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Solid medical waste management practices and awareness in COVID-19 screening stations

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ABSTRACT

BACKGROUND AND OBJECTIVES: During the Coronavirus disease 2019 pandemic, an effective and efficient medical waste management plan is required to prevent disease transmission from the Coronavirus disease 2019 viral solid wastes. Screening stations are critical locations where solid Coronavirus disease 2019 wastes are created. Solid trash collection and management strategies for screening stations must be studied as they are the first point of origin for solid Coronavirus disease 2019 wastes. The goal of this study is to evaluate the level of healthcare workers' knowledge in the medical waste management field in Jordanian Coronavirus disease 2019 screening stations, with an emphasis on understanding and implementing Jordanian medical waste management protocols, by examining the awareness, perspective, and practice about the many aspects of Coronavirus disease 2019 wastes.

METHODS: A study sample (n = 78) involving technicians, nurses, and physicians working at various screening stations in Jordan's public and private sectors was evaluated. From April 2021 to September 2021, a cross-sectional survey involving questionnaires was carried out. The survey included questions on medical waste management knowledge and awareness among healthcare personnel regarding the Coronavirus 2019 medical waste administrative and collection procedures.

There are various limitations to this cross-sectional study that should be noted. This is a study conducted among health care employees when an overwhelming amount of coronavirus disease cases were being recorded locally and worldwide, affecting transportation ability and minimizing time spent with screening station personnel.

FINDINGS: The outcomes of the first module of the questionnaire revealed a high degree of medical waste management knowledge and awareness among healthcare staff. On the other hand, nurses demonstrated the highest awareness and application of COVID-19 medical waste administrative procedures. Furthermore, the results of the third module revealed that the private sector fails to successfully execute national and international procedures, with the most significant negative responses among other categories.

CONCLUSION: It was concluded that Jordan's solid waste collection and disposal methods were effectively implemented, which might aid in the virus eradication. Even though most Jordanian screening stations have effectively implemented knowledge and awareness regarding solid Coronavirus disease 2019 wastes management practices, there is a need to undertake periodic training and continuous monitoring with a specific focus on the appropriate administrative and collecting processes for both technicians, and private sector stations.

