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Perceptions of healthcare employees regarding medical waste management in selected healthcare centers in Al-Karkh, Baghdad, Iraq, 2025

By

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Abstract

Medical waste management is a systematic process that includes the generation, handling, segregation, storage, treatment, transport, and disposal of healthcare-generated waste to safeguard public health and the environment. Essential procedures involve categorizing waste as sharps, infectious, or general, utilizing color-coded containers, and applying treatment methods such as incineration. This study aims to evaluate the perceptions of healthcare employees regarding medical waste management in selected healthcare centers in Al-Karkh, Baghdad, Iraq, in 2025. A cross-sectional study was conducted using a structured questionnaire to collect data from a randomly selected sample of 360 employees in healthcare centers. Three centers were randomly chosen from each of the 12 health districts in Al-Karkh, Baghdad, resulting in a total of 36 healthcare centers. Data collection occurred from April to June 2025. Analysis was performed using SPSS Version 26, employing a three-point Likert scale, mean, standard deviation, and T-test. The questionnaire included items on demographic characteristics and key functions of medical waste management. A total of 360 respondents participated in the study. The majority were aged 31-40 years (34%), and 39% were paramedical staff. Additionally, 28% had 11-15 years of work experience. There was an observed increase in medical waste production in health centers during the second quarter of 2025. Approximately 70% of respondents were medical or paramedical staff, and nearly 50% had extensive experience in the health sector. The overall perception of respondents, measured by weighted mean, was 2.14, with 70% answering 'no' or 'not sure' to most questions. Perception was highest for the function of waste segregation, with a weighted mean of 2.42 and 81% answering 'yes.' For collection and transportation, storage, disposal, and requirements, the weighted means and percentage of 'no' or 'not sure' responses were 1.99 with 67%, 2.08 with 62%, and 2.11, respectively..

Conclusion

The findings support the need for continuous training programs, monitoring systems, improved waste labelling, and the integration of digital tracking tools. These interventions can reduce environmental burdens, enhance healthcare sustainability, and support the development of more resilient waste management systems in medical institutions.

Keywords: *medical waste management, segregation , healthcare centers , employee , municipality scavengers*

Introduction

The World Health Organization defines medical waste as waste generated by health care activities, ranging from used needles and syringes to soiled dressings, body parts, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices, and radioactive materials. (1) , (2) .defined the Waste in general is any substance (solid, liquid, or gas) that has no direct use and is discarded permanently. A waste is considered hazardous if it exhibits any of the characteristics, such as being flammable, reactive, explosive, corrosive, radioactive, infectious, irritating, sensitizing, or bio-accumulative. Medical waste is limited to infectious, hazardous, and any other wastes that are generated from health care institutions, such as hospitals, clinics, dental offices, and medical laboratories. A study (3) revealed that the management of medical waste has a major concern due to potentially high risks to human health and the environment. In the past, medical waste was often mixed with household waste and disposed of in municipal solid waste landfills.

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The main groups of people at risk are: (1)

- medical doctors, nurses, health-care auxiliaries, and hospital maintenance personnel
- patients in health-care facilities or receiving home care
- visitors to health-care facilities
- workers in support services, such as cleaners, people who work in laundries, and porters
- workers transporting waste to a treatment or disposal facility
- workers in waste-management facilities (such as landfills or treatment plants), as well as informal recyclers (scavengers).

The main functions (activities) of Management A Study of the (4) explains the main function or activities including in medical waste management are :

1- Segregation: Use different coloured bags or containers for different categories of waste.

2- Collection & Storage : Use sealed, leak-proof containers and bags for collection. Store waste in a secure, ventilated location on the premises. Ensure waste bags are removed frequently, daily, from wards and units. Do not store untreated medical waste for more than 48 hours.

3- Transport: Use covered, wheeled containers or trolleys. Transport waste in closed motor vehicles with a "Bio-Hazard" symbol.

4- Disposal: Incineration: A method used to destroy hazardous waste, though ineffective incineration can still pose risks. Autoclaving: Sterilizes waste using heat and pressure, suitable for certain categories of waste. Microwaving: Another treatment method for specific waste categories. Deep Burial: A disposal method for certain waste categories in rural areas or smaller towns. Shredding: To prevent the reuse of materials.

