ORIGINAL ARTICLE

Assessing The Impact of Socio-Demographic Factors on Knowledge, Attitudes, and Practices in Healthcare Waste Management During Covid-19 Pandemic

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ABSTRACT

Introduction: Since the outbreak of COVID-19 in Malaysia in 2020, there has been a noticeable rise in healthcare waste (HCW) production. This pandemic has significantly strained healthcare waste management (HCWM) systems globally, posing human and environmental well-being risks. It underscores the urgent need to improve waste management protocols in healthcare settings. This study focuses on the evaluation of association between socio-demographic factors and knowledge, attitudes, and practices (KAP) on HCWM. All waste produced from clinics, regardless of whether it is a chemical, a hazardous material or not, and whether it is contagious or non-contagious in nature, is referred to as HCW and taken into account of the study. **Materials and Methods:** A researcher-designed tool (questionnaire) was used to collect data on waste management KAP among 265 healthcare personnel in Perak's government clinics. **Results:** On average, the findings indicated that the respondents in the study achieved satisfactory scores for knowledge (1.58+0.31), attitudes (3.57+0.54), and practices (2.66+0.32). The study also found that there are some socio-demographic characteristics are significantly associated with KAP of HCWM, with a p-value<0.05. The characteristics such as education level, work experience, training, and vaccination are the most significantly associated with KAP. **Conclusion:** It is advisable to propose and implement initiatives for the appropriate handling and disposal of healthcare waste (HCW) at health clinics to enhance and achieve more effective management, particularly during the pandemic.
Malaysian Journal of Medicine and Health Sciences (2025) 21(SUPP5): 1–11.doi:10.47836/mjmhs.21.s5.1

Keywords: COVID-19; waste management; awareness; practices; healthcare facility

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INTRODUCTION

Healthcare waste (HCW), according to the World Health Organisation (WHO), is waste produced by healthcare operations that includes a wide range of items, such as soiled dressings, parts of the body, diagnostic samples, blood, chemicals, pharmaceuticals, medical devices, and radioactive materials (1). WHO has reported that 75 to 90% of the waste generated by healthcare facilities is equivalent to household waste and is usually referred to as non-hazardous or general HCW. This waste typically can be generated from housekeeping, cooking, and other related tasks performed by healthcare facilities, though it can also include packaging waste and garbage generated during facility maintenance. The remaining 10 to 25% of HCW is considered hazardous, posing several environmental and health concerns (2). Sharps, radioactivity, dangerous chemicals or pharmaceuticals, infectious diseases, and genotoxicity are possible in HCW. There are known hazards associated with HCW exposure that could lead to illness or harm (3).

Globally, a recent WHO analysis found that the COVID-19 pandemic has caused a significant increase in HCW, which has severely strained healthcare waste management (HCWM) systems, putting public and environmental health at risk and emphasising the urgent need to raise the waste management standards (4). The increasing amount of HCW has been obvious in the last few years since COVID-19 spread widely throughout Malaysia on January 25, 2020, which should be concerned and monitored strictly by responsible bodies. The recorded amount of HCW produced in the year 2019 was 33.8 kilotonnes, with an increment of about

7.64% if compared to the year 2018 (31.4 kilotonnes) (5). Subsequently, in the year 2020, the amount of HCW produced skyrocketed to 39.9 kilotonnes or 18.05%, which three states recorded as having the highest generation of HCW, namely Selangor (9.7 kilotonnes), Sarawak (4.1 kilotonnes), and Wilayah Persekutuan Kuala Lumpur (4.1 kilotonnes) (6). In addition, the COVID-19 cases continued to increase dramatically in 2021, with 2,645,076 cases compared to 2020, which had only 113,010 cases (7). Hence, this indirectly impacted the increase in the production of HCW from time to time. Global attention definitely has been focused more on the COVID-19 pandemic since March 2020 and it has been discussed whether poor waste management could contribute to the COVID-19 pandemic. Investigations revealed that the SARS-CoV-2 survival rate on various surfaces ranged from 4 hours on copper to up to 3 days on stainless steel and plastic (8). HCWM systems have been overburdened by the pandemic's increased as well as the discarding of contaminated disposable masks and other PPE (9).