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INTRODUCTION

In recent years, public awareness of medical waste management has increased worldwide (Mihai, 2020). Medical waste includes any solid, liquid, or gaseous substance produced by healthcare institutions such as hospitals, medical centers, dental clinics, and medical labs. Before adopting medical waste management rules, medical waste was commonly combined with other municipal wastes and deposited in household trash cans, and inadequate treatment techniques were used (Ilyas *et al.,* 2020). There are two categories of medical waste: normal non-risk trash and hazardous waste. The healthcare sector produces 75–90% of non-risk or general healthcare waste (Prüss *et al.,* 2014). The World Health Organization (WHO) and the United States Environmental Protection Agency (USEPA) classify the remaining 10–25% of healthcare waste as hazardous or particular waste (Prüss *et al.,* 2014). According to the WHO, healthcare waste should be treated as special waste and kept apart from regular garbage. Medical waste could include highly infectious pathological and anatomical waste, genotoxic waste, sharp waste, chemical waste, pharmacological waste, radioactive waste, waste with high heavy metal content, and general healthcare waste, the majority of which are toxic, harmful, or infectious. Despite their small number, contagious and highly infectious medical waste, such as dirty needles and other sharps, can transfer diseases to healthy people. If medical waste management is not correctly done, all the rubbish might become infectious and dangerous (LaGrega *et al.,* 2015). Hazardous chemical wastes can pollute the environment (water, air, and soil), emit unpleasant odors, and spread diseases like cholera, human immunodeficiency virus (HIV), and hepatitis B and C (Babanyara *et al.,* 2013). According to WHO estimates, injection with contaminated syringes caused 21 million hepatitis B infections, 2 million hepatitis C infections, and 260,000 HIV infections in 2000 (Shinee *et al.,* 2008). Because of these hazards, determining acceptable procedures for the safe treatment of medical waste is critical to preserving human health and the environment. The emergence of the Coronavirus disease 2019 (COVID-19) has resulted in an increase in the medical waste throughout the world as well as amounts of household hazardous and plastic trash, suggesting a critical need for proper waste management, which is often overlooked (Sarkodie and Owusu, 2020; Prata *et al.,* 2020). The increased use of personal protection equipment (PPE) has been linked to a considerable rise in pollution load, which has been responded to by different community-based preventive policies and measures (Haque *et al.,* 2021). A good medical waste management system should consider clinical waste generation and disposal options, efficient segregation, handling, storage, safe transportation and treatment, improved monitoring and tracking techniques, emergency plans, and the need for staff training and awareness programs to manage medical wastes effectively. A professional should oversee the medical waste management system to verify that the management plan's criteria are followed (Neumeyer *et al.,* 2020). The epidemic has altered the dynamics of trash creation, posing challenges for governments and waste management personnel (Sharma *et al.,* 2020; Agamuthu and Barasarathi, 2020). During an outbreak, various forms of healthcare and hazardous waste are produced, such as contaminated masks, gloves, and more non-infected goods of the same nature (UNEP, 2020). A record amount of healthcare waste has been documented as a result of the large epidemic; on the other hand, because of many lockdowns throughout the epidemic, air quality was improved, which is seen as a beneficial influence (Isaifan, 2020). The COVID-19 outbreak in China is believed to be increasing healthcare waste from personal protective equipment such as gloves, face masks, and safety goggles due to an increase in personal protective equipment and quick disposal after use. Due to the massive increase in daily waste (over 240 metric tons) and a six-fold increase in hospital discharge trash, the influx of COVID-19 patients allegedly led to the construction of garbage plants and the deployment of 46 mobile waste treatment facilities in China (Sarkodie and Owusu, 2020; Filimonau, 2021). The WHO and the United Nations (UN) Model Regulations categorized COVID-19's medical waste as Category B, which refers to an infectious particle that is not capable of producing serious sickness, life-threatening, or dangerous disease in otherwise healthy animals or people when exposed to it (Gao *et al.,* 2020). Waste is mostly disposed of at hazardous waste dumps in third-world countries, which are regularly frequented by "rag-pickers" with no PPE, which can spread the infection and make contact tracing difficult (Tripathi *et al.,* 2020). As a result, prospective policy responses, and other approaches to trash collection and disposal locations are required for creating strong adaptation and

management of waste disposal amounts produced by various healthcare and home units in this area of the world (Ramteke and Sahu, 2020). On the other hand, governments have recognized the significance of solid waste management during the disease epidemic in developed countries and have developed various strategies to address the problem. For example, to ease the pressure on the local garbage system throughout this epidemic, residents in Austria are being advised to reduce disposal creation and separate waste as much as possible. The British government has released COVID-19 regulatory policy statements for municipal governments and waste collectors. These recommendations focus on prioritizing waste flow, increasing temporary storage capacity, proper disposal, modifying the solid waste incinerator to treat COVID-19 hazardous waste, and communicating with communities (Kulkarni and Anantharama, 2020). Following the COVID-19 epidemic, updated waste management requirements were implemented globally (Kulkarni, 2020). For example, according to the amended Italian standards, the municipal waste streams generated by houses must be classified into two major groups. One group is waste produced by COVID-19 confirmed cases in mandatory quarantine, while the second is waste generated by residences without COVID-19 confirmed persons. First group trash is typically processed by a small number of companies who gather it using standardized containers and adequate sterilization. Those waste standards encourage waste disposal in a double-layer container instead of segregation at the site of the confirmed COVID-19 cases. Furthermore, the second category of waste is being gathered in a different collecting system. Sheets, masks, and disposable gloves should be included in the residual waste stream and transported in double-sealed bags (Singh *et al.,* 2022). The Jordanian Minister of Health adopted local medical waste management legislation in October 2001. The goal of these rules is to keep medical waste management and disposal under control. The critical criteria defined by these regulations are categorizing medical wastes and managing medical wastes inside the healthcare institution. This domain includes medical wastes, separation, collection, storage, transportation, and disposal (JMWMRA, 2001). These instructions describe medical waste as well as the scope of each instruction. According to their classification, the instruction regulates all stages of proper and safe handling of medical wastes from generation to color-coded plastic bags and containers, packing, storing, transporting, and treatment, either by incineration or using alternative environmentally friendly techniques like autoclaving or microwaving. These guidelines establish criteria that all healthcare waste producers must follow to protect public health. Community protection against COVID-19 infection is a top concern for Jordan's government. As a result, medical waste and ordinary garbage from labs, health institutions, quarantine, and isolation centers run the danger of harboring germs that might infect the general population if not correctly disposed of. If the infectious microbe is not effectively confined within the laboratory or if accidents or emergencies occur, then the infected microorganism may be released into the environment. Medical laboratories, quarantine and isolation units, and inspection stations will be obligated to follow specific processes, emphasizing the proper waste management of hazardous substances, sample transport protocols, and workers washing before leaving the workplace and returning to their communities. The Environmental Health Department of the Ministry of Health (MOH) examines each healthcare facility's medical waste management and disposal systems to check if they meet the World Bank Group's standards and the current WHO COVID-19 regulations. Where these processes are not being implemented inside a healthcare facility, the MOH ensures that any necessary technical support or tools will be provided (JMWMRA, 2021). Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), specimens are collected from potential COVID-19 patients by swabbing the upper or lower respiratory tract as an initial diagnostic technique. Upper respiratory tract, including nasopharyngeal samples are recommended for most patients while lower respiratory tract samples such as sputum, endotracheal aspirate, and bronchoalveolar lavage are recommended for special clinical circumstances (NCoV-2019, 2019). COVID-19 specimens must be placed into a sterile transport tube containing a viral transport medium as soon as feasible. Good quality diagnostic samples are essential for accurate screening and future study. Therefore, specimens should be obtained by competent professionals. All respiratory specimens should be labeled appropriately and transferred to the laboratory within three days of the collection while remaining at a low temperature (Gao *et al.,* 2020; Abu-

