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Original article

Knowledge, Attitude and Practices Towards Dental Hazardous Waste Management Among Dentists in Tripoli Libya

Fatimah Buhour[1*], **Asam Aljwiw**[2]

[1]*Department of Health Management, Faculty of Health Sciences, University of Elmergib, Alkmas, Libya*
[2]*Department of Dental Technology, Faculty of Medical Technology, University of Elmergib, Alkmas, Libya*
Corresponding email. *Fabohour@elmergib.edu.ly*

Abstract
Dental clinics and laboratories produce waste that differs in types and amount, which needs good management by using a disposal system. Biomedical Waste is any waste from humans during treatment, diagnosis, and research called Biomedical Waste which is include including dental clinic amalgam, impressions, dental materials, or sharp waste like needles, also another waste has high risk, such as blood, human tissues, and saliva, because they may lead to infection. This study was conducted to evaluate the level of behaviors and knowledge of hazardous waste management among dentists in Tripoli, Libya. This cross-sectional and descriptive study was conducted in a dental clinic in Tripoli, Libya, to evaluate the level of behaviors and knowledge of management of hazardous waste. It was found that the majority of the respondents were work as dentist more than 4 years (45.4%) then (25%) were work as dentist between 3-4 years then (18.4%) were work as dentist between 1-2 years then (9.7%), knowledge of infectious and non-infectious waste management showed 53.6% thought the infectious waste called waste originating from service units in hospitals, attitudes towards the management of infectious and non- infectious waste 95.4% of Sample members agree are infectious waste can cause diseases while 9 or 4.6% disagree, Behavior towards the management of infectious and non- infectious waste. 81.1% of them separate trash cans for infectious and non-infectious waste. Medical waste and dental waste need more and more research in the future, especially hazardous waste.
Keywords. Dental Hazardous, Waste Management, Dentist, Libya.

Introduction

Dental clinics and laboratories produce waste that differs in type and amount, which needs good management by using a disposal system. Biomedical waste is any waste from humans during treatment, diagnosis, and research called biomedical waste which is include including dental clinic amalgam, impressions, dental materials, or sharp waste like needles, also another waste has a high risk, such as blood, human tissues and saliva, because they may lead to infection. Biomedical waste safely needs special handling, including using bags that are one-time use with different colors and coded, special procedures for collection, storage, transportation, and storage [1].

All staff who work in the dental clinic and laboratory must get training on how they deal with medical waste to be safe from infection and diseases that may come from waste [1]. Dental waste usually contains hard, liquid, also both hazardous and non-hazardous waste. Hard waste like X-ray film, needles, plastic, glass, and mercury may enter the body during a tooth extraction. Liquid waste, such as fluids from the body, like blood or chemical solvents. At the same time noted that the quantity of hard waste is more than liquid waste in the dental clinic and laboratory because of the use of disposable plastic like masks and gloves. Another hazard may be found, but too much of substances such as chromium and formaldehyde from cleaning materials. Regulations of solid dental waste controlled by sub-groups depend on the types [2]. Previous studies in Nigeria showed that 64% of 160 respondents usually didn't know how bad dental management can be a risk for humans and the environment, and sorting the waste, around 31 % had poor knowledge of sorting dental waste [3].

Mercury from dental amalgam is considered the most problematic waste due to its toxic potential, Mercury can enter the environment as solid waste by the disposal of extracted teeth as well as through the wastewater collection system by the disposal of amalgam particles during dental operations. For making dental restoration of any missing part of the mouth or teeth, we use many materials that may produce biomedical waste or be harmful, which can be harmful to the environment. The World Health Organization, in a previous study, showed that 63.75% of them did not know well about waste management [3].

Improper disposal of these dental wastes can be a risk to doctors, nurses, patients, and the environment. Although dental clinics produce medical waste less medical waste produce from other major medical but still should all staff should know very well how to handle medical waste because improper handling of dental waste causes problems to human health and the environment. Studies showed a lack about dealing knowledge and control of dental waste in most developing countries [3 -5].