The waste management-related situation also has raised concerns about insufficient knowledge and awareness of healthcare waste (HCW), inadequate management of HCW facilities, and inefficient policies (10). The frontline workers are at higher occupational risk due to their lack of knowledge and awareness in waste management. Annually, millions of health staff worldwide are experiencing skin wounds resulted from contaminated sharp instruments, which lead to thousands of reported cases of the hepatitis C virus (HCV), hepatitis B virus (HBV), and human immunodeficiency virus (HIV) infection. These infections also lead to 1100 fatalities and substantial impairments (11). This phenomenon is particularly prominent in third-world countries due to its high prevalence in such regions (12). Inadequate waste segregation at the origins is another common issue that HCWM faces (13).

There is no doubt that improper HCW and general waste segregation are widespread issues in HCWM around the world. Nonetheless, it is still critical to maintain the segregation process by the standards and regulations to maintain the safety and health of people and the environment, mainly during a pandemic. The incorrect usage of HCW bags and containers, notably sharps containers, is also common. In addition, there needs to be more adequate records on HCW production, a failure to provide suitable temporary central storage for HCW and a lack of education and training on HCWM among health workers. Hospitals in Malaysia are likely experiencing the same issues (14).
Cohen & Howard (15) stressed that HCWM is a pertinent criterion of any healthcare facility's sustainability initiative. HCWM should play a significant role in delivering effective healthcare services, which includes building a comprehensive and sustainable system, enforcing regulations, educating people about the hazards associated with HCW, and protecting people from the dangers of waste. When HCW is disposed of indiscriminately, it endangers public health and impacts surface and subsurface water quality. As a result of its hazardous nature and the related environmental and public health issues, it requires special care (16).

Numerous studies on the knowledge, attitudes, and practices (KAP) of the COVID-19 pandemic in developed and developing nations have been carried out over time such as Dalui et al. (17), Alzghoul et al. (18), Lemma et. al (19), and Mitiku et al. (20) that reported varying degrees of COVID-19-related KAP and their causes. Those studies also emphasising more country-specific investigations in varied situations with the same purpose of improving waste management and increasing the quality of KAP from time to time (17–20). Therefore, the research was implemented to assess the level of KAP among Perak health clinics staffs in managing HCW and to determine if there are significant associations to their socio-demographics to answer the study objectives. Perak is found to be an ideal example to represent the whole Malaysian HCWM scenario since it has numerous health facilities in the northern region and one of the states that reported more than hundred thousand COVID-19 cases in the year 2021. Perak also has a large numbers of government health facilities. Indirectly, if not studied well, it may be overlooked. The study's conclusions are anticipated to awaken and alert some responsible parties to this issue. They may be helpful to assist policymakers in their upcoming plans, mainly when facing the long-term occurrence of pandemics and challenging infectious diseases like COVID-19, and indirectly, that will enhance society and behaviour among individuals to ensure safety both during and after the pandemic.

MATERIALS AND METHODS

Study design

The data for the study was obtained from 265 participants, who had been selected purposely among workers at 13 health clinics in Larut, Matang, and Selama (LMS), Perak. Each staff member must have a minimum of a year of work experience (>one year), with priority given to those who are permanently engaged at the health clinics. All available staff members who were willing to participate throughout the data collection period were included. Total number of the sampling population, including doctors, nurses, other healthcare workers, paramedics, and sanitary workers involved in the healthcare waste (HCW) generation, was calculated using the formula introduced by Krejcie and Morgan (21). Confidentiality was guaranteed to the study participants, and they were made aware that they might leave the study at any time and choose not to answer any questions. Before completing the survey, each respondent must agree to give a permission and consent for the researcher to use all their answers as data in this study.

Data collection tools
The quantitative data had been collected using a structured self-administered questionnaire. Simple language formats in English and Malay versions were applied and kept as short as possible to avoid confusion. The questionnaire had been adapted from two previous studies, which are Adu et al. (22) and Deress et al. (23) and all questions were close-ended type.

The details of questionnaire structure are described such as the following: (i) Section A (Socio-demographic) are including gender, age, educational level, marital status, designation, experience, training, vaccination status, availability of waste management guideline, availability of waste management committee in the facility, needle stick/sharp injury involvement, gloves sufficiency, and availability of related bins. (ii) Section B (Knowledge) is comprised of 24 multiple-choice questions. There are about 17 questions that need answers with "Yes (1)", "No (2)", and "Not Sure (3)". Whereas, another 7 questions are prepared with four alternative answers for each question. (iii) Section C (Attitude) is comprised of 17 questions with Likert scale. To indicate scores, a five-point Likert scale is employed, with "Strongly Disagree (1)", "Disagree (2)", "Neutral (3)", "Agree (4)", and "Strongly Agree (5)". To align with previous studies such as Deress et al. (23), the original five-point Likert scale was transformed into a three-point Likert scale. This involved combining the responses of "strongly disagree" and "disagree" into a single category labelled "disagree." Similarly, the responses of "strongly agree" and "agree" were merged and marked "agree." The category of "neutral" remained unchanged such as in Table 4. (iv) Section D (Practice) is comprised of 7 multiple-choice questions. There are about 3 questions with Likert scale: "Never (1)", "Sometimes (2)", "Often (3)", and "Always (4)" and another 4 questions are prepared with four alternative answers for each question.