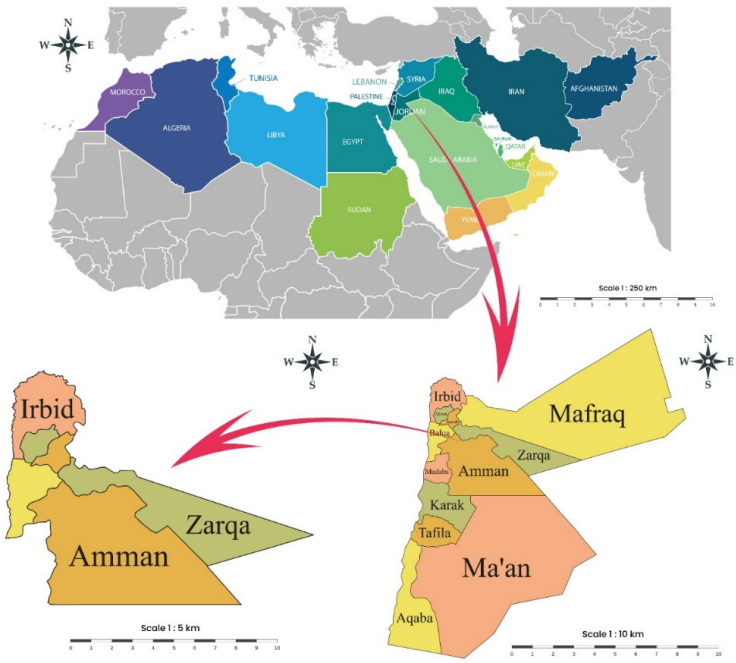

Fig. 1: Geographic location of the study area in the Jordan's central and northern regions in Amman, Zarqa, and Irbid of Jordan

Qdais *et al.,* 2020). Given the severe danger of COVID-19 samples, they must be tested immediately, and it is strongly recommended that the samples collectors contact the medical laboratory or recipients before submitting the specimens, along with a request form, to guarantee correct and efficient handling and treatment (CDC, 2021). The purpose of this study is to assess COVID-19 medical waste knowledge and management in Jordanian screening stations, with a particular focus on understanding and implementing the critical steps of medical waste management. These steps are well-defined and conveyed to technicians, physicians, and nurses who work with patients, medical equipment, and medical waste. This study also intended to verify the knowledge of ostensibly highly skilled medical staff and observe the waste data collection stage (the first stage of waste handling). The survey results will be used to analyze and evaluate the efficiency of medical waste treatment management. Any breach or misinterpretation of these rules and regulations is likely to cause significant issues, such as disease transmission between people and the discharge of dangerous substances into the environment. Furthermore, no significant variations in the answers to the staff of the participating sites are predicted. The objective of this study is to evaluate the level of healthcare workers' knowledge in the medical waste management field in Jordanian Coronavirus disease 2019 screening stations. This study was carried out at COVID-19 screening stations located in the Jordanian governorates of Amman, Zarqa, and Irbid from April 2021 to September 2021.

