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Knowledge and Awareness Regarding Hazardous Waste Management Among Healthcare Workers in a Secondary Care Hospital in Riyadh, Saudi Arabia

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Abstract

Background: Health care waste management constitutes one of major public health concerns of modern health care. Since the healthcare workers are at the forefront of the waste generation, their knowledge on its management and hazard prevention is a major determinant of safe handling practices and effective infection control. ***Methodology:*** Present study has been conducted as a cross-sectional study among a convenient sample of health care workers, in King Salman Hospital Riyadh (N=131), during July-August 2024. A self-administered questionnaire was used to collect the quantitative data, in both English and Arabic language. The questions were asked under three main domains of the waste management; segregation, transportation and hazard prevention. ***Result:*** Out of total 133 study participants, majority of our study participants were nursing staff (77%, 103/133), in the age group of 31-40 years (54%, 72/133) and been working at our hospital for 2-5 years (46%, 61/133). For the survey items, the positive responses ranged from 72%-98%, 81-96% and 81-100% among the segregation, transportation and hazard prevention domains respectively. ***Conclusion:*** We have observed a high level of knowledge and awareness regarding hazardous waste management among healthcare workers, reflecting the efforts taken for continuous capacity building.

Keywords: Bio-medical Waste Management, Knowledge, Awareness, Healthcare workers, Saudi Arabia.

INTRODUCTION

Healthcare waste (HCW) is defined as any type of waste produced during the diagnosis, treatment, or research involving humans and/or animals [1]. According to the World Health Organization (WHO), only 15% of the waste produced during healthcare activities is classified as hazardous waste, which includes waste such as human anatomical parts, blood, tissues, radioactive waste, toxic chemical drugs, and broken medical equipment. The remaining 85% of the waste is classified as non-hazardous, similar to household waste [2]. Hospitals, clinics, medical schools, research institutes, and veterinary hospitals are among the places where Biomedical Waste (BMW) is commonly produced [3].

The volume of waste generated in healthcare institutions worldwide has significantly increased due to advancements in medical treatment and the emergence of more advanced technology. Globally, rate of generation of medical waste has been estimated to as low as 0.2 kilograms per bed per day for low-income countries as high as 0.9 kilograms bed per day for high income countries [2] while it has been estimated to be 1.66 kilograms of healthcare waste per bed per day in Saudi Arabia (KSA) [4]. According to the World Health

Organization, approximately 16 billion injections are administered annually for medical care or vaccinations [5]. Unfortunately, not all used syringes and needles are disposed of according to safety rules and regulations, increasing the likelihood of needle-stick injuries and infection. Furthermore, this provides opportunities for recycling [5]. The COVID-19 pandemic has made healthcare waste management more challenging. This is because there has been an increase in infectious waste production, recycling strategies have been disrupted, and there are insufficient resources to cope with the increased waste production [6].

Healthcare workers (HCWs) who provide daily patient care and other healthcare-related tasks play a crucial role in managing healthcare waste [7]. These healthcare providers are categorized as including general practitioners, specialists, nurses, midwives, alternative medicine practitioners, pharmacists, physiotherapists, and others [8]. According to WHO, there are several reasons for the failure of waste management systems, including the lack of legislation and regulations related to waste management systems, insufficient knowledge about the health risks associated with managing healthcare waste (HCW), lack of skilled healthcare workers, and inadequate financial and human resources [2]. The knowledge about the Healthcare waste management, has been reported to be diverse from different region of Saudi Arabia. For instance, in a study conducted among health care personnels, including four regions of Saudi Arabia, a moderate level of knowledge has been reported, for the bio-medical waste management [9]. Considering the significance of this important public health concern, present study had been taken with the following aims and objectives.

Aims & Objectives

1. To assess the knowledge and awareness about different component of hazardous healthcare waste management among healthcare workers.
2. To determine association between the knowledge and awareness with selected socio-demographic factors.

METHODOLOGY

Study Design & Setting

A cross-sectional study was conducted during July-August 2024, among the health care workers in at King Salman Hospital, which is a secondary care public hospital in Riyadh, Saudi Arabia. The hospital provides services across all the major medical and surgical specialities including some of the super speciality services.