The questionnaire had been prepared on Google Forms with written informed consent forms were shared to research participants through social media (e.g. WhatsApp, Telegram, etc.) platform. Participation in this study was assured of confidentiality, fully voluntary and each staff is free to withdraw from this study at any time. Most of the questions are objective structures and are assumed that each respondent would need 10 to 15 minutes to complete all of them and the researcher would receive the answers automatically, after the respondent has answered each question given and submitted it.

Statistical analysis
All data were entered into Microsoft Excel and then exported to Statistical Packages for Social Science (IBM SPSS Version 26) for analysis. Descriptive statistics have been calculated by using frequencies to summarise the socio-demographic characteristics of the respondents and their knowledge, attitudes, and practices (KAP) about healthcare waste management (HCWM) at health clinics. The results of the descriptive statistics are expressed as percentages, mean scores, and standard deviation. The KAP data was normally distributed. Then, Pearson's correlation coefficient was calculated to examine the relationship between the respondents' socio-demographic attributes and KAP on HCWM. Every correlation is represented by correlation coefficient (r), which value that shows the relationship strength between 2 variables and ranging in between +1.00 to -1.00 such as 0.91 to 1.00 or -0.91 to -1.00 (very strong), 0.71 to 0.90 or -0.71 to -0.90 (strong), 0.51 to 0.70 or -0.51 to -0.70 (medium), 0.31 to 0.50 or -0.31 to -0.50 (weak), 0.01 to 0.30 or -0.01 to -0.30 (very weak), and 0.00 (no correlation).

Ethical clearance
The research obtained ethical approval from the Research Ethics Committee (REC) UiTM with reference number: REC/11/2022 (PG/MR/281).

RESULTS

Socio-demographic characteristics
Table I presents the socio-demographics (A1-A15) of the 265 participants in this study. It can be observed from the Table I that 57.7% of the respondents are males, slightly more than the female respondents (42.3%). Most respondents are grouped under the age range 26-35 (42.6%) and only one staff member is over 56. Almost 50% of the respondents are diploma/STPM holders. More than 20% of the respondents have work experience between 1-5 years, 6-10 years, and 11-15 years and almost all of them (99.6%) have an experience during the COVID-19 pandemic.

Regarding waste management training, almost 90% of the respondents have received the training on healthcare waste management (HCWM). For vaccination status, 72.1% of the respondents completed three doses of Hepatitis B, and all respondents received the COVID-19 vaccination altogether (2 and 3 doses). Majority of the respondents (77.7%) acknowledged the accessibility of HCWM guidelines at the workplace. More than 50% of the respondents knew of the existence and establishment of the HCWM committee at their workplace. Less than 5% of the respondents have experienced a needle stick or sharp injury while working in the last 12 months. Almost 93% of the respondents believed that the employer sufficiently provides the number of gloves at their workplace and nearly 100% of the respondents believed that both the yellow bin and the sharp bin are available at their workplace.

Knowledge of health staff on Healthcare Waste Management (HCWM)
Table II presents the results of the respondents' knowledge of HCWM (B16-B39). The majority of the respondents in this study can be considered to have good knowledge of HCWM. On average, 77.7% of the respondents have

Table I: Socio-demographics of the respondents for healthcare waste management (HCWM) at health clinics in Perak