MATERIALS AND METHODS

The current investigation was carried out in governorates throughout Jordan's central and northern regions. Three governorates were chosen from the total of twelve governorates, namely Amman, Zarqa, and Irbid, and a cross-sectional survey was undertaken to collect data for the current study (Fig. 1). Given that these governorates are hosting about 60% of Jordan's total COVID-19 screening sites (JHC, 2021). The work title distribution of the total healthcare employees at screening station facilities in Jordan is as follows: 60% technicians, 25% nurses, and the remaining amount represents physicians. There are two healthcare workers; one of them is working on the patient's data entry process (outside the screening station), and the other worker is taking COVID-19 swaps within the screening station. In the selected screening stations,

interviews were performed and a survey was conducted to evaluate the degree of awareness, knowledge, and implementation of Jordanians' medical waste management protocols amongst healthcare staff such as physicians, nurses, and laboratory technicians.

The participants' responses were gathered using a designed questionnaire containing closed-ended questions with meticulous consideration to the WHO's 2020 medical waste management regulations and implemented by Jordan's MOH (JMWMRA, 2021). The questionnaire includes information about different variables such as age, gender, education level, job title, smoking, and other details about medical waste handling, awareness, knowledge, and implementation. The data collection tools were created in English and then translated into Arabic. Jordan has about 150 government-run screening facilities and 59 privately run screening stations (JPSSSC, 2021; JHC, 2021). A total of 78 workers from the collecting station sample were chosen randomly to complete the survey (41 males and 37 females, with average age 32.4 years ± 7.5) and 45 government-run and 33 privately run screening stations (20 doctors, 21 nurses, and 37 technicians). Participants in the study were guaranteed of their anonymity and confidentiality. The questionnaire was subdivided into three modules to gather information on various areas of medical waste management. The first module was created to determine the level of COVID-19 knowledge and awareness among healthcare personnel (Table 1). The COVID-19 medical waste administrative procedures (Table 2) focused on the second module, which examined knowledge and implementation. The third module addressed the COVID-19 medical waste collection procedures (Table 3). Responses were given in five different levels and divided into two levels of positive responses ("Very high" and "high") and three levels of negative responses ("Good," Fair," and "Poor."). Positive responses suggest that the person has a high level of knowledge and application of the subject of this topic, while negative responses indicate the reverse (Dell-Kuster *et al.,* 2014).

Data from cross-sectional surveys conducted via interviews at selected COVID-19 screening sites have been entered utilizing the IBM Statistical Package for the Social Sciences (SPSS) version 25.0. IBM SPSS was

Table 1*:* COVID-19 awareness and knowledge among healthcare workers

No.	Question
1	Identify your level of awareness of getting infected of COVID-19.
2	Identify your level of hygiene awareness.
3	Identify your level of commitment to wearing gloves, mask, shield, and coat at the workplace.
4	Identify your level of commitment to wearing gloves and mask out of the workplace.
5	Identify your level of confidence about the safety and effectiveness of the COVID-19 vaccine.
6	After you started working at a COVID-19 screening facility, did you get infected by COVID-19?

Table 2: COVID-19 medical waste administrative processes: Healthcare workers' understanding and implementation inside COVID-19 screening stations Table 3: Healthcare workers' knowledge and implementation of COVID-19 medical waste collection protocols inside COVID-19 screening stations

No.	Question
1	Level of hygiene awareness
2	Speed of screening tests
3	Having warning signs that clarify the hazards of COVID-19 medical wastes
4	Having a clear plan in case there is COVID-19 medical waste emergency pollution
5	Giving periodic training that clarifies the importance of managing COVID-19 wastes
6	Having a fixed schedule for COVID-19 waste removal
7	Having labeled and color-coded containers that identify the content of each container
8	Having a clear and daily record that shows the amount and type of COVID-19 wastes
9	Does your department have spare containers in case the main containers are full?