Study Population and Sampling

The study population includes all the healthcare workers at King Salman Hospital including doctors, nurses, medical staff and waste management staff. The inclusion criteria was any healthcare worker who consent to participate and has been working at this hospital since not less than six months. The sample size was selected using the convenient sampling, including the number of staff completing the survey during study period.

Data Collection

For this study, the data was gathered through the administration of a self-administered questionnaire. The questionnaire consisted of sections on socio-demographic characteristics, items related to segregation, transportation and hazard prevention pertaining to biomedical waste. The survey instrument was disseminated through online mode. The survey was conducted both in English and Arabic, and a pilot study was conducted on a small sample of healthcare workers to test the clarity, understanding, and suitability of the questions.

Data Analysis

The data was collected and was analysed using the Statistical Package for the Social Sciences software (IBM-SPSS 21). The Descriptive statistics are presented as frequencies and percentages. Inferential statistics like chi-square tests was used to compare the participants' socio-demographic characteristics, knowledge, practices, and attitudes. A value of 0.05 was used as cut-off to set the statistical significance.

Ethical Considerations

All the participants in the study were required to give their informed consent before participating in the study. To ensure anonymity and cover the identity of the participants, none or personal identification data was collected using the questionnaires. Participants were assured of the confidentiality of the data collected.

RESULT

Socio-demographic information of the study participants

Table 1 shows the basic information about the study participants. The final analysis included 133 study participants. As shown in the table, the majority of our study participants were nursing staff; 77% (103/133), in the age group of 31-40 years; 54% (72/133) and been working at our hospital for 2-5 years; 46% (61/133).

Table 1: Socio-demographic information of the study participants (N=133)

Socio-demographic variables		Frequency	Percent (%)
Profession	Doctor	6	4.5
	Medical staff	10	7.5
	Non-medical staff	5	3.8
	Nurse	103	77.4
	Waste management staff	9	6.8
	Total	133	100.0
Age	21-30 years	41	30.8
	31-40 years	72	54.1
	41-50 years	16	12.0
	51-60 years	3	2.3
	less than 20 years	1	0.8
	Total	133	100.0
Years of experience	10-15 years	27	20.3
	2-5 years	61	45.9
	5-10 years	28	21.1
	more than 15 years	17	12.8
	Total	133	100.0
Department	ER	23	17.3
	Medicine ward	7	5.3
	Ob-Gynae ward	13	9.8
	Operation Theatre	6	4.5
	Others	67	50.4
	Outpatient Departments	3	2.3
	Surgical ward	14	10.5
	Total	133	100.0

Knowledge about Biomedical waste segregation

Table 2 shows the knowledge about biomedical waste segregation among the study respondents. As shown in the table, a great majority 97% (129/133) of our study participants were aware that the hazardous waste materials are segregated in different color-coded bags. Almost all of them 99% (132/133) were aware of the healthcare waste management system in the hospital. About 98% (130/133) of the respondents knew that needles, scalpels, and broken glass were disposed of in puncture-resistant plastic containers. About 89.5% (119/133) of the respondents considered expired and used medications as hazardous healthcare waste. The lowest proportion of positive responses were noted for awareness regarding use of autoclaving for pre-treatment of hazardous waste before disposal 74% (98/133), correct identification begs for disposal of tissues, human organs, foetuses, and placentas 73% (97/133) and proper disposal of the liquid waste 61% (81/133).

Table 2: Knowledge and awareness about the hazardous waste management among study participants (N=133)

Items	Yes	%	No	%	Don't know	%
Waste segregation						
Are hazardous healthcare waste bags and containers distinguished by approved colours (yellow and red) in the hospital?	129	97%	3	2%	1	1%
Is there a hazardous healthcare waste management system in the hospital?	132	99%	1	1%	0	0%
Are needles, scalpels, and broken glass disposed of in puncture-resistant plastic containers?	130	98%	3	2%	0	0%
Are expired and used medications considered hazardous healthcare waste?	119	89%	6	5%	8	6%
Are tissues, human organs, foetuses, and placentas disposed of in red bags?	97	73%	24	18%	12	9%
Are liquid chemical wastes disposed of in the hospital's sewage system?	81	61%	30	23%	22	17%
Is the preliminary treatment of highly infectious hazardous waste from bacterial cultures done using an autoclave in the hospital?	98	74%	12	9%	23	17%

