

Evaluation of Healthcare Professionals' Ability to Manage Biomedical Waste in Saudi

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Abstract - Mishandling of biomedical waste has, and will continue to be, a serious threat to the health of medical professionals and the general population. The goal of this research was to identify and evaluate the knowledge, attitudes, and behaviors of persons involved in biomedical waste management. A cross-sectional approach was adopted for this investigation. Research was done at several medical facilities in Riyadh City, Saudi Arabia. Health workers in Riyadh City, Saudi Arabia, were the study's population. There were 140 total healthcare professionals that took part in the research. Structured questionnaire was used to gather Quantitative data and analyzed using descriptive statistical methods guided by the Statistical Package for Social Sciences (SPSS) version 20. According to the results, almost all (96.5%!) healthcare personnel are aware that poor biomedical waste management might pose health risks. Nearly all respondents (97.1%) agreed that environmental issues were caused by improper handling of biological wastes. According to the survey, 73.2 percent of respondents said that cremation and throwing biomedical waste into trash cans were the most common ways to dispose of such materials. The findings showed that most employees (80.3%). had not gotten proper training on how to handle biological waste. Saudi health care personnel in Riyadh City, Saudi Arabia, have a favorable attitude and perspective toward efficient management of health care waste, however they have poor practice when it comes to biological waste. There is a pressing need in Saudi Arabia to establish a unified framework for the collection, transportation, treatment, and disposal of biomedical wastes.

Keywords - Biomedical wastes, hazardous, health, workers, Saudi , knowledge.

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INTRODUCTION

Health care institutions, both public and private, as well as human safety, environmental, and law enforcement organizations, have lately begun to express significant concern about the proper disposal of biomedical waste. The term biomedical waste (BMW) means "any waste generated during diagnosis, treatment, or immunization of human beings or animals or in research activity pertaining to or in the production or testing of biological or in health camps" [1]. Every healthcare institution must have a system in place for handling biomedical waste if patient health and environmental sustainability are to be prioritized. As per government requirements, any health institution, major medical institute, or small clinic must guarantee adequate biological waste management. In this context, "health care facility" (HCF) refers to any establishment, big or little, dedicated to the diagnosis, treatment, or immunization of human beings. Private

facilities range from huge corporate hospitals to minor clinics, while public facilities span from district hospitals to sub-district hospitals to community health centers to primary health centers to sub-centers [2]. Nosocomial infections, illnesses, and harmful effects on the environment may all originate in HCFs [3, 4].

Regulatory framework for BWM is often lacking at the national level. When it comes to biomedical waste management (BMWM) regulations, India was an early adopter . The "Bio-medical Waste Management and Handling Rules" were first announced in July 1998 by the Ministry of Environment and Forest under the Environment Protection Act, 1986 [5]. India's hospitals still have not reached the targeted BMWM criteria after a decade of implementation [6]. On March 28, 2016, the Ministry of Environment, Forest, and Climate Change announced the updated guidelines, which

may be referred to as BMW Rules 2016. [7]. New regulations for 2016 regarding the disposal of biomedical waste - BMW classifications and available therapies are laid out in color-coded detail in Schedule 1. Biomedical waste management regulations are outlined in Schedule 2. Labels for biomedical waste bags or containers are described in Schedule 4, and a list of specified authorities and their responsibilities are described in Schedule 3.

RESEARCH METHODOLOGY

- **Study Area**

Hospitals, health clinics, and dispensaries in Riyadh urban were the sites of the research. Government, non-governmental organizations, and a rising number of Health Centres, commercial clinics, and pharmacies all contribute to the city of Riyadh's health care infrastructure. To combat rising rates of maternal and infant mortality and HIV/AIDS transmission, the city operates mobile clinics, which are often active during local and national immunization programs.

- **Study Design**

A cross-sectional design with a quantitative approach was adopted for this investigation. Research started in August of 2022.

- **Study Population**

A population is the whole collection of cases from which a sample is drawn for in-depth research.

- **Sampling Procedure and Sample Size**

The sampling process for this investigation consisted of many stages. The first step is the selection of 12 health care institutions using a simple random sample method that does not include any replacements. Stage 2: Selection of 146 healthcare professionals using a straightforward random sample method, with no replacements made.