Table 3: Healthcare workers' knowledge and implementation of COVID-19 medical waste collection protocols inside COVID-19 screening stations

No.	Question
1	Following national and international protocols of separating and managing COVID-19 wastes
2	COVID-19 wastes are treated appropriately
3	A qualified person with the appropriate outfit takes COVID-19 wastes out of your faculty
4	COVID-19 wastes are collected in separate bags based on waste color codes and labels
5	The availability of specific bags and collecting tools at your department
6	The containers are sterilized after waste transportation

used to evaluate the data acquired for item analysis, validity, and reliability of the produced instrument. Descriptive statistics were used to calculate frequency, percentage, average, and variance for study participants' general characteristics. The study's findings were presented in the form of figures and texts as needed. Internal consistency reliability (Cronbach's alpha coefficient) was used to verify the uniformity of questions in this study. Linear regression, multinomial logistic regression (Taber, 2017), and the analysis of variance (ANOVA) were conducted to evaluate the differences between groups. The significance level was set at $p \leq 0.05$.

RESULTS AND DISCUSSION

The reliability statistics for each of the three modules and on the overall questionnaire are discussed as; The first module's Cronbach's alpha coefficient is 0.797 with a Guttman split-half coefficient of 0.674; The second module's Cronbach's alpha coefficient is 0.797 with a Guttman split-half coefficient of 0.68; The third module's Cronbach's alpha coefficient is 0.877 with a Guttman split-half coefficient of 0.788, specifying that the subscale has adequate inter-term reliability; and the entire questionnaire's Cronbach's alpha coefficient is 0.895 with a Guttman split-half coefficient is 0.831, indicating that the subscale has sufficient inter-term reliability. Further analysis revealed that removing any of the items would not significantly increase the alpha level. The questionnaire demonstrates that 99% of participants can recognize more than three COVID-19 symptoms and characterize more than three COVID-19 preventative approaches. In addition, only 5.2% of workers have poor faith in SARS-CoV-2 vaccines, whereas 91% are eager to get vaccinated. The purpose of the first module was to determine the level of knowledge and awareness in medical waste management among healthcare professionals. Fig. 2 depicts the survey findings of several categories. The additive positive replies (the sum of positive answers/ the total number of answers) and additive negative replies (the sum of negative answers/the total number of answers) are summarized in this graph. Different categories represent different replies to the survey's questions. Doctors and government-run screening stations had the highest positive value with a positive average of 0.83 and 0.86, respectively, whereas private sector screening stations had the lowest positive value with an average of 0.78. Nurses and laboratory technicians also showed a lack of personal awareness among other job titles. Nurses and private-sector screening station personnel, in particular, were less likely to commit to wearing gloves and masks outside of the workplace, with p-values of 0.024 and 0.043, respectively. Furthermore, doctors had the highest level of hygiene awareness (p-value 0.042). A five-point Likert scale was used to evaluate module 1, the outcomes were highly satisfying, with a scale value of 4.23 (Lange *et al.,* 2020).

The additive sums of the second module, which focused on COVID-19 medical waste administrative procedures, are shown in Fig. 3.

The results demonstrate that most categories have negative additive sums of answers with a value of 0.27 or greater, with the highest negative averages found for males, technicians, and among doctors. Government-run and private sector stations have nearly identical negative averages of 0.3 and 0.31, respectively. However, multinomial logistic regression (Petrucci, 2009) revealed that government-run screening stations were 2.36 times more likely to have a clear plan in the event of COVID-19 medical waste emergency pollution (p-value 0.044) and were more prepared if the main containers were full by providing spare containers

(p-value 0.001). On the other hand, nurses have the highest rate of correctly applying COVID-19 medical waste administrative procedures, with an average of 0.73. Moreover, they were more confident than other healthcare personnel in performing nasal swaps (the fastest speed of test) with p-value 0.031. Besides, a value of 3.86 on a five-point Likert scale indicates that module 2 overall performance was satisfactory. Fig. 4 depicts the results of the additive sums of answers in the third module, which examines knowledge and application of COVID-19 medical waste collection measures. Males have a lower understanding of waste management methods than females. Furthermore, the private sector fails to execute national and international protocols properly, with a negative average of more than 40%. Nurses, unlike the first and second modules, had the highest positive average of 0.69. Further analysis showed that government-run screening stations employers outperformed private-run screening stations employers in terms of adhering to national and international procedures for separating and handling COVID-19 wastes (p-value 0.028). Females, on the other hand, treated waste better than males (p-value 0.045). Finally, nurses were more concerned with ensuring that containers were sterilized following the waste collection process (p-value 0.023). As expected, the third module has the lowest Likert scale value of 3.8.

