessing waste, and a lack of comprehensive BMWM plans that clearly outline the roles and responsibilities of individuals and institutions involved in BMWM [10]. Inadequate training of healthcare personnel leads to incorrect management and disposal of infectious waste [11]. Additionally, it was reported that the majority of healthcare professionals fail to adhere to the appropriate waste disposal protocols, resulting in frequent occurrences of sharp injuries and infections [12]. A study conducted by the WHO found that 66% of hospitals in 22 countries were not adhering to appropriate protocols for managing infectious trash [13, 14].

The WHO has identified many causes that contribute to the failure of the BMWM system [15]. The factors contributing to the issue of BMWM include a lack of knowledge about the health risks associated with it, healthcare professionals who are not adequately trained in managing BMWM, the absence of laws and regulations governing waste management systems, and insufficient allocation of human and financial resources [15]. Furthermore, the occurrence of malpractice at BMWM can be ascribed to the inattentiveness of emergency clinic personnel, the lack of motivation among medical clinic staff to comply with and enforce standards, inadequate supervision, the absence of a dedicated waste management facility within the clinic, and insufficient funding [16].

Regardless of attempts to comprehend and regulate inadequate waste management, the problem persists uniformly in all healthcare institutions and at every management level [17]. Numerous studies have sought to qualitatively examine the process of BMWM [10–14]. However, few studies used the qualitative approach to identify the barriers and facilitators in BMWM among HCPs. This study seeks to utilize a qualitative methodology to examine the barriers and facilitators faced by HCPs in effective BMWM at several hospitals in Riyadh, Saudi Arabia. The barriers and facilitators were defined as the perceived factors that act as enablers or obstacles in BMWM.

Methods

Study design

We adopted a Phenomenological qualitative study with semi-structured individual interviews to gain a comprehensive understanding of the various factors that impact adherence to hand hygiene among HCPs. The fundamental concepts derived from the data collected were thoroughly evaluated, examined, and developed using standard content analysis, a methodical process for categorizing and classifying data [18]. Standard content analysis is a necessary method in qualitative research for studying emotions, and views; and understanding the intricacies of human behavior that cannot be captured by quantitative studies [19].

Participants and settings

A group of 36 HCPs, currently employed in several large hospitals in Saudi Arabia, were invited to participate in semi-structured individual online interviews.

Table 1 Interview questions

- What mechanism do you have in place to deal with BMWM?
- Does the healthcare facility have written policies, written plans, manuals, or written procedures dealing with BMW?
- Have you ever received formal/technical training in HCW? If yes, provide details of what kind of training it was and how often you have received it.
- Is there a system of internal monitoring or inspection to determine compliance with healthcare waste management requirements?
- How would you rate your knowledge and the knowledge of your colleagues in terms of BMWM?
- What is the major motivation behind your BMWM?
- How do you feel about BMWM of other healthcare job groups?
- What are the barriers to practicing proper BMWM regularly in your workplace?
- Would you kindly provide anything else you believe is relevant to this matter?

Table 2 Participants' demographic characteristics (*n*=32)

Individuals' characteristics	Categories	*N*	%
Sex	Male	18	56.3
	Female	14	43.7
Age (years)	18 – 23	2	6.3
	24 – 29	6	18.8
	30 – 36	13	40.6
	37 above	11	34.4
Profession	Physician	8	25
	Nurse	14	43.8
	Anesthesiologist	4	12.4
	Lab technician	6	18.8
Work Experience (years)	Less than 1 year	4	12.5
	1–3	8	25
	4–6	11	34.4
	7–10	6	18.8
	More than 10 years	3	9.3

Data collection was conducted in July 2023 in four distinct regions, namely the Central, Southern, Eastern, and Western regions. To identify participants with the greatest diversity in terms of age, sex, educational attainment, and employment history, purposive sampling was implemented.

Inclusion and exclusion criteria

The study's inclusion criteria included HCPs who were currently working at a healthcare institution throughout the data-collecting period. HCPs who are not currently working at any healthcare institution were excluded. The participants' size is decided by the saturation of the data, which indicates if there are sufficient results to provide a full understanding [18]. Following the completion of interviews with 32 individuals, the present research was able to reach a state of data saturation.