There is a high weakness in the management of dental waste safely in dental clinics in Libya, which may cause infection to patients and all the staff [5]. That's why we need to evaluate the level of behaviors and knowledge of hazardous waste management among dentists in Tripoli, Libya.

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Methods

Study design

This cross-sectional and descriptive study was conducted among 196 dentists working in a dental clinic in Tripoli, Libya, from November 2024 to March 2025.

Data collection

Data was collected using a questionnaire. This questionnaire was divided into four parts. Part one included information about age, gender, Occupation, Education Level, and Length of work as a dentist. Part Two: Knowledge about infectious and non-infectious waste management. Part Tree Attitudes towards the management of infectious and non-infectious waste. Part four: Behavior towards the management of infectious and non-infectious waste

Statistical Analysis

All collected data were inserted into SPSS version 25 software. Descriptive statistics were used to present the data.

Results

As shown in Table 1, the majority of respondents (45.4%) have more than 4 years of experience, and only 9.7% have less than one year of experience.

Table 1. Frequency and Percentage Distribution based on the Length of work as a dentist

Length of work as a dentist	Frequency	Percentage
Less than one year	19	9.7%
1-2 years	36	18.4%
3-4 years	49	25%
More than 4 years	89	45.4%
Total of answers	193	98.5%
Missing answer	3	1.5%
Total	196	100%

About 53.6% correctly associate it with waste from hospital service units, but 38.8% narrowly specify "medical service units," which could exclude other infectious sources (e.g., labs). Only 7.7% incorrectly link it to external garbage, indicating a knowledge gap among some respondents (Table 2).

Most identified hazardous items like syringes (42.3%) or cotton/gauze (18.4%), but 39.3% erroneously included non-hazardous items (pens, food wrappers), suggesting confusion about waste classification. About 34.7% wrongly labeled it as originating from medical units, while 56.1% correctly identified office waste (paper, pens). 24% had a partially correct but vague answer ("all rooms not directly related to patients"). About half (51%) of the participants understood the need to differentiate waste types, but 25% still believed in mixing waste, posing a risk of cross-contamination. Also, 45.4% omitted the critical "destruction" step, highlighting gaps in awareness of full protocols.

Most (55.6%) correctly chose black, but 33.2% incorrectly selected purple (often used for cytotoxic waste). Only 29.6% knew it should be yellow (standard for biohazard waste); 42.3% incorrectly chose black. Moreover, 52.6% accurately included patients/visitors, but 32.1% excluded them, underestimating exposure risks, and 46.9% correctly cited incineration by licensed parties, but 37.8% erroneously mentioned landfills (unsafe for infectious waste). Further, 15.3% confused autoclaving (for disinfection, not destruction) with incineration.

Table 2. The frequency and percentages for answers to questions related to knowledge about infectious and non-infectious waste management:

Questions	Response	Frequency	Percentage
What is called infectious waste?	Waste originating from service units in hospitals	105	53.6%
	Waste originating from medical service units in hospitals	76	38.8%
	Garbage that comes from outside the hospital	15	7.7%
What is included in infectious waste?	Paper, pens, medicine wrappers, and food wrappers	77	39.3%
	Used gauze, syringes, bandages, and medicine wrappers	83	42.3%
	Used cotton, used gauze, syringes, and infusion bottles	36	18.4%