The analysis also showed that modules 3 and 2 have a significant positive correlation (R-value = 0.66, p-value < 0.001). However, modules 1 and 3 have weak significant association (p-value = 0.24 and p-value < 0.004, respectively). Finally, between the second and first modules, there is a significant positive correlation (R-value = 0.31, p-value < 0.001). The findings of this investigation revealed that there are no significant medical waste management shortages at the screening stations. Although the results of government screening stations in Jordan are better than those of private-sector screening stations, which require more attention to improve their performance, this is not to say that these hospitals are entirely following the proper and most acceptable medical waste administrative processes and collecting practices. The medical team should be well competent and adequately trained in this field due to the importance and danger of medicinal wastes on both humans and the environment. Figs. 2–4 illustrate that doctors and nurses are the most likely healthcare workers to correctly follow administrative and collection rules. Furthermore, because they have noticed hazardous or unpleasant habits and practices in the collection of medical wastes within screening stations, technicians must pay closer attention to national and international waste management rules.

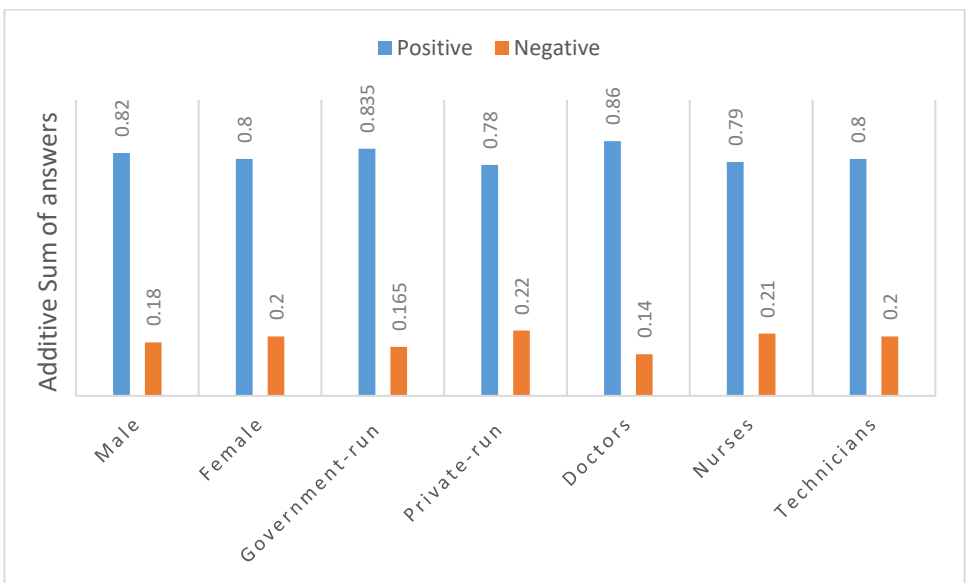

Fig. 2: Module 1 additive sums of positive answers (blue) and negative answers (orange)

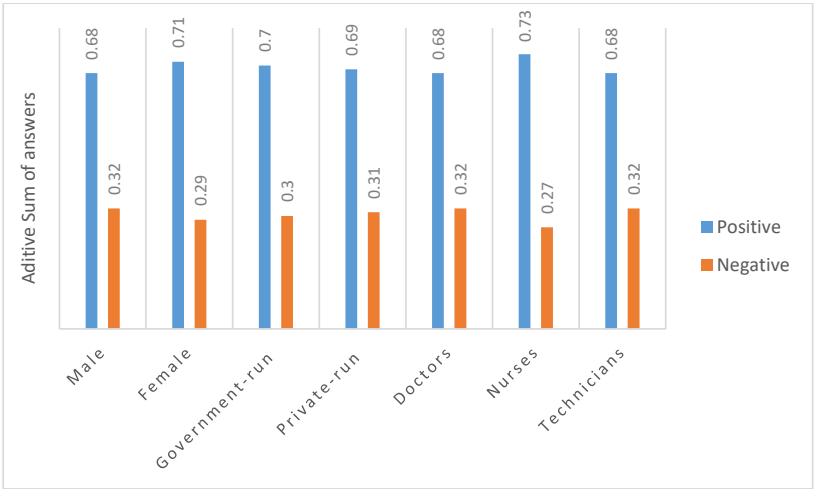

Fig. 3: Module 2 additive sums of positive answers (blue) and negative answers (orange)