- **Type of Data**

Primary data was gathered from the study's participants using questionnaires. Primary data were collected by interviewing staff members at the participating institutions.

- **Ethical Clearance**

Before beginning data collecting in the field, permission to perform the research was requested from OUS. Authorization was also secured from DMO and the facility administrators prior to the start of the research. Request for permission to participate in the research was also obtained from the possible

participants. Participants in the surveys were told that their responses would remain confidential and that the data gathered would be used only for research. Since the researcher had no involvement with or exposure to the biological waste, communication with the responders was also made safer.

- **Data Collection Methods**

The questionnaire was pilot tested on health care professionals drawn from the research population prior to data collection to gauge how well the questions were comprehended by the study's intended respondents. Through piloting, we were able to hone the survey's questions.

- **Data Analysis**

All of the information gathered for this research was classified, categorized, and ranked according to the replies' emerging categories. Data was entered into SPSS version 20 (IBM Corp., Armonk, NY) for statistical analysis. Descriptive statistics, such as frequency and percentage distributions, and inferential statistics, such as the Chi-square test for significance, were used to draw conclusions about the data.

RESULTS

Rate of Reaction:

Only 140 (94.7%) of the originally planned 150 health care professionals (50 from hospitals, 50 from health centers, and 50 from dispensaries) were really available to participate in the study. Eighty from clinics and health centers, forty from hospitals, and forty from dispensaries.

Personal Information Provided by Respondents:

Table 1 shows that out of the total number of healthcare institutions, data was obtained from 60 (42.8%) health centers, 40 (28.2%) hospitals, and 40 (28.2%) dispensaries. Of the respondents, 45 (30.3%) had less than one year of work experience, 43 (30.3%) between six and ten years, 25 (17.6%) between eleven and twenty years, and 17 (12.0%) or more than twenty years.

The gender analysis of the responses revealed that female workers were the majority, that is 88 (62.0%) and men were 52 (37.01%). One person (0.7%) was found to be 19 or younger, 75 (53.5%) were found to be 20-29 years old, 32 (22.5%) were found to be 30-39 years old, 17 (12.0%) were found to be 40-49 years old, and 15 (10.6%) were found to be 50 or older.

There were a total of 150 responders; 50 (35.7%) were nurses, 40 (28.1%) were pharmaceutical

workers, 32 (22.5%) were clinicians (MD, AMO, CO), 16 (11.3%) were laboratory workers, and 2 (1.4%) were cleaners. “There was one responder with a graduate degree (0.7%); 69 with a diploma (48.6%); 32 with an undergraduate degree (22.5%); 28 with an undergraduate certificate (19.7%); 6 with a secondary degree (4.2%); and 4 with a basic degree (2.8%).

Table 1. Participants' Socio-demographics in the Research Sample

Demographic characteristic	Valid	Frequency	Percent	Valid Percent	Cumulative percent
Health facility category	Hospital	40	28.2	28.2	28.2
	Health center	60	42.8	42.8	71.8
	Dispensary	40	28.2	28.2	100.0
	Total	140	100.0	100.0	
Gender of HCW	Male	52	37.1	37.1	38.0
	Female	88	62.0	62.0	100.0
	Total	140	100.0	100.0	

HCW age group	19 or below	1	0.7	0.7	0.7
	20-29	75	53.5	53.5	53.8
	30-39	32	22.5	22.5	77.5
	40-49	17	12.0	12.0	89.4
	50 or above	15	10.6	10.6	100.0
	Total	140	100.0	100.0	
HCW field work	Clinicians (MD, AMO, CO)	32	22.5	22.5	22.5
	Nurses	50	35.7	35.7	58.2
	Pharmaceutical personnel	40	28.2	28.2	87.3
	Laboratory personnel	16	11.3	11.3	98.6
	Cleaners	2	1.4	1.4	100.0
	Total	140	100.0	100.0	