Items	Yes	%	No	%	Don't know	%
Waste Transportation						
The hazardous healthcare waste worker uses personal protective equipment and specialized clothing when handling it at all stages?	128	96%	2	2%	3	2%
Is the hazardous healthcare waste replaced when it reaches the allowed fill level of 3/4?	124	93%	2	2%	7	5%
Are there dedicated elevators for hazardous healthcare waste in the hospital?	114	86%	10	8%	9	7%
Is the hazardous healthcare waste transported in specialized carts that carry the biohazard symbol to storage areas in the hospital?	129	97%	2	2%	2	2%
Are there temporary storage rooms dedicated to hazardous healthcare waste in the hospital?	108	81%	7	5%	18	14%
Is there a company assigned to transport hazardous healthcare waste from the hospital?	117	88%	1	1%	15	11%
Biomedical waste hazard prevention						
Does wearing personal protective equipment reduce the risk of infection?	133	100%	0	0%	0	0%
Is an annual medical examination conducted at the hospital?	110	83%	12	9%	11	8%
Have you been vaccinated against Hepatitis B?	128	96%	3	2%	2	2%
Are tetanus vaccinations administered after exposure to needle stick injuries in the hospital?	119	89%	7	5%	7	5%
Is there a system for reporting needle stick injuries and accidents, and for recording occupational injuries in the hospital?	130	98%	2	2%	1	1%
Are there tools available for handling spills of waste materials in the hospital?	132	99%	1	1%	0	0%
Are there written policies and awareness posters for handling hazardous healthcare waste in the hospital?	131	98%	1	1%	1	1%
Have you ever attended a training course on handling hazardous healthcare waste?	107	80%	25	19%	1	1%

Table 5: Association between knowledge of biomedical waste management and selected socio-demographic factors

Knowledge Component	Socio-demographic variable*			
	Profession	Age	Years of experience	Department
Are hazardous healthcare waste bags and containers distinguished by approved colours (yellow and red) in the hospital?	p=0.005	p=0.445	p=0.253	p=0.233
Is there a hazardous healthcare waste management system in the hospital?	p=0.99	p=0.688	p=0.756	p=0.567
Are needles, scalpels, and broken glass disposed of in puncture-resistant plastic containers?	p=0.925	p=0.738	p=0.667	p=0.181
Are expired and used medications considered hazardous healthcare waste?	p<0.001	p=0.344	p=0.003	p=0.103
Are tissues, human organs, fetuses, and placentas disposed of in red bags?	p<0.001	p<0.001	p=0.004	p=0.033
Are liquid chemical wastes disposed of in the hospital's sewage system?	p=0.184	p=0.431	p<0.001	p=0.675
Is the preliminary treatment of highly infectious hazardous waste from bacterial cultures done using an autoclave in the hospital?	p=0.094	p=0.787	p=0.89	p=0.086

*tested through chi square test.

Knowledge regarding Biomedical waste transportation

As shown in the table 2, about 96% (96/133) of our respondents were aware about personal protective equipment to be worn while handling at all stages of waste management. About 93% of the study participants were aware that the hazardous waste is to be replaced once it has reached the fourth fill level. About 86% (114/133) of the study participants were aware that there are dedicated elevators for hazardous healthcare waste in the hospital. About 93% (124/133) of the respondents were aware that the hazardous healthcare waste was transported in specialized carts that carry the biohazard symbol to storage areas in the hospital. About 81%

(108/133) of healthcare workers in our study were aware that there is temporary storage rooms dedicated to hazardous healthcare waste in the hospital. Similarly, about 88% (117/133) were aware that there is a there a company assigned to transport hazardous healthcare waste from the hospital.

