Knowledge and Attitudes of Healthcare Workers regarding Medical Waste Management in Hospitals of Al-Najaf Province

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ABSTRACT

Aims This study aimed to assess the knowledge and attitudes of healthcare workers on medical waste management and determine the relationship between the socio-demographic characteristics of healthcare workers with their knowledge and attitudes at public hospitals.
Instrument & Methods A descriptive cross-sectional study was conducted at the public hospitals of Al-Najaf, Iraq. The study includes 443 participants (93 medical staff, 310 paramedical staff, and 40 housekeeping staff) collected from 2nd January until 31st March 2022 using a researcher made questionnaire. Analysis of data carried out using SPSS 25.
Findings The study was conducted on 443 participants with a mean±SD age of 29.18 ±7.68 years. The age group 20-29 years had the highest percentage (69.1%), females (58.9%) represented the studied sample compared to males (41.1%). The highest percentage of the studied sample had Baccalaureate certification (44%) and a period of experience of 1-5 years (62.98%). The majority of the studied sample were paramedical staff (70%). Regarding training on medical waste management, the majority of them (69.1%) did not undergo any training program. In general, the overall assessment of participants' knowledge about medical waste management was 69.9% fair, 25.1% good, and 4.9% poor knowledge, while about attitudes, 51.9% had good attitudes, 46.7% had fair attitudes, and (1.4%) had poor attitudes.
Conclusion The current study concluded that only 25.1% of healthcare workers had good knowledge of medical waste management, and about half of them 51.9% had a good attitude. The good knowledge and attitude of paramedical staff were higher than medical and housekeeping staff.

Keywords Public Hospitals; Medical Waste Disposal; Attitude of Health Personnel

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Introduction

Hospitals are health institutions that supply heath treatment, protect people's health, and save their lives. Simultaneously, they produce waste and by-products. The management of this waste is a complicated process and for this process to be influential, it should be understood and directed by all healthcare workers starting from the cleaners to the senior administrators [1]. Hospitals generate several kinds of liquid, solid, and gaseous waste in large quantities [2]. Globally, each country has a generation rate of medical waste ranging from 0.5 to 3.0 Kg/bed/day [3] and approximately 85% of this waste is non-hazardous or general waste while the rest (15%) is a hazardous waste [4]. Medical waste management (MWM) is one of the components that reflect the ability of the hospital to provide a good standard of health care. Hospitals, especially in developing countries, usually face difficulties in monitoring MWM [5], including Iraq where the process of management is not safe and medical waste is not classified into hazardous or non-hazardous waste, which makes the actual volume of hazardous waste higher, thus poses a threat to the environment and public health [6]. MWM refers to the ways of separating, transporting, storing, treating, and disposal of hazardous and non-hazardous waste that is generated as a result of the process of providing health care [7]. The responsibility of MWM is shared between various sectors starting from health institutions down to municipality services and the major role of the environment ministry that participates in monitoring different phases of waste disposal [8].

Since 2020 so far, the already unsustainable increase in the generation of medical waste was suddenly exacerbated by the COVID-19-pandemic [9], and the rapid utilization of masks, protective clothing, and large amounts of other medical supplies has generated large amounts of hazardous medical waste which can cause several environmental hazards, mainly pollution of the atmosphere, waters, and soil [10]. Healthcare workers have a great role in the management of medical waste and one of the major key factors for proper MWM is the knowledge, attitudes, and practices (KAP) of the healthcare workers in hospitals regarding MWM, over and above, research on this important issue has been very limited, and there is a grave need for information for planning in the future and providing data are needed to obtain a reliable picture of this situation [11].

This study aimed to assess the knowledge and attitudes of healthcare workers on MWM and determine the relationship between the socio-demographic characteristics of healthcare workers with their knowledge and attitudes at public hospitals.