Data collection procedure

During July 2023, we conducted a series of semi-structured individual online interviews. We aimed to gain a comprehensive understanding of the various factors that impact adherence to hand hygiene. The interviews were facilitated by the main author SA and designed to be open-ended, allowing participants to provide detailed responses. To create the question guides, and fulfill the objectives of the study, we conducted a thorough evaluation of pertinent literature [20]. The questions were slightly modified to enhance their adequate coverage and understanding after a pilot test involving four participants. At the beginning of each interview, the standard procedure was followed, which included getting acquainted with the investigators and receiving information about the study's goals and methods. Furthermore, the researcher used a sequence of pre-written conversations to acquaint themselves with the participants. The interview's open questions were designed to enable the participant to articulate their views on the BMW management process and the factors that could influence it (Table 1). The interviews had a length ranging from 40 to 50 min. To maintain privacy, only the primary author, the interviewer, was present during the online interview and was the only one having access to the recorded sessions. Furthermore, to ensure that the interview occurred at a suitable time, the participants were sent an email to verify their preferred timing. They were advised to secure a quiet place with a reliable internet connection to prevent any potential disconnection.

Data analysis

A content analysis approach developed by Graneheim and Lundman, consisting of five steps, was used to analyze the data that was acquired [21, 22]. The core ideas extracted from the acquired data were meticulously assessed, analyzed, and refined using conventional content analysis, a systematic approach for categorizing and classifying material [18]. Standard content analysis is an essential methodology in qualitative research for examining emotions and perspectives, as well as comprehending the complexities of human behavior [19]. The methodology employed in this process allows for the discovery of codes and themes through a systematic categorization procedure. All interviews were transcribed word for word throughout the initial interview phase. After conducting a thorough examination of the interview transcripts on many occasions, the researchers were able to thoroughly immerse themselves in the material and get a comprehensive understanding of the matter. Subsequently, a thorough analysis was carried out on the transcripts of the interviews to identify significant aspects that were pertinent to the objectives of the research. The last phase

Table 2 Categories related to the barriers and facilitators of BMWM among HCPs

Knowledge of BMWM
Attitudes toward BMWM
Continuous supervision control and monitoring
Training on BMWM

required the compression of essential parts and the classification of those segments using appropriate codes. Based on the similarities and differences between the codes, the original codes were grouped into categories. With the guidance of this method, the latent information contained within the data was identified and recovered. The principal author and an assisting researcher were responsible for carrying out all the analytical procedures. Trustworthiness was evaluated based on the criteria developed by Guba and Lincoln. These standards include the following: confirmability, transferability, credibility, and dependability [23, 24]. As part of the peer review process, the following were assessed: background information, data collection techniques, procedure, data management, transcripts, data evaluation, strategy, and study results. The primary language of most participants was Arabic. Consequently, if the participant opted to converse in Arabic, the interview transcripts were translated into English by the two authors.

Ethical considerations

The study was approved by the Saudi Electronic University Institutional Review Board under number SEU-REC-4447. Following the recruitment of participants, the objectives of the research were explained to the participants, and before the beginning of the interview, informed written permission was obtained before any audio recording began. All the participants were informed of the confidentiality of their data as well as their ability to join or withdraw from the study at any time.

Results

A total of 32 HCPs with varying specialties were included in this investigation, with an average age of 38 years. The interviewees consisted of 8 physicians, 14 nurses, 4 anesthesiologists, and 6 lab technicians. The participants consisted of 14 females and 18 males. Most of them have between 4 and 6 years of experience. Table 2 illustrates the participants' demographic characteristics. Using the content analysis method, we were able to determine four overarching categories related to the barriers and facilitators of BMWM among HCPs: Knowledge of BMWM, attitudes toward BMWM, continuous supervision control and monitoring, and training on BMWM.

Knowledge of BMWM

Having a comprehensive understanding of BMWM procedures and guidelines plays a vital role in helping to adhere to recommended protocols and reducing the risk of hazards among HCPs.