Challenges :

1. Gaps in knowledge, poor compliance with regulations, and inadequate training are common issues, especially in microbiology laboratories and various healthcare settings.
2. Additional challenges arise from the evolving nature of waste streams generated by medical procedures and the inconsistent enforcement of regulatory standards. Study by (5) . found that the complexity of infectious and chemical waste makes segregation more difficult without clear and consistently applied guidelines , Organizational and systemic barriers, such as poor infrastructure and weak administrative oversight, further exacerbate classification errors. Studies by (6) ,(7) reported that these issues contribute to ineffective waste practices as improper sorting at the source, waste handling inefficiencies, and poor human resource management .the study of (8) that Digitalization and automated segregation offer potential ways to transform and improve medical waste management

The main functions of medical waste treatment in most countries of the Middle East are incineration; however, other techniques that produce less pollution are now being introduced. The literature shows numerous case studies on the mismanagement of medical waste as described above for illustration purposes, the key to minimizing and effectively management of medical waste is segregation (separation) and identification of the waste. The most appropriate way of identifying the categories of medical waste is by sorting the waste into color-coded plastic bags or containers (9)

Methodology:

Cross-sectional study, we implemented a tool of a questionnaire with a three-point Likert scale, which provides three response options, typically including a neutral option positioned between two opposing views, such as "Yes and No," which contains two parts. First, the demographic information about respondents; the second part includes the answer of respondents about the main functions of medical waste management. during the period April, May, and June ,2025

- The respondents are employees in a healthcare center who were selected randomly, 360
- Three healthcare centers included in the study, selected randomly (sub-center, main, and family health centers), are affiliated with 12 health districts in Baghdad Al-Karkh, so the total number of included healthcare centers is 36.
- Data collected in Excel software formats and converted to Social Statistical Programs (SPSS) Version 26
- The data was analysed using the Likert three-point scale, mean, standard deviation, and T-test.
- Interval of liker three scales 1s shown in Table 1 (10)

Table 1: Likert three-scale, intervals, and description

Likert scale	Intervales	Description
1	1-1.66	No or disagree
2	1.67- 2.23	Neutral or don't know or sure
3	2.24- 3	Yes or agree

- Used weighted mean to explain the answer or perception of respondents, either low when the mean is below the weighted mean, or high perception when the mean is higher than the weighted mean

Results :

First : Demographic characteristics of the study sample:

The study comprised a total sample size of 360 health-care workers. Distribution of the respondents by sex indicated that male employees accounted for the highest proportion, 56% According to the age distribution of the respondents, the majority 43% were in the age group of 31-40 years old., Most of the employers are paramedics 39% Regarding the experience of working (length of employment), 28% have 11-15 years, as illustrated in figures 1,2, 3and 4, respectively

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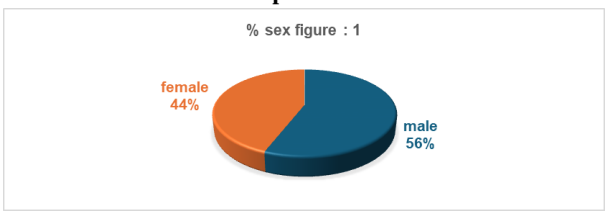
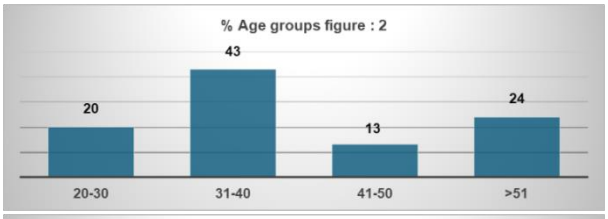
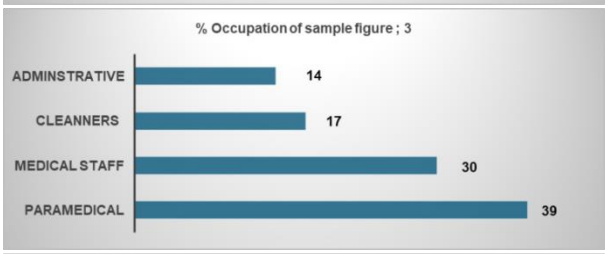
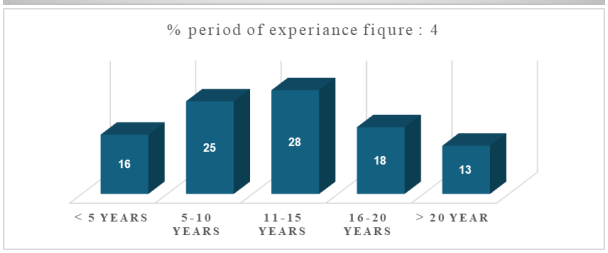
Figure 1 revealed the demographic characteristics of the respondents