Further investigation shows that 46% of participants did not get infected with COVID-19 after they started working in screening stations. After starting working, the average time to get infected is 3.9 months, indicating that most of the staff are applying module 1 correctly. The findings are analyzed and compared with many categories like gender, job title, employer, age, and smoking status via a one-way ANOVA. In the first module, there were no significant differences in any of the category responses. Furthermore, in the module 2 questions, there are no significant differences between the different groups. When the replies to the job title and employer categories are examined in the third module, no significant difference appears in the areas mentioned above as shown in Figs. 2 and 3. The current study found that healthcare practitioners had a high degree of knowledge regarding COVID-19. The average percentage of positive answers was 81.9 %. This is consistent with research undertaken in Egypt, Pakistan, and China (Abdel Wahed *et al.,* 2020; Saqlain *et al.,* 2020; Zhang *et al.,* 2020). Furthermore, a study found that the effect of one's family and society improved the degree of awareness of healthcare personnel (Nabe-Nielsen *et al.,* 2021). Regardless of their profession, the participants in this research had a decent knowledge, particularly about COVID-19 disease prevention methods. With an emphasis on the correct belief that personal hygiene may prevent infection, which was prevalent among physicians, practically all healthcare workers were aware of the proper infection control procedures, which conforms with research from Bangalore and Egypt (Elgibaly *et al.,* 2021). The findings of this investigation demonstrated a very high degree of trust in COVID-19 vaccinations, which is consistent with other study (Shrestha *et al.,* 2021). In contrast, research showed that Iran, Japan, and the United States revealed a low degree of trust in COVID-19 vaccines (Wong *et al.,* 2021; Hou *et al.,* 2021). Additionally, a survey found that 68% of healthcare professionals acknowledged that proper segregation is the most critical stage in waste management, and 82 % of participants working in this setup were familiar with the various color-coded containers used for medical waste separation (Ilyas *et al.,* 2020). Another study showed that the majority of healthcare workers 79.3% were consistently implemented the MOH recommendations for medical waste management, and 69.1% of healthcare workers categorized the color-coded containers used for medical waste disposal according to the kind of waste. While treating COVID-19 patients, about 76.6 % of healthcare personnel always followed infection control procedures (Jalal *et al.,* 2021). In this study, most of the participating healthcare workers (88.3 %) demonstrated a high level of awareness inside screening facilities and adhered to infection control policies while taking nasal swaps from COVID-19 patients. Additionally, 73.1% of screening station workers were able to recognize the labeled and color-coded containers used to identify each container's content. The availability of spare

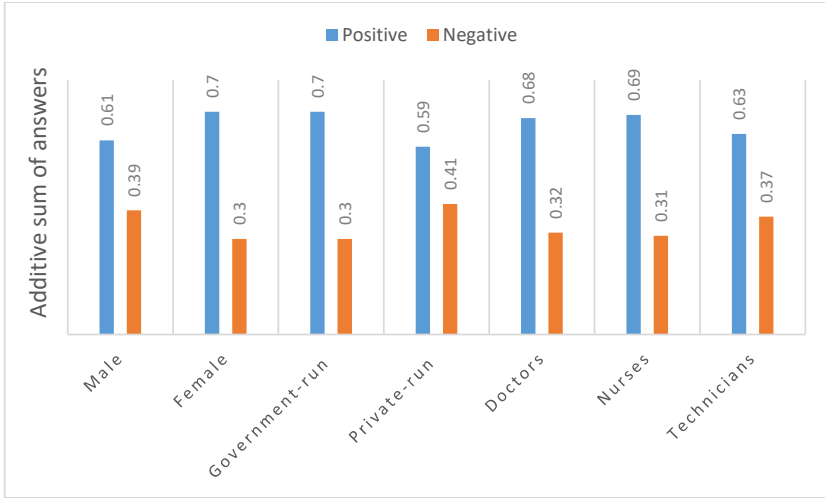

Fig. 4: Module 3 additive sums of positive answers (blue) and negative answers (orange)