Instrument and Methods

A descriptive cross-sectional study continued for the period from 2nd January to 31st March 2022 and was conducted at public hospitals of Al-Najaf province (Al-Sadder Medical City, Al-Zahraa Teaching Hospital, Al-Hakeem General Hospital, Al-Furat Al-Awsatt Teaching Hospital, Al-Manathera General Hospital, Imam Sajjad General Hospital, Al-Haydaria General Hospital, Al-Mushkhab General Hospital, and Al-Qadisiyah General Hospital). Al-Najaf is located to the southwest of Baghdad, the capital of Iraq. It surrounding by Babylon, Karbala, Al-Anbar, Al-Qadisiyah, and Al-Muthanna governorates and has international borders with Saudi Arabia [12]. The study population consists of all healthcare workers who work in hospitals of Al-Najaf province which were 9447 persons according to the Al-Najaf Health Directorate/ Statistics Department. The sample size was 443 participants estimated using the Steven K. Thompson sample size calculator shown, and an additional 20% for the loss or refusal to participate by some respondents:

$$n = \frac{N \times P(1-P)}{\left[(N-1)\left(\frac{d^2}{z^2}\right)\right] + P(1-P)}$$

Where: n=sample size; N=Population size; z=Confidence level at 95% (1.96); d=Error proportion (0.05); P=Probability (0.5)

The sampling technique was conducted in two stages, at the first stage, a proportional random sampling technique (Stratified random sampling technique) was done to select many participants from each of the 9 hospitals based on the number of healthcare workers in each hospital. This was based on the numbers of healthcare workers obtained from the Al-Najaf Health Directorate where healthcare workers were grouped into 9 strata.

$$\frac{Sample\ size}{population\ size} \times statum\ size$$

In the second stage (on the level of each hospital), a Stratified random sampling was again employed to select the participants to ensure adequate representation from all categories of healthcare workers. The healthcare workers were grouped into three strata (medical staff, paramedical staff, and housekeeping staff), then participants were selected randomly by simple random sampling from each stratum.

The researchers develop a structured questionnaire depending on the National Guide to Infection Control in the Iraqi Health Institution and the previous study [13]. The questionnaire was consisting of 3 parts; the first part was about demographic data. The second part was about

knowledge, which contains 5 domains including the 4 stages of MWM in addition to the general information of MWM. The third part was about attitude. Using a 3-point Likert scale regarding knowledge (26 questions) score, each question had three responses (3=Yes, 2=Don't know, and 1=No). Then the evaluation of knowledge was categorized into "poor" <52, "fair" =52-64, and "good" >65. The same for the attitude (14 questions) score, each question had three responses (3=agree, 2=neutral, and 1=disagree). Then the evaluation of attitudes is categorized into "poor" <28, "fair" 28-34, and "good" =>35.

Firstly, ethical approval and all administrative agreements were obtained from the College of Health and Medical Technology/ Baghdad/ Community Health Department and the research committee at Middle Technical University. Secondly, followed a formal agreement from the AL-Najaf Health Directorate/ Human Development Training Center that in turn provided official permissions directed to all hospitals of the study. Finally, the researcher obtained an oral agreement from participants to participate voluntarily in the study. Analysis of data was carried out using SPSS 25.

Findings

In total, 443 healthcare workers participate with a mean±SD of age 29.18±7.68 years ranging from 20 to 59 years. Most of them were 20-29 years, females, baccalaureate, the experience of 1-5 years, paramedical staff, and working at wards. Regarding training on MWM, 69.1% of them did not undergo any training program (Table 1).

In general, the overall assessment of participants' knowledge about MWM was fair (69.9%). The percentage of good knowledge among paramedical staff was 29.35%, higher than medical and housekeeping staff who have the same percentage approximately (15%). Participants' responses according to their knowledge regarding MWM are demonstrated in Table 2.

According to Table 3, the overall assessment of participants' attitudes about MWM, 51.9% had good attitudes. The percentage of good attitudes among paramedical staff was 56.13% compared to 48.4% of

medical staff and 27.5% of housekeeping staff.

Statistically, the current study showed a significant association between knowledge and years of experience and a highly significantly associated with profession, workplace, and training respectively (Table 4).

Statistically, the current study showed a significant association between attitudes and educational level also highly significantly associated with profession (Table 5).