Second : Safety management of the medical west was achieved through several functions, including:

1- Collection of medical waste in all healthcare centers, 133 distributed in Baghdad Al-Karkh, was taken over a period of one year, as shown in table 2

Table 2 revealed the total amount of medical waste during one year , monthly, and daily.

year	Amount of medical waste /ton
3rd, quarter ,2024	11,706,191
4th, quarter ,2024	14,204,700
1st ,quarter ,2025	12,060,975
2nd, quarter ,2025	13,742,665
total	51,714,531
monthly	4,309,544
daily	143,661 / kg

While Figure 5 shows that the amount of medical waste has increased during the second quarter of 2025, which was produced by the healthcare centers

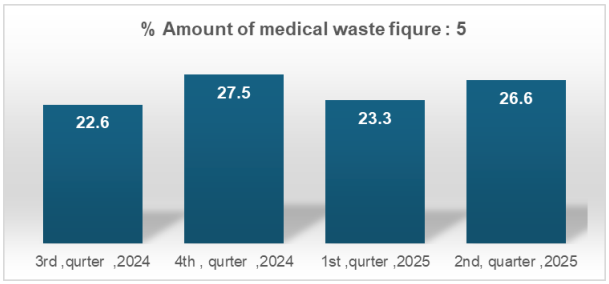


Table 3 presents respondents' answers regarding the administrative requirements for management.

administrative Requirements issues		Mean	SD	P value	%	Description
Q1	There is a person responsible for managing medical waste who is qualified and trained in the program	1.66	0.681	.000	55	Low perception
Q2	There is a special committee for managing medical waste and it holds regular meetings.	1.72	0.768	.000	57	Low perception
Q3	There is a guide for safe management of medical waste	1.89	0.861	.000	63	Low perception
Q4	There are policies, procedures and indicators for safe waste management	2.14	0.863	.000	71	High perception
Q5	There are guideline	2.33	0.78	.000	78	High

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	s on waste classification and how to deal with it.		1			perception
Q6	There is a regular training program to train all employees on the safe management of medical waste	2.36	0.774	.000	79	High perception
Q7	The vaccination policy is implemented for healthcare and medical personnel and sanitation workers, and this is documented in special records	2.76	0.634	.000	92	High perception
Q8	There is a special form for reporting occupational injuries while handling medical waste, and this is documented.	2.02	0.855	.000	67	low perception
Overall Composite Mean Score (Weighted Mean)		2.11	0.777	.000	70	low perception

Table 3, shows the answer of the respondents about the part of the administrative requirement for medical waste management with low perception (half of them) (about 67% of respondents answered no or don't know to Q8 'There is not a special form for reporting occupational injuries while handling medical waste, and this is documented. ' standard deviation is 0.855 and mean is 2.02 and a p-value of .000, indicated statistical significance in the sample members' answers.

On the other hand, we note that the other half of the respondents with high perception , (about 92% of respondents answered yes to Q7 ' there is a vaccination policy implemented for healthcare and medical personnel and sanitation workers, and this is documented in special records standard deviation is . 634 and mean is 2.67 and the p-value is .000, indicated statistical significance in the sample members' answers.

Table 4 presents the responses of participants regarding the Medical Waste Sorting (Segregation) System in healthcare centers.