The level of BMWM knowledge was perceived to be adequate. The majority of participants reported that they had the proper knowledge of BMWM's appropriate guidelines and processes:

> *"In our division, we are worried about waste management, and most of us are aware of how to effectively separate the various phases of garbage, as well as how to correctly apply the color-coding system." (P28- Nurse).*

The level of BMWM knowledge was perceived to be variable among the staff. For instance, several participants noted deficiencies in BMWM knowledge among interns and recent graduates from health-related schools:

> *"when we include a new intern who has just graduated, they do not have the appropriate level of understanding. To deliver the correct information, we need to demonstrate to them how to do it and enroll them in related education courses." (P4- Physician).*

Several participants noted that their broad understanding of BMWM could be a result of the comprehensive training and education provided by their respective organizations:

> *"Throughout the course of the year, I have participated in a number of workshops on waste management, during which we have been provided with in-depth information on the meaning of BMWM, the significance of managing waste, and the many approaches to dealing with the various kinds of waste." (P15- anesthesiologist).*

Observing other staff practicing proper BMWM can positively enhance adherence. Some participants indicated that they might acquire an understanding of BMWM via practical experience and by seeing and emulating senior staff members in their department.

> *"the majority of our work is done in teams, the frequent contact and demonstration provided by other members of the department was really helpful to me in gaining an understanding of the significance of waste management" (P31- Nurse).*

Attitudes toward BMWM

Attitudes toward BMWM by HCPs could serve a crucial role in shaping individuals' views and affecting their behaviors. The predominant attitudes towards the implementation of BMWM among HCPs were often raised and extensively discussed. The respondents indicated that some colleagues did not sufficiently appreciate the significance of adhering to BMWM standards and practices.

> *"The way we think about biomedical waste varies among us …there are always a few who don't believe that following at least the basic rules can lower the risk that comes with these kinds of wastes." (P11-lab technician).*

Such variation has been viewed as a challenge to some participants:

> *"While implementing the best practices for biological waste, I think that if you don't have the right attitude, you can have a negative influence on those around you. It can be contagious. It could spread and ruin their work to get people to follow biological waste management rules more closely." (P23- Nurse).*

Additionally, having a role model with more qualifications and experience was an important influential factor. Several HCPs have emphasized that the attitudes of senior doctors and specialists might have a more significant impact on their colleagues:

> *"Hearing staff members with a lot of experience stress how important it is to follow the biomedical waste management rules can have a bigger effect on us. On the other hand, if top specialists play down how important it is to follow the rules, it would harm us." (P27- physician).*

Continuous supervision control and monitoring

One of the recurring themes among the participants was the importance of effective supervision, control, and monitoring in ensuring a safety culture and consistent best practices in BMWM. Although healthcare organizations have implemented pre-mandated standards and policies, some participants expressed concerns about an apparent lack of continuous monitoring:

> *"It is crucial to consistently monitor the management of medical waste, not just in cases where patient safety is at risk or a colleague is injured. Recognizing that this is a daily responsibility, it is important to maintain vigilance in this area." (P29-Anesthesiologist).*

Some HCPs have proposed a method of continuous supervision without having fear of discipline such as implementing a peer monitoring system to ensure the long-term sustainability of supervision and monitoring:

> *"I believe that having a supervisor who is close to us, one that we see on a daily basis and with whom we feel comfortable talking, will be beneficial in the process of establishing a culture that adheres to the management of medical waste. Additionally, having a colleague who is knowledgeable and has experience in waste management working as a peer supervisor can be effective in maintaining a process that is both successful and continuous." (P14- Lab technician).*

Training on BMWM

Most hospitals require HCPs to possess knowledge of the BMWM Rules to ensure efficient operations. Thus, it is important to convey and educate facility staff on these rules. Healthcare staff must possess a comprehensive understanding of the regulations and protocols that govern the BMWM. HCPs should also be familiar with the procedures for segregating waste at its origin, storing it on-site, disinfecting it, and transferring it to the designated disposal place. The majority of the participants said that they have knowledge of current regulations and standards. Nevertheless, several individuals expressed that they had not been given enough instruction about the specifics of the BMWM procedure.:

> *"it was generic. It is not the detailed instruction on how to disinfect, the life cycle method for biomedical waste management, the segregation of biomedical waste, or collection and transportation that is being discussed." (P3- Nurse).*

Other HCPs have indicated that certain training courses might be repetitive due to having the same content and might benefit from being interactive and including more practical, hands-on activities:

> *"We have training classes with an excessive amount of information and instructions but little opportunity to put what we've learned into practice. I think that applying what we learn will help to make the knowledge stick." (P24- Physician).*

Discussion

This Study investigated the facilitating factors and barriers to the effective BMWM among HCPs employed at several hospitals in Riyadh, Saudi Arabia. We found that most participants focused on four primary themes

that pertain to the challenges and problems related to BMWM among HCPs (Table 2).