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What is called non-infectious waste?	Waste originating from medical service units in hospitals	68	34.7%
	Garbage that comes from office spaces the hospital	81	41.3%
	Garbage comes from all rooms in the hospital that are not directly related to patients	47	24%
What is included in non-infectious waste?	Paper, pens, medicine wrappers, and food wrappers	110	56.1%
	Used paper, pens, medicine wrappers, and masks	49	25%
	Food packaging, medicine packaging, and ampoules	37	18.9%
What is mean by infectious waste segregation?	Dispose of infectious and non-infectious waste in one trash can	49	25%
	Differentiate waste according to the type of waste before throwing it into the trash	100	51%
	Dispose of waste in the trash that does not match the waste category	47	24%
What are the stages of infectious waste management?	Sorting, collection, temporary storage, transportation, and destruction	73	37.2%
	Sorting, collection, temporary storage, and transportation	89	45.4%
	Collection, temporary holding, separation, transportation, and destruction	34	17.3%
What color is the plastic of the non-infectious trash can	Purple	65	33.2%
	Black	109	55.6%
	Yellow	22	11.2%
Is the color of the plastic trash can infectious?	Purple	55	28.1%
	Black	83	42.3%
	Yellow	58	29.6%
What is at risk of infectious waste	Medical officers, paramedics, and healthcare employees	63	32.1%
	Medical workers, paramedics, healthcare employees, patients, and visitors	103	52.6%
	Medical officers, paramedics, and visitors	30	15.3%
How is infectious waste destroyed?	Handed over to third parties who have permission and burned using an incinerator	92	46.9%
	Handed over to third parties and burned in a landfill	74	37.8%
	Handed over to a licensed party and ignited using an autoclave	30	15.3%

As reported in Table 3, about 95.4% agree that infectious waste can cause diseases, showing strong awareness of biohazard risks, and only 4.6% disagree, which may reflect a lack of training or underestimation of hazards.

The majority of participants (90.8%) agree that infectious and non-infectious waste should be separated, and 85.7% acknowledge that non-infectious waste (e.g., food packaging) can breed disease vectors (e.g., rats, insects). Moreover, 91.3% agree that bins should be labeled and plastic-coated, but 8.7% disagree, suggesting some non-compliance. In addition, 93.4% agree bins should be strong, leak-proof, and lidded, 87.2% would warn colleagues about improper disposal, 88.3% correctly dispose of syringes in puncture-proof safety boxes, 85.2% correctly place medicine waste in non-infectious bins, but 14.8% may mix it with hazardous waste, and 86.7% agree waste should not stay >24 hours, but 13.3% may delay disposal, increasing infection risks. Furthermore, 89.3% agree bins should be accessible yet safe, but 10.7% may place them poorly (e.g., near patient areas).

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Table 3. The frequency and percentages for answers on questions related to Attitudes towards the management of infectious and non-infectious waste.

Questions	Response	Frequency	Percentage
Infectious waste can cause diseases	Agree	187	95.4%
	Disagree	9	4.6%
Trash bins must be separated to accommodate infectious and non-infectious waste	Agree	178	90.8%
	Disagree	18	9.2%
Non-infectious waste can cause vector breeding	Agree	168	85.7%
	Disagree	28	14.3%
Each service room must provide a trash can for infectious and non-infectious waste that contains symbols /labels and is coated with plastic	Agree	179	91.3%
	Disagree	17	8.7%
Trash bins are provided with the criteria of being strong, watertight, closed, and with steps	Agree	183	93.4%
	Disagree	13	6.6%
Give a warning to fellow officers if they dispose of infectious waste inappropriately.	Agree	171	87.2%
	Disagree	25	12.8%
Syringe waste is disposed of in a remarkable safety box trash can	Agree	173	88.3%
	Disagree	23	11.7%
Waste packaging/ medicine packaging is disposed of in non-infectious waste bins.	Agree	167	85.2%
	Disagree	29	14.8%
Waste must not be left in its container for more than 24 hours	Agree	170	86.7%
	Disagree	26	13.3%
Placement of trash cans must be in a safe and strategic location so that they are easy to reach.	Agree	175	89.3%
	Disagree	21	10.7%

In Table 4, about 81.1% report separating infectious and non-infectious waste bins, but 18.9% do not, risking cross-contamination. The majority, 89.3%, correctly dispose of bandages/gauze in infectious bins, but 10.7% do not, and 78.6% properly discard non-contaminated wrappers in general waste, while 87.2% use safety boxes for syringes, and 89.8% wash their hands after handling infectious waste. Most of the participants (90.8%) say they would reprimand improper disposal, and 4.2% call cleaning staff when bins are ⅔ full, but 15.8% wait until overflow, whereas 86.2% place bins in safe, accessible locations, and 91.3% keep infectious waste bins closed, but 8.7% leave them open, exposing others to contaminants.