Table 1) Demographic characteristics of the study sample

Characteristic		Number	Percent
Age (years)	20-29	306	69.1
	30-39	79	17.8
	40-49	48	10.8
	≥50	10	2.3
Gender	Male	182	41.1
	Female	261	58.9
Years of experience	1-5	279	62.98
	6-10	91	20.54
	11-15	22	4.97
	16-20	24	5.42
	>20	27	6.09
Educational level	Secondary or less	94	21.2
	Diploma	140	31.6
	Baccalaureate	195	44.0
	Master	11	2.5
	PhD	3	0.7
Profession	Medical staff	93	21
	Paramedical staff	310	70
	housekeeping staff	40	9
Hospital name	Al-Sadder	114	25.7
	Al-Zahraa	62	14
	Al-Hakeem	72	16.3
	Al-Furat Al-Awsatt	57	12.9
	Al-Manathera	52	11.7
	Imam Sajjad	40	9
	Al-Haydaria	22	5
	Al-Mushkab	15	3.4
	Al-Qadisiyah	9	2
Workplace	Wards	123	27.8
	Laboratory	104	23.5
	Pharmacy	57	12.9
	Emergency	55	12.4
	Public health unit	21	4.7
	Consulting clinic	13	2.9
	Resuscitation unit	12	2.7
	Infection control unit	9	2
	Other*	49	11.1
Training	Trained	137	30.9
	Non trained	306	69.1

* Other: blood drawing unit, Intensive care unit I.C.U, vaccine unit, dialysis unit, blood bank, surgery room, operation room, isolation room, and delivery room.

Table 2) Responses of participants according to their knowledge of MWM

Items	Yes		No		Don't know		Evaluation
	N	%	N	%	N	%	
General information on medical waste and MWM							
MW generated from the hospital are considered all hazardous (100% hazardous)	281	63.4	114	25.7	48	10.8	Poor
cultures and stocks, human tissue, sharps, chemical solvents, and expire medicine are hazardous MW.	410	92.6	18	4.1	15	3.4	Good
Paper, carton boxes, plastic water bottles, food cans, metal, glass, and wood are hazardous MW.	112	25.3	302	68.2	29	6.5	Good
The process of MWM includes the following stages: Separation, collection, and storage, transportation, treatment, and disposal	375	84.7	13	2.9	55	12.4	Good
The hospital is considered the major source of medical waste.	375	84.7	38	8.6	30	6.8	Good
Associated risks with inappropriate MWM can affect Healthcare workers only and don't affect the patients and the environment.	83	18.7	318	71.8	42	9.5	Good

Continue of Table 2) Responses of participants according to their knowledge of MWM

Separation of medical waste

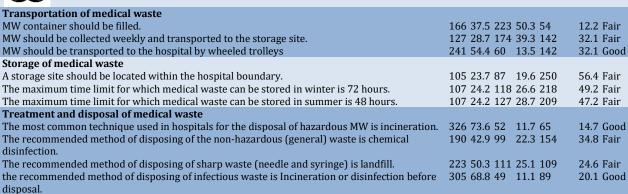|	N	%	N	%	N	%	Evolution
The key to effective MWM is the separation of waste.	362	81.7	20	4.5	61	13.8	Good
MW should be separated after 24 hours.	168	37.9	138	31.2	137	30.9	Fair
The color coding for highly infectious waste is black.	74	16.7	225	50.8	144	32.5	Good
The color coding for other infectious waste and pathological waste is yellow.	210	47.4	105	23.7	128	28.9	Fair
The color coding for pharmaceutical waste is brown.	95	21.4	69	15.6	279	63.0	Fair
The color coding for chemical treatment waste is blue.	104	23.5	62	14.0	277	62.5	Fair
The color coding for general waste is red.	52	11.7	257	58.0	134	30.2	Good
Sharp MW should be mixed with other waste.	14	3.2	398	89.8	31	7.0	Good
Sharp MW must be put into a Puncture-proof box.	408	92.1	11	2.5	24	5.4	Good
The infectious medical waste is labeled with the following Bio-Hazard Symbol:	267	60.3	31	7.0	145	32.7	Good

Transportation of medical waste

	N	%	N	%	N	%	Evolution
MW container should be filled.	166	37.5	223	50.3	54	12.2	Fair
MW should be collected weekly and transported to the storage site.	127	28.7	174	39.3	142	32.1	Fair
MW should be transported to the hospital by wheeled trolleys	241	54.4	60	13.5	142	32.1	Good