Socio-demographic variables	Variable category	Respondent, n (%)
A1-Gender	Male	153 (57.7)
	Female	112 (42.3)
A2-Age	<25	20 (7.5)
	26-35	113 (42.6)
	36-45	104 (39.2)
	46-55	27 (10.2)
	>56	1 (0.4)
A3-Level of education	PHD	0 (0.0)
	Master/Post-graduate	6 (2.3)
	Degree/Under-graduate	74 (27.9)
	Diploma/STPM	128 (48.3)
	Certificate	11 (4.2)
	SPM	44 (16.6)
	PMR	2 (0.8)
A4-Marital status	Single	31 (11.7)
	Married	222 (83.8)
	Divorced	12 (4.5)
	Widowed	0 (0.0)
A5-Designation	Doctor	56 (21.1)
	Nurse	49 (18.5)
	Assistant medical officer	67 (25.3)
	Medical laboratory technologist	10 (3.8)
	Assistant environmental health officer	7 (2.6)
	Assistant public health	5 (1.9)
	Pharmacist	5 (1.9)
	Attendant	23 (8.7)
	General worker	14 (5.3)
	Driver	3 (1.1)
	Cleaner	14 (5.3)
	Other	12 (4.5)
A6-Job experience (year)	1-5	62 (23.4)
	6-10	70 (26.4)
	11-15	74 (27.9)
	16-20	48 (18.1)
	21-25	11 (4.2)
	>26	0 (0.0)
A7-Work experience during COVID-19 pandemic	Yes	264 (99.6)
	No	1 (0.4)
A8-Trained for healthcare waste management	Yes	231 (87.2)
	No	34 (12.8)
A9-Received Hepatitis B vaccination	Complete (3 doses)	191 (72.1)
	Not complete	56 (21.1)
	Not receive	18 (6.8)
A10-Received COVID-19 vaccination	Complete with booster (3 doses)	226 (85.3)
	Complete (2 doses)	39 (14.7)
	Not complete	0 (0.0)
	Not receive	0 (0.0)
A11-Accessibility of healthcare waste management guideline at health facility	Yes	206 (77.7)
	No	17 (6.4)
	Not sure	42 (15.8)
A12-Establishment of healthcare waste management committee at health facility	Yes	151 (57.0)
	No	35 (13.2)
	Not sure	79 (29.8)
A13-Involvement and experience in any needle stick / sharp injury in the last 12 months while working	Yes	13 (4.9)
	No	252 (95.1)
A14-Sufficiency of gloves quantity at health facility	Yes	246 (92.8)
	No	6 (2.3)
	Not sure	13 (4.9)
A15-Availability of yellow bin and sharp bin at health facility	Yes	264 (99.6)
	No	1 (0.4)
	Not sure	0 (0.0)

some related knowledge of HCWM for part 1 and 67.2% have answered correctly for part 2 with an overall score (mean+SD), 1.58+0.31 is satisfactory.

However, there are still many respondents who are not aware of some important matters related to HCWM. When confronted with a COVID-19 scenario, the respondents should have supposedly been well aware of the WHO guidelines for managing the healthcare waste (HCW) of COVID-19, but more than 50% of them were not. Most of the respondents (83%) gave wrong answers about the maximum time infectious HCW can be stored before treatment or disposal and 80.4% of respondents also did not know the optimum temperature for refrigerated storage of HCW before collection for disposal. The Guidelines on the Handling and Management of Clinical Waste in Malaysia has recommended that HCW be stored in refrigerated storage for up to 48 hours, and the temperature should be maintained between 4°C and 6°C (24).

Attitudes of health staff on Healthcare Waste Management (HCWM)

The respondents' views towards healthcare waste management (HCWM) (C40-C56) are shown in Table III. The table shows that most of the respondents (81.9%), agreed and believed that poor management of healthcare waste (HCW) may caused infection, while 10.6% of the respondents disagreed with the statement. More than 80% of the respondents are concerned about good HCW handling, while 10.6% of the respondents did not concerned and only 6.8% of them have been neutral. The statement 'safe HCWM is an issue involving teamwork' has been agreed upon by 81.9% of the respondents and 11.3% of the respondents disagreed. Only 9.4% of 265 respondents disbelieved that COVID-19 would likely be transmitted through HCW. In contrast, the majority of the respondents (75.5%) agreed and believed that the disease virus has the potential to be transmitted through HCW.

Most of the respondents also believed that HCW may transmit other infectious diseases as well. Moreover, in terms of segregation, 75.1% of the respondents agreed that HCW should be segregated at each of the generation points and 81.9% of the respondents agreed that segregation of HCW can facilitate safe handling of waste, whereas 12.8% of the respondents disagreed with both of these statements (C45 and C46). Nearly 80% of the respondents disagreed with the statement, 'COVID-19 wastes should be mixed into general waste'.