Table 4. The frequency and percentages for answers on questions related to Behavior towards the management of infectious and non-infectious waste.

Questions	Response	Frequency	Percentage
Do you separate trash cans for infectious and non-infectious waste?	Yes	159	81.1%
	No	37	18.9%
Do you provide and dispose of waste syringes in a safety box?	Yes	171	87.2%
	No	25	12.8%
Do you wash your hands with running water and soap/antiseptic after handling infectious waste?	Yes	176	89.8%
	No	20	10.2%
Would you be reprimanded if someone accompanying you at the clinic did not dispose of infectious waste inappropriately?	Yes	178	90.8%
	No	18	9.2%
Do you /your companion at the clinic throw away used tissue, medicine wrappers/packaging that are not contaminated with the patient body fluids into non-infectious trash?	Yes	154	78.6%
	No	42	24.4%
Do you/your companion at the clinic contact the cleaning service staff if the trash can is 2/3 full of plastic bags?	Yes	165	84.2%
	No	31	15.8%
	Yes	169	86.2%

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Do you/your companion at the clinic place the trash can in a safe and strategic location so that it is easy to reach?	No	27	13.8%
Do you/your companion at the clinic throw away the patient's used bandages, gauze, and sanitary napkins in the infectious waste bin?	Yes	175	89.3%
	No	21	10.7%
Do you/your companion at the clinic use a hands-on when disposing of infectious waste?	Yes	176	89.8%
	No	20	10.2%
Do you/your companion at the clinic always pay attention to the fact that the trash can containing infectious waste must always be closed?	Yes	179	91.3%
	No	17	8.7%

Discussion

The present study showed that the majority of the respondents were work as dentist More than 4 years (45.4%) and (25%) were work as dentist between 3-4 years and(18.4%) were work as dentist between 1-2 years and (9.7%) were work as dentist Less than one year.

In a previous study regarding the six behavior questions that were asked about dental waste management and handling, percentages of the correct answers exceeded 60% for four of the questions. The lowest percentages of the correct answers were observed for the questions about the disposal of the used needles and usage of protective eyeglasses, 56.1% and 38.5%, respectively.

Knowledge about infectious and non-infectious waste management showed 53.6% thought the infectious waste called waste originating from service units in hospitals, 83 42.3% thought included in used gauze, syringes, bandages, and medicine wrappers,41.3% thought called garbage that comes from office spaces in the hospital.

In this study showed that the majority of sample members 110 or 56.1% thought the non-infectious waste included in Paper, pens, medicine wrappers and food wrappers, 51% thought infectious waste segregation means Differentiate waste according to the type of waste before throwing it into the trash, 45.4% thought the stages of infectious waste management are Sorting, collection, temporary storage, and transportation.

The present study showed that the majority, 109 or 55.6% of sample members, thought the color plastic of the non-infectious trash can is black, 42.3% of thought the color of the plastic infectious trash can is black.

The present study showed that the majority103 or 52.6% of sample members, thought the risk of infectious waste is medical workers, paramedics, healthcare employees, patients, and visitors, 46.9% thought infectious waste is destroyed and handed over to third parties who have permission, and burned using an incinerator.

Previous study in Libya found good knowledge about safety in dental clinics because 97.5% of dentists in the study did before always wore gloves, while 49.32% wore a facemask [7]. A previous study in Libya reported that 89.0% sterilize dental chairs were sterilized after every patient [7].