Higher education for HCW	Primary school	4	2.8	2.8	2.8
	Secondary school	6	4.2	4.2	7.0
	Certificate	28	19.7	19.7	26.8
	Diploma	69	48.6	48.6	75.4
	Graduate	32	22.5	22.5	99.3
	Postgraduate	1	0.7	0.7	100.0
	Total	140	100.0	100.0	
Years of HCW work experience	Less than 1 year	45	31.7	31.7	31.7
	1-5 years	43	30.3	30.3	62.0
	6-10 years	25	17.6	17.6	79.6
	11-20 years	10	7.5	7.5	88.0
	Above 20 years	17	12.0	12.0	100.0
	Total	140	100.0	100.0	

• **Evaluation of the Respondents' Expertise:**

The findings in Table 2 below reveal that, 135 (95.5%) of health care personnel were aware that incorrect waste management produces different health dangers,” 3 (2.1%) replied No and 2 (1.4%) did not know improper waste management causes health hazards or not.

One hundred and one respondents (71.1% of the total) indicated that the government of Saudi Arabia offered rules for the treatment of biological waste; nine respondents (6.7% of the total) responded no; and thirty respondents (21.1%) did not know.

Of the respondents, 55 (38.7%) said that biomedical wastes were disposed of by dumping them directly into garbage cans, 49 (34.5%) said that the waste was incinerated, 22 (15.9%) said that they were given to garbage collectors, and 14 (9.9%) said that the waste was given to a biomedical waste management (BMWM) company. “Sixty-four percent (64%) of respondents noted that it was required to keep records of biomedical waste (BMW) at their health care institutions, whereas twenty-five percent (14%) reported that no such records were maintained. Only three people out of 137 (2.1%), however, were uninformed that poor waste management may harm the environment.

Table 2. A Review of the Health Care Professions' Common Body of Knowledge

Knowledge assessment	Valid	frequency	Percent	Valid percent	Cumulative percent
Can incorrect waste management harm health?	Yes	135	95.5	96.5	96.5
	No	3	2.1	2.1	98.6
	Don't know	2	1.4	1.4	100.0
	Total	140	100.0	100.0	
Does the Tanzanian government give guidelines for BMWM?	Yes	101	71.1	71.1	71.1
	No	9	6.7	6.7	78.9
	Don't know	30	21.1	21.1	100.0
	Total	140	100.0	100.0	

How does your hospital dispose of BMW?	Dump directly into garbage bins	55	38.7	38.7	38.7
	Handing it over to garbage collectors	22	15.9	15.9	55.6
	Handing it over to BMWM agency	14	9.9	9.9	65.5
	Incineration	49	34.5	34.5	100.0
	Total	140	100.0	100.0	
Does your hospital need BMW records?	Yes	92	64.8	64.8	64.8
	No	20	14.5	14.5	80.3
	Don't know	28	19.7	19.7	100.0
	Total	140	100.0	100.0	

Can inappropriate waste management harm the environment?	Yes	137	96.9	96.9	97.9
	No	3	2.1	2.1	100.0
	Total	140	100.0	100.0	

• **Evaluation of Health Care Workers' Attitudes:**

Data from 129 respondents (90.8%) shows support for safe handling of biological waste, whereas 11 respondents (8.2%) express opposition. A total of 116 (81.7%) of the respondents indicated safe

management of health care waste is the duty of government and 24 (17.3%) answered it is not for the government to control waste.” There were 111 yes votes (78.6%) and 29 no votes (20.4%) on whether or not trash management is a team sport. On the topic of whether or not safe management efforts by hospitals add to the financial burden on management, 86 respondents (61.0%) replied no, while 54 (38.0%) said yes. “Safely disposing of medical waste was seen as an additional hardship by 121 (85.2%) respondents but not by 21 (14.8%).