Knowledge of BMWM

In the current study, most participants indicated having sufficient knowledge to practice proper BMWM. These findings align with the results of previous research in the Al-Ahsa region in Saudi Arabia revealed that the majority of participants exhibited a high level of BMWM knowledge, ranging from excellent to good. However, roughly a quarter of the participants were identified as having low BMWM knowledge [25]. Another study conducted in the Aseer Region of Saudi Arabia indicated that healthcare workers demonstrated a sufficient understanding of infection control measures [26]. Other international studies have shown that most participants agreed on the significance of effectively separating medical waste during its creation and applying a system of color coding. Additionally, participants demonstrated a high level of knowledge regarding the management of medical waste [27]. However, other studies noted that HCPs often lack awareness and knowledge of the repercussions of inadequate waste segregation [28]. These differences in the reported BMWM knowledge could be an indication that specific challenges may be associated with either the person or the organization level. Thus, more research is required to identify the root cause and find appropriate solutions.

In our study, many participants stated that they gained a deep understanding of BMWM through the extensive training offered by their organizations. Other participants stated that they acquired the necessary knowledge through hands-on experience, observing and imitating senior staff members in their department. The literature has emphasized the need for comprehensive training in BMWM. For example, a study indicated that HCPs were expressing the need for frequent training sessions to improve the abilities and knowledge of hospital personnel in managing infections. Furthermore, further research has highlighted the need to provide waste management training to HCPs as a means of enhancing their practices [26]. Specifically, participants highlighted several concerns regarding waste segregation at the point source, collection methods, transportation, storage facilities, disposal practices, and the lack of PPE [27].

Several participants noted the lack of BMWM knowledge among interns and newly graduated HCPs. The literature provided evidence that corroborated these views. According to the findings of one research, medical school students and graduates might lack the proper knowledge about the BMWM standards that should be followed for effective waste management [28]. In another study, it was shown that 50% of the participants had an adequate understanding of color coding about waste segregation [29]. From the findings of another research, it was shown that the majority of dentistry and medical students had not received any guidance in BMWM [30]. Other research revealed that the findings indicated a deficient level of understanding and awareness about the risks, regulations, and handling of biological waste among senior medical and nursing students. One study determined that only 8% of final-year students had a good knowledge of infectious waste produced by healthcare facilities, but a staggering 92% exhibited a lack of expertise in this area [31].

Attitudes of HCPs

We observed that several participants expressed that certain coworkers did not adequately appreciate the importance of adhering to BMWM standards and procedures. There have been many studies that have investigated the differences in the levels of attitudes held by healthcare staff. The results of a research that was conducted using a cross-sectional design revealed that, among the many groups that were investigated, the cleaning staff had the highest overall scores for attitudes toward the disposal and management of waste, exceeding both the doctors and the lab technicians [32]. A recent research study found that the majority of participants, 73.1%, had a favorable attitude toward BMWM, while the remaining 26.9% held a negative attitude. Physicians and nurses demonstrated the greatest degree of positive attitudes, with 89% and 78% respectively [33]. At a tertiary-level healthcare institution in India, a study revealed that physicians showed greater support for the implementation of measures to ensure proper BMWM, in comparison to nurses and other healthcare personnel [34]. Another study found that healthcare professionals have varying perspectives on the safe handling of BMW. Specifically, laboratory technicians expressed more concern about BMW compared to nurses, physicians, and housekeeping staff [25]. Additionally, in our study, several participants highlighted that the attitudes of senior physicians and experts have a greater influence on their colleagues. Other research has also demonstrated a positive correlation between the participants' degree of attitude and the years of experience they have [35]. The findings may be attributed to the fact that HCPs who have more professional experience are exposed to and deal with many different situations and experiences, which in turn enhances their attitude towards BMWM [36, 37].