Storage of medical waste

	N	%	N	%	N	%	Evolution
A storage site should be located within the hospital boundary.	105	23.7	87	19.6	250	56.4	Fair
The maximum time limit for which medical waste can be stored in winter is 72 hours.	107	24.2	118	26.6	218	49.2	Fair
The maximum time limit for which medical waste can be stored in summer is 48 hours.	107	24.2	127	28.7	209	47.2	Fair

Treatment and disposal of medical waste

	N	%	N	%	N	%	Evolution
The most common technique used in hospitals for the disposal of hazardous MW is incineration.	326	73.6	52	11.7	65	14.7	Good
The recommended method of disposing of the non-hazardous (general) waste is chemical disinfection.	190	42.9	99	22.3	154	34.8	Fair
The recommended method of disposing of sharp waste (needle and syringe) is landfill.	223	50.3	111	25.1	109	24.6	Fair
the recommended method of disposing of infectious waste is Incineration or disinfection before disposal.	305	68.8	49	11.1	89	20.1	Good

Table 3) Responses of participants according to their attitudes regarding (MWM).

Items	Agree		Neutral		Disagree		Evolution
	N	%	N	%	N	%	
Separation of waste at the source of generation increases the risk of injury to waste handlers.	252	56.9	81	18.3	110	24.8	Fair
Safe medical waste disposal should be the priority.	427	96.4	13	2.9	3	0.7	Good
MWM is a team work, not a hospital responsibility.	347	78.3	39	8.8	57	12.9	Good
You are responsible for MWM in your workplace.	351	79.2	49	11.1	43	7.9	Good
Containment of sharps doesn't help in safe MWM.	157	35.4	100	22.6	186	42.0	Fair
Reporting needle-stick injuries is a work burden.	164	37.0	207	46.7	72	16.3	Fair
Safe disposal of MW is necessary for the hospital.	425	95.9	7	1.6	11	2.5	Good
MWM creates an extra burden on your work.	169	38.1	80	18.1	194	43.8	Fair
Safe disposal of MW is important to prevent infection transmission.	420	94.8	15	3.4	8	1.8	Good
Separate MW into different categories is time-consuming.	161	36.3	130	29.3	152	34.3	Fair
Post-exposure prophylaxis should be initiated immediately	401	90.5	29	6.5	13	2.9	Good
Safe MW disposal is a financial burden to the hospital.	123	27.8	111	25.1	209	47.2	Fair
PPE decreases the risk of contracting an infection at the hospital.	419	94.6	14	3.2	10	2.3	Good
Training about MWM is necessary	353	79.7	52	11.7	38	8.6	Good

Table 4) Association between participant's Knowledge and demographic data

Characteristics		Poor		Fair		Good		Total	p-value
		N	%	N	%	N	%		
Age (years)	20-29	10	3.27	231	75.49	65	21.24	306	0.069
	30-39	11	13.92	47	59.49	21	26.58	79	
	40-49	1	2.08	29	60.41	18	37.5	48	
	≥50	-	-	3	30.00	7	70.00	10	
Gender	Male	11	6.04	116	63.73	55	30.21	182	0.057
	Female	11	4.21	194	74.2	56	21.45	261	
Years of experience	1-5	12	4.3	208	74.55	59	21.14	279	0.041
	6-10	7	7.69	64	70.32	20	21.97	91	
	11-15	2	9.09	10	45.45	10	45.45	22	
	16-20	-	-	16	66.66	8	33.33	24	
	>20	1	3.7	12	44.44	14	51.85	27	
Educational level	Secondary or less	11	11.7	65	69.15	18	19.15	94	0.053
	Diploma	5	3.57	101	72.14	34	24.29	140	
	Baccalaureate	6	3.08	136	69.74	53	27.18	195	
	Master	-	-	6	54.55	5	45.45	11	
	PHD	-	-	2	66.67	1	33.33	3	
Profession	Medical staff	6	6.45	73	78.49	14	15.05	93	0.001
	Paramedical staff	7	2.26	212	68.39	91	29.35	310	
	Housekeeping staff	9	22.5	25	62.5	6	15	40	