Medical Waste Sorting (segregation) System		Mean	SD	P value	%	Description
Q1	Medical waste is sorted in all health center units according to the container's colour code	2.10	0.922	.000	70	Low perception
Q2	All health center staff are committed to sorting according to the container's colour code.	2.67	0.646	.000	89	High perception
Q3	Adequate quantities of containers with coloured bags are always available within health center units.	2.54	0.728	.000	85	High perception

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Q4	Containers have lids that can be opened by foot.	2.12	0.774	.000	71	Low perception
Q5	Bags are always available in each container according to colour code.	2.80	0.597	.000	93	High perception
Q6	There are warning signs on the containers indicating that waste is being collected as hazardous materials.	2.14	0.649	.000	71	Low perception
Q7	All sharps containers and receptacles are thick, puncture-resistant, and should be three-quarters full.	2.61	0.676	.000	87	High perception
Weighted mean		2.42	0.713	.000	81	High perception

Table 4 , shows the answer of the majority of respondents about the part of the ' the Medical Waste Sorting (segregation) ' with high perception (About 93% of respondents answered yes to Q5: "Bags are always available in each container according to colour code." standard deviation is 0.597, mean is 2.80, and the p-value is .000. indicated statistical significance in the sample members' answers.

. On the other hand, the minority of respondents with low perception (about 71% of respondents answered no or don't know to Q4 'Containers haven't lids that can be opened by foot. ' standard deviation 1s .774, mean is 2.12, and a p-value of .000, indicated statistical significance in the sample members' answers

Table 5 presents respondents' responses regarding the medical waste transportation system in healthcare centers.

Transportation of Medical Waste	Mean	SD	%	P-value	Description
Q1	Medical waste bags are sealed properly before collection and transportation	2.27	0.870	76	.000	High perception
Q2	Each unit in the health center has a secure, ventilated, and tightly sealed area, inaccessible to visitors. This area is cleaned and disinfected regularly	2.04	0.854	68	.000	High perception
Q3	A dedicated program is in place to transport waste from each unit in the health center to a storage area or room.	1.80	0.697	60	.000	Low perception
Q4	Are medical waste collection bags prone to holes, leaks, or tears during transport to storage?	2.33	0.709	78	.000	High perception
Q5	Are there signs on the plastic bags indicating the type	1.90	0.804	63	.000	Low perception

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	and location of the medical waste?					
Q6	Medical waste is transported to storage using special transport vehicles with smooth surfaces for easy cleaning.	2.53	0.758	84	.000	High perception
Q7	Waste transport workers are trained in how to transport waste safely and wear uniforms	1.60	0.745	57	.000	Low perception
Q8	Appropriate personal protective equipment is worn during the collection and transport of medical waste	1.32	0.707	44	.000	Low perception
Weighted mean		1.99	0.768	67	.000	Low perception

Table 5 , shows the answer of the respondents about the part of the ' Medical Waste transportation System ' half of them with high perception (about 84% of respondents answered yes to Q6 ‘Medical waste is transported to storage using special transport vehicles with smooth surfaces for easy cleaning. ' standard deviation is .758 mean is 2.53 and a p-value of .000, indicated statistical significance in the sample members’ answers. On the other hand, the other half of respondents with low perception (Approximately 63% of respondents indicated either 'no' or 'do not know' in response to Q5 that ' there are no signs on the plastic bags indicating the type and location of the medical waste?' with a standard deviation . 805 and mean is 1.90, and the p-value is .000, indicating that there is statistical significance in the sample members’ answers.

Table 6 shows the answered of respondents about the storage of the Medical Waste System in healthcare centers

Storage of medical waste		Mean	SD	%	P-value	Description
Q1	The medical center has one main central storage room	1.52	0.758	51	0.000	Low perception
Q2	The path to the main storage room is easy and safe to access	1.49	0.729	50	0.000	Low perception
Q3	The medical waste storage room is adequately ventilated and lit, and is clearly marked with a sign prohibiting entry	1.48	0.786	49	0.000	Low perception
Q4	Cleaning materials, a water source, and a drainage system are available	2.36	0.815	79	0.000	High perception
Q5	Animals, rodents, and birds are prohibited from entering the medical waste storage room	2.08	0.890	71	0.000	Low perception
Q6	Medical waste bags are stored in large	2.07	0.812	70	0.000	Low perepti

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	containers inside the medical waste collection room					on
Q7	Medical waste storage is limited to two days in the summer and three days in the winter	1.90	0.856	63	0.000	Low perception
Q8	Record the receipt and delivery of medical waste, including the day, date, and quantity of waste	1.88	0.866	63	0.000	Low perception
	delivered (kg).					
Weighted mean		2.08	0.814	62	0.000	Low perception

Table 6 , shows the answer of the majority of respondents about the part of the ' storage of Medical Waste System ' with low perception (about 71% of respondents answered to Q5 ‘Medical waste bags are not stored in large containers inside the medical waste collection room ' standard deviation 0.890 and mean is 2.08 and a p-value of .000, indicated statistical significance in the sample members’ answers.