In our study showed attitudes towards the management of infectious and non-infectious waste 81.1% they separate trash cans for infectious and non- infectious waste, 90.8% agree are Trash bins must be separated to accommodate infectious and non- infectious waste, or 85.7% agree are non- infectious waste can cause vector breeding, while 91.3% agree are Each service room must provide a trash can for infectious and non-infectious waste that contains symbols /labels and is coated with plastic,183 or 93.4% agree are Trash bins are provided with the criteria of being strong, watertight, closed, and with steps, 87.2% agree are Given a warning to fellow officers if they dispose of infectious waste inappropriately, 88.3% agree are Syringe waste is disposed of in remarkable safety box trash can, 85.2% agree are Waste packaging/ medicine packaging is disposed of in non- infectious waste bins, 86.7% agree are Waste must not be left in its container for more than 24 hours and 89.3% agree are Placement of trash cans must be in a safe and strategic location so that they are easy to reach.

Regarding the disposal of used fixer and developer, 93.9% of clinics poured it down the drain. About 83.7% of the clinics put X-ray films in the regular waste. As for the lead foil, 81.6% of the dentists discarded it with the regular waste. Previous study in Ajman showed around 79 % segregation the waste in the area in the room treatment, at the same time, 40.8% was segregated in the clinics, and 67.3% it was stay in the clinics, maybe for 5 days until the municipality collected it. Because the hazardous waste is very harmful to all staff and patients, so needs special handling, and all staff must be aware of the storage and segregation of this waste and should receive some training to increase awareness. One of the most highly dangerous is syringes and needles because they are sharps and can cause injuries to any of the Staff, then transfer the diseases, so they need special disposal and handling in a hard container with clear labeled. In a previous study, all the clinics had segregated the waste that could be infectious in different color bags, like yellow. Studies have been done before in Riyadh that show that 72% of dental clinics used containers for sharp instruments, and 56% of dentists used special containers for needles. All the clinics separated the infectious waste, like human Fluids, from the other types of waste, 30.6% of clinics segregated the amalgam. One of the materials usually

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used by dentists is Fixer, and because it has silver, it has become harmful, so we must deal with this material like hazardous waste, with storage in a special container or recycling.[8]
About Behavior towards the management of infectious and non-infectious waste in present study showed that the majority of Sample members 159 or 81.1% they separate trash cans for infectious and non-infectious waste, 87.2% they provide and dispose of waste syringes in a safety box, 89.8% they wash their hands with running water and soap/antiseptic after handling infectious waste, 90.8% they were reprimanded if someone accompanying you at the clinic did not dispose of infectious waste inappropriately, 78.6% they companion at the clinic throw away used tissue, medicine wrappers/packaging that are not contaminated with the patient body fluids into non-infectious trash, 84.2% they or their companion at the clinic did contact the cleaning service staff if the trash can is 2/3 full of plastic bags,86.2% they or their companion at the clinic are placed the trash can in a safe and strategic location so that it is easy to reach,89.3% their companion at the clinic were thrown away the patient's used bandages, gauze, and sanitary napkins in the infectious waste bin,89.8% they or their companion at the clinic used a hands-on when disposing of infectious waste and 91.3% they or their companion at the clinic always paid attention to the fact that the trash can containing infectious waste must permanently be closed.
In a previous study, liquids can drain after preprocessing and using yellow bags with hard waste. Some dentists reported that they have weak awareness about managing chemical waste. At room temperature, if the biomedical waste is left for a long time, all microbes can multiply and become more dangerous. [9]

Conclusion

Medical waste and dental waste need more and more research in the future especially hazardous waste and need more focusing for give more information how it can be highly risk for human, animals and environment in the same time give regular training to all people working in dental clinic how can manage, storge and segregation the waste in Libya.

Conflict of interest. Nil

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