Continue of Table 4) Association between participant's Knowledge and demographic data

		N	%	N	%	N	%	Total	p-value
Workplace	Ward	11	8.94	92	74.8	20	16.26	123	0.004
	Lap	2	1.92	66	63.46	36	34.62	104	
	Pharmacy	3	5.26	47	82.46	7	12.28	57	
	Emergency	5	9.09	37	67.27	13	23.64	55	
	Public health unit	-	-	13	61.9	8	38.1	21	
	Counseling	1	7.69	9	69.23	3	23.08	13	
	Resuscitation unit	-	-	10	83.33	2	16.67	12	
	Infection control unit	-	-	4	44.44	5	55.56	9	
	Other	-	-	32	65.3	17	34.69	49	
Training	Trained	3	2.19	83	60.58	51	37.23	137	0.001
	Non trained	19	6.21	227	74.18	60	19.61`	306	

Table 5) Association between participant's attitudes and demographic data

Characteristics		Poor		Fair		Good		Total	p-value
		N	%	N	%	N	%		
Age (years)	20-29	6	1.96	141	46.08	159	51.96	306	0.996
	30-39	-	-	39	49.37	40	50.63	79	
	40-49	-	-	22	45.83	26	54.17	48	
	≥50	-	-	5	50	5	50	10	
Gender	Male	1	0.55	84	46.15	97	53.3	182	0.447
	Female	5	1.91	123	47.13	133	50.96	261	
Years of experience	1-5	6	2.15	125	44.8	148	53.05	279	1.000
	6-10	-	-	51	56.04	40	43.96	91	
	11-15	-	-	7	31.82	15	68.18	22	
	16-20	-	-	12	50	12	50	24	
	>20	-	-	12	44.44	15	55.56	27	
Educational level	Secondary or less	-	-	61	64.89	33	35.11	94	0.013
	Diploma	2	1.43	64	45.71	74	52.86	140	
	Baccalaureate	4	2.05	78	40	113	57.95	195	
	Master	-	-	3	27.27	8	72.73	11	
	PHD	-	-	1	33.33	2	66.67	3	
Profession	Medical staff	3	3.22	45	48.39	45	48.39	93	0.003
	Paramedical staff	3	0.97	133	42.9	174	56.13	310	
	Housekeeping staff	-	-	29	72.5	11	27.5	40	
Workplace	Ward	2	1.63	67	54.47	54	43.9	123	0.134
	Lap	2	1.92	35	33.65	67	64.42	104	
	Pharmacy	2	3.51	33	57.89	22	38.6	57	
	Emergency	-	-	27	49.09	28	50.91	55	
	Public health unit	-	-	9	42.86	12	57.14	21	
	Counseling	-	-	6	46.15	7	53.85	13	
	Resuscitation unit	-	-	8	66.67	4	33.33	12	
	Infection control unit	-	-	1	11.11	8	88.89	9	
	Other	-	-	21	42.86	28	57.14	49	
Training	Trained	1	0.73	59	43.07	77	56.2	137	0.398
	Non trained	5	1.63	148	48.37	153	50	306	

Discussion

This study showed only 25.1% of the study sample had good knowledge about (MWM) while (69.9%) had fair knowledge, this may be because the majority of the studied sample was the new staff who had experience of fewer than 5 years and were not trained in stages of MWM. This result is similar to [14] in India. In general, paramedical staff demonstrated better knowledge 29.35% compared with medical and housekeeping staff who have the same percentage (15%). This result agrees with a study done in Basra/ Iraq by [1] but disagrees with studies [15-17] in which medical staff were the highest good knowledge than others. These results might be the highest percentage of trained healthcare workers about MWM in our study were from paramedical staff. However, all healthcare workers have regular contact with MW and must be knowledgeable about MWM.