On the other hand, just one of the respondents with high perception (79% of respondents answered to Q4 that ' Cleaning materials, a water source, and a drainage system are available . ' with a standard deviation of 0.815, the mean is 2.36, and a p-value of .000, indicated statistical significance in the sample members’ answers.

Table 7 shows the answered of respondents about the disposal of Medical Waste System in healthcare centers

disposable of Medical Waste		Mean	SD	%	P-value	Description
Q1	Medical waste is disposed by contracting with an external contractor for transportation and disposal	2.01	0.945	67	.000	Low perception
Q2	The health center has its own incinerator for medical waste disposal	1.77	0.612	59	.000	Low perception
Q3	Preliminary treatment of highly infectious waste is carried out at the site of generation	1.88	0.878	63	.000	Low perception
Q4	Liquid medical waste is discharged through the main sewage network	2.53	0.743	84	.000	High perception
Q5	Medical waste is disposed of by incineration	2.38	0.735	79	.000	High perception
	Weighted mean	2.11	0.781	71	.000	Low perception

Table 7 shows the answer of the majority of respondents about the part of the 'disposable of medical waste system' with low perception (about 67% of respondents answered 'no' or 'do not know' to 'Q1: Medical waste is not disposed of by contracting with an external contractor for transportation and disposal' with a standard deviation of 0.945, a mean of 2.01, and a p-value of .000, indicating that there is statistical significance in the sample members’ answers.

On the other hand, two of the respondents with high perception (84% of respondents answered Q4 that 'Liquid medical waste is discharged through the main sewage network' with a standard deviation of .743, a mean of 2.53, and a p-value of .000, indicating that there is statistical significance in the sample members’ answers.

Table 8 shows the answers of all respondents about the functions or activities regarding medical waste management in healthcare centers.

safety management of medical west		mean	SD	%	Description
S1	administrative Requirements issues	2.11	0.777	70	Low perception

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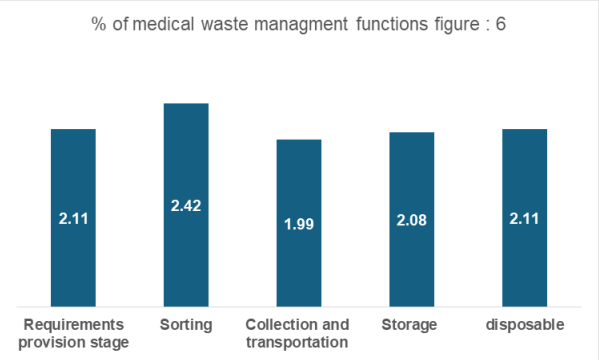
S2	Medical Waste Sorting (segregation)	2.42	0.713	81	High perception
S3	Collection and transportation of medical waste	1.99	0.768	67	Low perception
S4	Storage of medical waste	2.08	0.814	62	Low perception
S5	disposal of Medical Waste	2.11	0.781	71	Low perception
Weighted mean		2.14	0.77	70	Low perception

Table 8 shows the answers of all respondents about the functions of medical waste management in healthcare centers with low perception (about 70% of respondents answered no or did not know for the function), except for the function of sorting (segregation), for which the answer of respondents is high perception (81% of respondents answered yes for this function) that 'medical waste is disposed of by contracting with an external contractor for transportation and disposal' with a mean of 2.24, which is higher than the weighted mean of 2.14, and a p-value of .000, indicating statistical significance in respondents' answers.



Discussion

The main argument of this paragraph is that increased medical waste production, particularly in developing countries like Iraq, poses significant environmental and health risks due to improper handling and disposal. This is evidenced by the higher quantities of medical waste produced in healthcare centers in recent times, as compared to previous ones. Several studies support the finding that medical waste is growing, sometimes due to mixing with general waste, and this increase underscores the need for continuous evaluation and training to improve waste management. The current situation is characterized by insufficient and improper isolation, collection, storage, and safe disposal of medical waste.