Continuous supervision control and monitoring

A number of participants in our research had concerns with the lack of effective BMWM supervision and ongoing monitoring. Additionally, some participants proposed the implementation of a peer monitoring system to ensure ongoing supervision and monitoring in the

future. Efficient and effective hospital waste management depends on diligent and skilled staff, who must also be regularly monitored [38]. Additionally, every hospital is required to maintain an atmosphere that is free of any pathogens [39]. Therefore, it would be necessary to conduct regular assessments of the procedures that are used for waste disposal in hospitals, and ensuring the safety of the personnel may be achieved via ongoing capacity development and fostering a shift in attitude [40]. Moreover, implementing continuous BMWM supervision and monitoring may enhance the motivation of healthcare personnel, leading to improved productivity and timely completion of tasks [41]. Consistent monitoring of healthcare personnel could yield positive outcomes and advancements in the control of infectious waste inside the hospital [21]. Thus, hospitals must prioritize the execution of the waste management strategy to prevent potential health and environmental risks [42].

Training on BMWM

Training is crucial for healthcare workers to ensure effective BMWM. HCPs must possess knowledge of the correct procedures for handling, cleaning, and wearing PPE. This includes understanding when to use different types of PPE, as well as the necessary techniques for donning, doffing, and changing them. Adhering to these protocols is crucial to prevent contamination. These processes and regulations must be implemented in every healthcare organization [43].

We found most participants expressed that they have derived benefits from the training offered by their organization. The literature has effectively demonstrated the importance of providing training to HCPs. A study has shown that training can have a positive impact on the knowledge, practices, and efficiency of HCPs in waste management, while also increasing their confidence [44]. However, in our study, some participants have proposed that certain training courses are repetitive and may be improved by including interactive components and providing more practical, hands-on activities. This may be one of the reasons for the decrease in the number of participants in these training sessions. According to an observational study, a significant portion of the respondents (35%) did not participate in waste management practices [44]. In another study, only 35.2% of HCPs have received training in BMWM [43]. A study conducted in the Aseer Region of Saudi Arabia found that healthcare professionals in the area have limited training in proper methods and standards for disposing of BMW and using PPE [44]. The lack of training may be ascribed to several constraints, including technical impediments such as inadequate facilities, resources, inter-professional disagreements, excessive workloads, and monetary constraints [45]. Thus, It is imperative that healthcare organizations ensure that all HCPs receive adequate training regarding the appropriate use, disinfection, and donning of PPE.

Strengths and limitations

The study presents some limitations which deserve consideration. First, the primary author facilitated the interviews, which might introduce some bias as the primary author also played a crucial part in coding and analyzing the interview transcripts. Consequently, the principal investigator's pivotal role in both the study and the qualitative evaluation introduces the potential for researcher bias. To reduce the likelihood of bias, we engaged a second researcher without prior connections to the study participants to aid in data interpretation and analysis. Second, Due to the qualitative nature of our study and the limited number of participants, we must exercise caution when generalizing the results. Finally, this study employed a qualitative methodology due to its exploratory nature. Contextual bias and issues with data processing and presentation are inherent characteristics of qualitative research. Despite these limitations, we gained significant insights into the barriers and facilitators encountered by HCPs to effective handling of BMW.

Conclusion

In light of our findings, we recommend assessing the BMWM knowledge and attitudes among HCPs, particularly those with limited experience, including interns and recent graduates. well-designed and comprehensive training programs must be conducted to increase HCP's knowledge, attitudes, and teamwork dynamic to collectively improve BMW adherence. In addition, authorities must implement timely and effective surveillance measures, along with regularly conducting training sessions for healthcare professionals and support staff. The MOH in Saudi Arabia has developed and distributed regulations and guidelines that are applicable to the BMWM system. It is important for healthcare personnel to follow the BMWM guidelines at the organizational and institutional level, regardless of their age, position, or level of expertise. In order to maintain a high level of expertise in the field of BMWM principles, it is important for hospitals to provide regular training sessions to their staff. This will help to ensure that individuals stay up-to-date and proficient in their knowledge and application of these principles given using a valid and reliable tool to assess HCP regularly. It is important for patients and communities to have a clear understanding of waste management systems in order to minimize the risk of infections and environmental hazards.

Author contributions

SA and MA wrote the main manuscript text and SA reviewed the manuscript.

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Data will be available by the author upon reaonsbl request.

Declarations

Consent for publication
I give my consent for the publication of identifiable details to be published in the Journal.

Competing interests
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