Table 3. A Review of the Research on the Attitudes of Health Care Professionals

Attitude assessment	Valid	Frequency	Percent	Valid percent	Cumulative percent
Safely managing health care waste is not a concern?	Yes	11	8.2	8.2	8.2
	No	129	90.8	90.8	100.0
	Total	140	100.0	100.0	
Is the government responsible for safe waste management in healthcare?	Yes	24	17.3	17.3	17.3
	No	116	81.7	81.7	100.0
	Total	140	100.0	100.0	
Waste management requires teamwork and no one person is accountable for safety.	Yes	111	78.6	78.6	79.6
	No	29	20.4	20.4	100.0
	Total	140	100.0	100.0	
Hospital safe management costs more?	Yes	54	38.0	38.0	38.0
	No	86	61.0	61.0	100.0
	Total	140	100.0	100.0	
Safely managing healthcare waste adds work?	Yes	19	14.8	14.8	14.8
	No	121	85.2	85.2	100.0
	Total	140	100.0	100.0	

• Evaluation of Healthcare Providers' Normative Behavior:

Table 4 below displays the findings, showing that 131 respondents (92.7%) agreed that different colored bags were used to dispose of various wastes, whereas 5 respondents (3.5%) disagreed and 4 (2.8%) were unsure.” A total of 43 (30.3%) respondents reported used disposable plastic goods were disposed of in Yellow bags, 50 (35.2%) in Red bags, 13 (9.6%) in Black bags and 34 (23.9%) claimed they did not know.

Among the respondents, 15.0% claimed blue/white bags were used to dispose of used dressings and impression materials, 43.4% said red bags were used, 21.1% indicated black, and 34.9% were unsure. Among those polled, 103 (72.5%) answered that they disposed of discarded sharps and needles in Safety boxes, 12.4 percent in Red boxes, 6.3% in Yellow bags, and 7.7 percent did not know. Ninety-seven respondents (68.3%) indicated red bags were used to dispose of human tissue and tooth extractions, nine (6.3%) answered yellow bags, five (3.5%) said black bags, and twenty-nine (20.8%) did not know.

“Plaster of Paris (POP) waste disposal was broken down as follows: 55 (38.5%) indicated yellow bags, 28 (20.1%) said black, 2 (14.1%) said red, and 37 (26.1%) claimed they didn't know.

Table 4. Evaluation of Health Care Professionals' Duties in Practice

Practice assessment	Valid	Frequency	Percent	Valid percent	Cumulative percent
Waste produced daily?	0-2Kg	12	8.5	8.5	8.5
	2-4Kg	57	40.1	40.1	48.6
	Above 4kg	71	52.4	52.4	100.0
	Total	140	100.0	100.0	
Does waste segregation occur before disposal?	Yes	124	87.3	87.3	87.3
	No	18	12.7	12.7	100.0
	Total	140	100.0	100.0	
Are various colored bags used for different trash types?	Yes	131	92.7	92.7	92.7
	No	5	3.5	3.5	97.2
	Don't know	4	2.8	2.8	100.0
Total	140	100.0	100.0		

Color of plastic bag used to dispose of catheters?	Yellow bags	43	30.3	30.3	30.3
	Red bags	50	35.2	35.2	65.5
	Black bags	13	9.6	9.6	76.1
	Don't know	34	23.9	23.9	100.0
	Total	140	100.0	100.0	
Soiled dressings and used imprint materials are disposed away in what color bags?	Blue/white bags	15	10.6	10.6	10.6
	Red bags	61	43.4	43.4	54.9
	Black bags	30	21.1	21.1	76.1
	Don't know	34	23.9	23.9	100.0
Total	140	100.0	100.0		
Sharps and needle disposal bags—what color?	Yellow bags	9	6.3	6.3	6.3
	Safety box	103	72.5	72.5	78.9
	Red bags	17	12.4	12.4	92.3
	Don't know	11	7.7	7.7	100.0
	Total	140	100.0	100.0	

Color of bags used to dispose of extracted teeth and tissue?	Yellow bags	9	6.3	6.3	6.3
	Red bags	97	68.3	68.3	74.6
	Black bags	5	3.5	3.5	78.2
	Don't know	29	20.8	20.8	100.0
	Total	140	100.0	100.0	
Color of Plaster of Paris disposal bags?	Yellow bags	55	38.7	38.7	38.7
	Red bags	20	14.1	14.1	52.8
	Black bags	28	20.1	20.1	73.9
	Don't know	37	26.1	26.1	100.0
	Total	140	100.0	100.0	

• Evaluation of Healthcare Providers' Expertise and Practical Experience:

Table 5 shows that inappropriate waste management is associated with a number of

health risks for experienced employees, and this association is statistically significant ($p < 0.05$). The other indices of knowledge status are unrelated to employment history ($p > 0.05$).