Additionally, the same study illustrated that between 75% and 90% of the waste produced by healthcare providers is comparable to domestic waste and is usually referred to as "non-hazardous" or "general healthcare waste." It primarily originates from administrative, kitchen, and housekeeping functions at healthcare facilities and may also include packaging waste and waste generated during the maintenance of healthcare buildings. The remaining 10–25% of health-care waste is regarded as "hazardous" and may pose a variety of environmental and health risks. (16) that general (non-hazardous health-care waste) is 85%, infectious (hazardous health-care waste) is 10%, and chemical/radioactive (hazardous health-care waste) is 5% (17), and the study by (18) revealed that the number of health care workers has been increased annually by 2.11%, and the generation rate ranges between 2.53 and 2.68 kg/bed/day. The number of hazardous healthcare workers has increased by 20.19% over the 5-year period studied, with a generation rate varying between 1.13 and 1.31 kg/bed/day. The same study also illustrated that hazardous waste has increased faster than non-hazardous waste, which can be explained by the increasing use of single-use medical devices and personal protective equipment (which are mostly contaminated with blood, exudate, and chemical substances and contain sharp parts and should therefore be separated as hazardous waste). The study (19) finds that the use of disposable instruments and packaging materials, rather than reusable items, in healthcare centers in developed countries has increased waste generation. The study agreed with a previous study (20) that the generation of medical waste in Korea has been increasing in quantity and variety due to the wide acceptance of single-use disposable items (e.g., gloves, plastic syringes, medical packages, bedding, tubing, and containers). The incorrect classification and disposal of expired pharmaceuticals, fluorescent lamps, cytotoxic drugs, and personal protective equipment continue to pose serious risks to public health and the environment. The World Health Organization (WHO) estimates that approximately 15% of healthcare waste is hazardous and requires specialized handling [21]. Misclassification leads not only to improper disposal but also increases the potential for cross-infection, injuries, and environmental contamination [22].

The segregation perception in the study done by (23) found that 15% of staff misclassified hazardous waste, while the study of 924 found that for waste separation, housekeepers demonstrate a slightly higher knowledge about waste separation, with 49.4% of correct answers, with nurses at 45.7% and doctors at the lowest value at 38.6%. In our study, the perception of respondents was 81%. study of (24) The study reveals that there is no proper, systematic management of medical waste except in a few private hospitals that segregate their infectious waste. Some cleaners were found to salvage used sharps, saline bags, blood bags, and test tubes for resale or reuse. And the study of [20]. In recent years, increased public concerns over the improper disposal of medical waste have led to a movement to regulate the waste more systematically and stringently by the Korean Ministry of Environment. Waste minimization and recycling are still not practiced; thus, significant amounts of medical waste are disposed of. Incineration is the main method of medical waste

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treatment in Korea. (21), (22) The incorrect classification and disposal of expired pharmaceuticals, fluorescent lamps, cytotoxic drugs, and personal protective equipment continue to pose serious risks to public health and the environment. The World Health Organization (WHO) estimates that approximately 15% of healthcare waste is hazardous and requires specialized handling. [Misclassification leads not only to improper disposal but also increases the potential for cross-infection, injuries, and environmental contamination. The WHO (25) revealed that there are several methods to minimize the hazards resulting from medical waste. Medical waste material, which is produced in any type of health facility, including health centers, is highly hazardous and puts people at risk of fatal diseases. As illustrated by (16), every health area (hospital or medical center) should be committed to the good management (sorting/collection/transport/storage and processing) of wastes resulting from all procedures in accordance with the standards required by the Ministry of Public Health, and to ensure the safety of the environment and health.

Our study showed that perceptions in general for medical waste management are low, with 70% of respondents answering "no" or "not sure," as part of the administrative requirements issues. The same result was found in the study by (26), which showed that perception and awareness among health workers of health hazards associated with poor medical waste management is low, few types of personal protective equipment are supplied and used in the healthcare institution, and this leads to poor disease prevention. There is also low knowledge among health workers on administrative issues related to medical waste management in Tanzanian hospitals.

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