The study showed few participants 25.7% agree with Iraq, Ethiopia, and India by [18-20] that had information about the percentage of hazardous medical waste to general waste, this may be due to the absence of the national guideline in the hospitals that contain this important information. A percentage of 84.7% of the studied sample was knowledgeable about the four stages of the MWM process as well as the major source of medical waste. These results agree with [21] in India, and it considers a logical result because they are in direct contact with medical waste, and every day they see large amounts of medical waste generated by their hospitals. The present study shows that 81.7% of the studied sample have good knowledge that the separation of medical waste is a golden step in MWM, but they lack knowledge about the time of medical waste separation where only 31.2% of them have an idea about the separation of medical waste must be happened immediately not after 24 hours, this may be that the majority of them have not trained about MWM, especially the separation, in addition to unavailability of educational posters that

explain this importance easy step. These results agree with in India [22] that 78.8 of the study population considered the separation of waste as the effective key in the management of medical waste but disagree with the study [23] in Thailand in which 94.8% of participants said the separation of medical waste must have happened immediately.

Depending on the color coding of medical waste, approximately half of the participants correctly determine the color coding for highly infectious waste, other infectious waste, and general waste, while low percentages 21.4% and 23.5% of them knew the color coding for pharmaceutical waste and chemical treatment waste respectively. These results disagree with studies [24, 25] in Saudi Arabia and India; this difference in results may be due to the color coding system in all Al-Najaf hospitals isn't implemented correctly according to the Iraqi Health Ministry Guide. Regarding dealing with sharp medical waste and the safe method of its separation, the current study shows that 89.8% and 92.1% which corresponded with the study [23] in Thailand where participants have good knowledge about the importance of separation of sharp waste from other waste and put them in hard container respectively, due to the availability of safety boxes for the disposal of sharps medical waste. That 60.3% of the studied sample agree with the study [26] in India where they can identify Bio-Hazard Symbol depending on present many posters, billboards, and sometimes waste containers, which make these symbols familiar to healthcare workers.

Because of insufficient waste containers in hospitals of the present study or inconsistency with the amount of generated waste, half of the studied sample 50.3% disagree with the study [23] in Thailand that found 82% have good knowledge about filling the waste container to no more than 3/4 full, as well as 39.3% of our study participants conflict with the study [15] in Pakistan in which 88.5% of the total participant had good knowledge about the daily collection of medical waste, and about 54.4% of our studied sample knew about the transport of medical waste by wheeled trolleys which also conflict with a study in Yemen [27] that showed 77.3% knew vehicles. This difference in results may be attributed to the majority of our studied samples don't deal with the transportation of medical waste except for housekeeping staff.

Depending on the perfect time of medical waste storage, about 26.6% and 28.7% of the studied sample which were lower than [28] and [29] in India knew about the maximum time limit storage in cold and hot seasons respectively. According to results [30], medical wastes in Al-Najaf hospitals were stored for multiple days, a practice which is not recommended, so make the healthcare workers lack information about maximum storage time. Finally, and depending on concepts of treatment and disposal, this study showed that 73.6% of participants prefer incineration as the most common technique for disposal and treatment of hazardous medical waste which agrees with the study [25] in India. This comes back to the fact that incineration is considered the typical way used for the management of hospital waste in Iraq [31] and this method has a great ability in minimizing and reducing infectious waste [32].

When talking about the attitudes generally, the present study showed that Just over half (51.9%) of the studied sample were considered to have a good attitude towards MWM which agree with studies in India [33] that show 54%, and Mansoura/ Egypt [17] that showed 57.5%, but lower than reported in Oman [34] that showed 91.2%. This is somewhat of a surprise and needs further investigation. A good attitude towards MWM in hospitals is an important finding with the WHO stating that concerning safe MWM A good attitude towards MWM in the hospitals is an important finding under the WHO states, "the human element is more important than the technology. Almost any system of treatment and disposal that is operated by well-trained, and well-motivated staff can provide more protection for staff, patients, and the community than an expensive or sophisticated system that is managed by staff who do not understand the risks, and the importance of their contribution" [35].

There are 2 limitations such as:
- No cooperation from some healthcare workers (especially male nurses) may be because of working loads.
- Inability of some of the housekeeping staff for reading and writing.

Conclusion

The current study concluded that only 25.1% of healthcare workers had good knowledge of MWM, and about half of them 51.9% had a good attitude. The good knowledge and attitude of paramedical staff were higher than medical and housekeeping staff.

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