Table 5. Chi-Square Analysis: A Brief Overview.

Experience	Knowledge base assessment	Working experience of HCW in years	Highest level of education to HCWs					Total	Chi-square	Df	P value	Decision	
			Yes	No	Don't know	Total	Pri edu						Sec edu
Can incorrect waste management harm health?		Less than 1	44	0	1	45							
		1-5 years	42	1	0	43							
		6-10 years	25	0	0	25							
		11-20 years	9	1	0	10							
		Above 20 years	17	0	0	17							
		Total	137	2	1	140	2.015	8	0.010	Accept			
Does the government give guidelines for BMW?		Less than 1	31	2	12	45							
		1-5 years	26	4	11	42							
		6-10 years	20	0	5	25							
		11-20 years	9	2	1	12							
		Above 20 years	14	2	1	17							
		Total	100	10	30	140	9.921	8	0.271	Reject			
Does your hospital need BMW records?		Less than 1	27	5	13	45							
		1-5 years	24	8	11	43							
		6-10 years	15	7	1	24							
		11-20 years	9	1	2	12							
		Above 20 years	15	1	1	17							
		Total	90	22	28	140	14.639	8	0.067	Reject			
Does inappropriate waste management harm the environment?		Less than 1	43	2	0	45							
		1-5 years	42	1	0	43							
		6-10 years	23	0	0	23							
		11-20 years	12	0	0	12							
		Above 20 years	17	0	0	17							
		Total	137	3	0	140	2.358	4	0.067	Reject			

Evaluation of Health Care Providers' Attitudes Relative to Their Educational Background:

Table 6 shows that there is no statistically significant relationship between education level and attitude evaluation factors related to biomedical waste management.

Table 6. Overview of Chi-Square Analysis Testing the Null Hypothesis of No Substantial Difference in Health Care Workers' Educational Attitudes

Attitude assessment		Highest level of education to HCWs						Total	Chi-square	Df	P value	Decision
		Pri edu	Sec edu	Cert	Dip	Gra	Posgra					
No problem managing health care waste safely.	Yes	1	2	3	6	1	0	13	7.204	5	0.206	Rejected
	No	3	4	24	62	33	1	127				
	Total	4	6	28	69	34	1	140				
Government must safely handle health care waste.	Yes	1	2	8	10	5	0	26	4.188	5	0.523	Rejected
	No	3	4	20	58	28	1	114				
	Total	4	6	28	69	34	1	140				
Keeping our communities safe from waste requires a collaborative effort.	Yes	2	4	21	57	26	1	111	3.433	5	0.633	Rejected
	No	2	2	6	12	7	0	29				
	Total	4	6	28	69	34	1	140				

The cost of hospitals' efforts to ensure patient safety continues to rise.	Yes	1	3	7	31	11	1	54	6.158	5	0.291	Rejected
	No	3	3	21	37	22	0	86				
	Total	4	6	28	69	34	1	140				
The responsibility for the secure disposal of medical waste increases the workload.	Yes	1	0	5	10	3	1	20	7.595	5	0.180	Rejected
	No	3	6	23	58	30	0	120				
	Total	4	6	28	69	34	1	140				

DISCUSSION

Knowledge Evaluation for Healthcare Professionals: The majority of health care personnel in Riyadh, Saudi Arabia, have sufficient understanding about the dangers of inappropriate biomedical waste management to communities and the environment, according to the results of a recent research.

The outcomes of this research suggested that most health professionals in Riyadh displayed good attitudes towards safe handling of biomedical waste. Similar results were found in a research on attitudes toward Hepatitis B virus (HBV) prevention in Ethiopia [8],” who found that, on the whole, participants had positive attitudes toward HBV prevention when prevention was linked to biomedical waste management. On the other hand, research conducted revealed that all hospital managers stated that their operations in regards to healthcare waste management and occupational safety measures had never been exposed to review by relevant government bodies. Everyone who participated in this survey expressed a desire to better protect the health of their employees, patients, and the surrounding community.