Knowledge regarding Biomedical waste hazard prevention

As shown in the table 2, all of our respondents 100% (133/133) were aware that wearing personal protective equipment reduces the risk of infection. Almost all of our respondent 96% (128/133) were vaccinated against hepatitis B. About 82.5% (110/133) of respondents were aware that an annual medical examination was conducted at the hospital. About 89.5% (119/133) knew that tetanus injections are administered after the needle stick injury. About 97.7% (130/133) of the study respondents were aware that there is a system for reporting needle stick injuries and accidents, and for recording occupational injuries in the hospital. Almost all of our study participants were aware of the availability of the tools for handling spills of waste materials in the hospital. About 98.5% (131/133) of the respondents were aware of the written policies and awareness posters for handling hazardous healthcare waste in the hospital.

Association between knowledge of biomedical waste management and selected socio-demographic factors.

Largely, there was no significant difference observed between the awareness and socio-demographic factors, however, the professional class of the participant was observed to be significantly associated with awareness of colour coded bags ($p<0.05$), expired and used medications as hazardous healthcare waste ($p<0.05$) and correct identification of disposal bags for tissues, human organs, foetuses, and placentas ($p<0.05$) as shown in table 3. Similarly, work experience was observed to be significantly associated with expired and used medications considered hazardous healthcare waste ($p<0.05$) and disposal bags for tissues, human organs, foetuses, and placentas ($p<0.05$)

DISCUSSION

Present study has been conducted in a secondary care public hospital in Riyadh, Saudi Arabia, targeting healthcare worker who directly or indirectly involved with patient care, aiming to evaluate HCW's awareness, compliance, and perceptions regarding management of hazardous healthcare waste across the study facility. Majority (about three- fourth) of our sample size consisted of nursing staff. Overall, we observed a high level of knowledge regrading different components of waste management. A great majority were aware about most of the component of segregation, transportation and hazard prevention. However, there were certain aspects where its knowledge level was relatively low. The specific items for which relatively low level of awareness was observed included proper disposal of liquid waste, segregation of tissues/human organs/foetuses/placentas and awareness towards pre-treatment of bacterial cultures through autoclave.

Our findings are corroborated with a study conducted among healthcare workers in Al Ahsa region, whereby, about 85% healthcare staff were reported to be have excellent and high knowledge level regarding healthcare waste management [10]. However, this study was conducted during COVID-19 epidemic period [10]. Similarly, a good level of knowledge about bio-medical waste management has been reported in a study conducted among dentists, dental students and auxiliary Staff from different cities and town in Saudi Arbia [11]. Another study which was conducted across four regions of Saudi Arbia, has reported moderate level of knowledge among healthcare staff [9].

In a study conducted among the healthcare workers, who dealt with bio-medical waste management, in the primary health care centres, only about 55% of the participants had good knowledge about bio-medical waste management [12]. A similar survey carried out in northern Saudi Arabia revealed that only 47% study respondents had adequate knowledge of Biomedical waste management [13]. The high level of knowledge among our respondents might be explained by the fact that majority of our study participants were nursing staff, who are primarily responsible for the overall supervision of the infection control practices in their respective wards/patient care area. Moreover, since nurses are the largest group of employees in hospitals, they usually show a better understanding of waste management than other healthcare staff. This might be attributed to the fact that they are more involved directly in patient care thus needing to have detailed information concerning waste disposal [14].

These disparities of knowledge among regions within Saudi Arabia could indicate variations in the training programs, the existence of effective implementation of the regulations, or differences in organizational culture account for a gap in the knowledge of healthcare workers on waste management practices.

Limitations

This was cross-sectional study was carried out in a single public hospital in Riyadh; therefore, the results cannot be generalized to other healthcare facilities or areas. It could be that this hospital which was the study setting had certain resources, policies, and culture that impacted the study findings. HCWM may also differ between regions and between public and private healthcare institutions, which may influence the practices and available resources in each setting.

Secondly, the use of questionnaires as a means of data collection may lead to social desirability bias. It is also possible that participants may have given more favourable responses than what was observed from them,

thereby inflating the scores for HCWM compliance. This limitation is a general characteristic of survey research and demonstrates the importance of employing multiple methodologies. Further research should consider supplementing self-report measures with more objective forms of data collection, which would give a more accurate depiction of the actual HCWM practices. Furthermore, the application of anonymous reporting systems or third parties' observations could reduce the impact of the social desirability bias and contribute to obtaining more objective data regarding HCWM practices.

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