containers at screening stations was rated positively by 93.6 % of healthcare workers. Unfortunately, only 48.7% of Jordanian healthcare workers at COVID-19 screening stations received periodic medical waste management training; as a result, policymakers must devote more time and effort to providing health workers with appropriate training. The survey findings also revealed that 69.2 % of healthcare personnel followed local and international (WHO) guidelines for separating and treating COVID-19 wastes, which is greater than the positive response in other countries such as Vietnam and Bangladesh (Tien *et al.,* 2021). A research conducted in Alahsa on the attitudes of healthcare workers toward correctly managing COVID-19 medical wastes revealed that most healthcare professionals agreed that medical wastes must be appropriately handled and that management needs collaboration (Jalal *et al.,* 2021). However, in this study, only 65.4 % of healthcare workers handled COVID 19 medical waste appropriately, which is lower than the proportion of healthcare professionals in Alahsa, Saudi Arabia. Overall, this study found that Jordanian healthcare workers at COVID-19 screening stations demonstrated a high level of knowledge and practice when compared to medical waste treatment guidelines in many countries with emerging and developing economies, which are poorly regulated and frequently disregard WHO recommendation for adequate medical waste treatment (Singh *et al.,* 2021).

CONCLUSION

This study reports the results of a survey of personnel in several COVID-19 screening sites located across Jordan. The key criteria listed in the WHO and MOH rules released following the epidemic were covered in this study. These requirements include healthcare personnel's expertise and awareness, administrative processes, and collecting techniques. The research survey focused on personal medical waste knowledge and awareness, medical waste administrative procedures which were applied by the healthcare workers inside COVID-19 screening stations, and applying national and international COVID-19 medical waste administrative and collection standards inside COVID-19 screening sites. According to the study, 99 % can identify more than three COVID-19 symptoms and define more than three COVID-19 preventative procedures. Furthermore, 5.2 % have little confidence in SARS-CoV-2 vaccinations, whereas 91% are ready to be immunized. For the first module, all categories provided highly satisfactory responses, but the private sector screening stations, females, nurses, and laboratory technicians, among others, showed a lack of personal awareness. The results of the second module revealed that the majority of categories have unfavorable responses in terms of awareness and application of COVID-19 medical waste administrative processes inside screening stations. However, the overall performance of the second module was

adequate. The results of the third module, which examined knowledge and application of COVID-19 medical waste-collecting procedures inside screening stations by health care workers, revealed that males have a lower knowledge of waste management methods than females. Furthermore, the private sector fails to implement national and international protocols fully. As a result, Jordan's medical waste management system are effective, although it needs further attention. Although the Jordanian government is paying close attention to this issue, some who work with hazardous waste are ignorant of the actual implications. Furthermore, the management of these institutions should pay greater attention to how medical waste is treated and disposed of at all levels. More thorough studies will be necessary in the future. This study did not calculate the quantity of medical waste generated in various medical institutions. Contaminants of various sorts were not calculated as well.

AUTHOR CONTRIBUTIONS

S.M. Alzghoul conducted the literature review, statistical analysis of the gathered data, data analysis and interpretation, paper preparation, and manuscript edition. O. Smadi compiled the data analysis and helped with paper preparation, literature review, and manuscript editing. M.B. Alzghoul assisted with the literature review, data interpretation, and paper writing. T.D. Almomani conducted the literature review, analyzed the acquired data statistically, and manuscript edition. O. Albataineh edited and prepared the text, as well as analyzed the data.

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CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

ABBREVIATIONS

%	Percent
ANOVA	The analysis of variance
COVID-19	Coronavirus disease 2019
Fig.	Figure
HIV	Human immunodeficiency virus
MOH	Ministry of Health
n	Number of samples
PPE	Personal protection equipment
p-value	Probability value
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
SPSS	Statistical package for the social sciences
UN	United Nations
USEPA	United States Environmental Protection Agency
WHO	World Health Organization

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