All of the participants in this research adhered to universal measures while dealing with biological waste, and their results corroborate those of a comparable study conducted. However, the results of the current study are at odds with those of an Ethiopian study who found that hospital workers had negative attitudes toward BMW and used few safety precautions and waste management tools. The majority of people in Botswana agreed that medical waste should be separated out at the

source. Most multipurpose staff believe that segregating BMW is not an issue and is solely the responsibility of the concerned institution, as well as feeling that safe segregation of BMW is an additional burden at work, and all doctors feel that safe segregation of Health Care waste is an additional burden to their work, which can have negative consequences. A greater risk of infection and harm is associated with healthcare waste than with any other sort of trash, as shown in the current research. It bears repeating that an insufficient and unsuitable approach to managing health care waste may have severe health repercussions and a substantial impact on the environment. Therefore, Saudi typically has to develop positive attitudes, dedication and team effort in combating repercussions associated to ill-effects of health care wastes. From the data, it's clear that hospitals in general generate more trash than clinics of a lower quality.

Shinyanga municipality, Saudi Arabia, was the site of a research [9] showing that, as the number of healthcare institutions has grown, so too have healthcare wastes, posing major hazards to the environment, the health condition of workers, and the general environment.

While this research found that biological waste segregation was performed by many healthcare institutions, appropriate segregation practice was not observed in the vast majority of healthcare facilities. Sharps waste was found along with regular garbage in shared trash cans. The findings are consistent with those who found that in Nigeria, hazardous waste was not collected, segregated, and disposed of properly; there was widespread open dumping of potentially infectious materials; and there were no incinerators to treat waste. This confirms the findings [10] who conducted their own research in Shinyanga municipality and discovered that residents there still have a low level of knowledge about the health concerns associated with improper trash color coding. Another research done in Ethiopia [11] revealed that health care practice scores were inadequate despite their use of proper personal protective gear and waste management procedures. research on the real-world management of biomedical waste in Botswana mirrored the present study, especially with regards to the presence of a color-coding system in the hospitals sampled.

These results are consistent with those of a research conducted in South-Eastern Nigeria by [12] which found that 98.1% of hospitals there engaged in the careless disposal of biological waste. Therefore, it is suggested that standardized techniques, in accordance with national and international criteria, be used for the correct segregation of healthcare waste. . The vast majority of healthcare providers in Riyadh city do not practice proper management of medical waste by not using the designated, color-coded bags. This study's findings did not support hypotheses about

a link between health professionals' biomedical waste management knowledge, attitudes, and behaviors.

The aforementioned results, however, contradict those of a research done in Uganda [13] who found that health professionals' behavior and HCW management procedures were good. The Ugandan result is about respectable knowledge, since there was a statistically significant correlation between the two measures of competence ($p < 0.001$). There is a severe deficiency in knowledge, appropriate attitudes, and practices for efficient BMW management among medical and health care workers, particularly in poor countries like Saudi Arabia, as shown by the many research reviewed in the literature.

CONCLUSION

Medical professionals in Riyadh, Saudi Arabia, have shown a high level of knowledge of the consequences of incorrect health care waste management. A total of 96.5% of health care personnel were aware that inappropriate waste management generates different health dangers and 97.9% were aware that improper waste management causes environmental difficulties. Also, many hospitals were found to rely on the two waste disposal procedures (dumping directly into trash cans and incineration) that pose the greatest threat to patients' health. The most common means of trash disposal were incineration (34.5%) and dumping (32.7%). Together, they accounted for 73.2% of all waste disposal techniques. Some of the medical centers in Riyadh City failed to properly execute waste management guidelines for biological materials. Flyers of various types were discovered with the goal of raising public awareness about the dangers of improperly handling biomedical wastes, but most health professionals were unaware of their presence since they were not posted in all sections of health facilities. It was fascinating to learn that the general mentality and attitude of health care personnel in Riyadh city was one that prioritized the proper disposal of medical waste. According to the results of the studies mentioned above, most healthcare professionals in Riyadh city, Saudi Arabia, did not engage in or exhibit safe management of health care waste. In most cases, they failed to properly utilize the designated color bags.

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