Furthermore, more than half of the respondents (59.3%) disagreed with the statement 'labelling HCW containers does not add value to waste management'. Almost 80% of the respondents believed suitable HCW disposal was essential to prevent infection transmission. Most respondents (83.8%) also agreed that disinfection or decontamination can reduce the chance of contracting

the infection from HCW. Almost 90% of the respondents believed that the risk of infection with HCW could be reduced by wearing personal protective equipment (PPE), while the remaining, 11.3% of them disagreed. Only 10.9% of the respondents felt that HCWM was an extra burden of work, whereas more than 50% of the respondents definitely disagreed with the statement.

More than 50% of the respondents agreed that HCW must be disinfected before disposal. Less than 18% of the respondents felt that HCW was unnecessary to be stored in designated storage, while another 73.6% felt the opposite. Regarding training, 69.8% of the respondents agreed and are willing to attend a special, dedicated training on COVID-19 HCWM if they were invited. Majority of the respondents (85.3%) believed that training could help handle HCW properly and better.

Practices of health staff on Healthcare Waste Management (HCWM)

Table IV shows the results of staff practices on healthcare waste management (HCWM) (D57-D63). Majority of the respondents (76.2%) successfully have maintained a record for healthcare waste (HCW) at the point of origin, which implies that 23.8% of the respondents

Table II: Knowledge of health staff on healthcare waste management

Knowledge (Part 1)	Yes, n (%)	No, n (%)	Not Sure, n (%)	Score (mean±SD)
B16-Does your facility generate healthcare wastes?	229 (86.4)	18 (6.8)	18 (6.8)	1.20±0.55
B17-Do you know about healthcare waste management?	217 (81.9)	30 (11.3)	18 (6.8)	1.25±0.57
B18-Is there any health hazard associated with healthcare wastes?	187 (70.6)	24 (9.1)	54 (20.4)	1.50±0.81
B19-Does healthcare waste of COVID-19 patients can be considered as infectious waste?	216 (81.5)	11 (4.2)	38 (14.3)	1.33±0.71
B20-Do you think that needle stick or sharp injury is a concern?	247 (93.2)	11 (4.2)	7 (2.6)	1.09±0.37
B21- Does wearing personal protective equipment (PPE) reduce the risk of infection?	247 (93.2)	11 (4.2)	7 (2.6)	1.09±0.37
B22-Do all healthcare wastes biologically hazardous (infectious)?	194 (73.2)	40 (15.1)	31 (11.7)	1.38±0.69
B23-Do items contaminated with body fluids considered as healthcare wastes?	207 (78.1)	22 (8.3)	36 (13.6)	1.35±0.71
B24-Do you know about colour coding segregation of healthcare wastes?	203 (76.6)	38 (14.3)	24 (9.1)	1.32±0.63
B25-Does it necessary for healthcare waste containers to be labelled with a biohazard symbol?	241 (90.9)	10 (3.8)	14 (5.3)	1.14±0.48
B26-Does it necessary for healthcare waste to be segregated into different categories at the point of generation?	190 (71.7)	36 (13.6)	39 (14.7)	1.43±0.74
B27-Does disinfection of infectious wastes reduce infection transmission?	203 (76.6)	34 (12.8)	28 (10.6)	1.34±0.66
B28-Does it necessary to close healthcare waste containers while transport?	252 (95.1)	6 (2.3)	7 (2.6)	1.08±0.35
B29-Does it necessary to secure stored healthcare wastes awaiting treatment and disposal?	241 (90.9)	17 (6.4)	7 (2.6)	1.12±0.40
B30-Do you know about healthcare waste disposal methods?	178 (67.2)	42 (15.8)	45 (17.0)	1.50±0.77
B31-Do you know about the WHO guideline to manage the healthcare waste of COVID-19?	124 (46.8)	61 (23.0)	80 (30.2)	1.83±0.86
B32-Do you know about the Malaysia healthcare waste management rules and regulations?	138 (52.1)	36 (13.6)	91 (34.3)	1.82±0.91
Knowledge (Part 2)	**Correct Answer, n (%)**			**Score (mean±SD)**
B33-What is the maximum time of infectious healthcare wastes can be stored before treatment or disposal?	45 (17.0)			2.51±1.26
B34-Which one of the following is an internationally accepted symbol for biohazards?	247 (93.2)			1.20±0.76
B35-What type of healthcare waste should be disposed of in a yellow bin?	234 (88.3)			2.13±0.51
B36-What type of waste should be disposed of in a black bin?	230 (86.8)			1.29±0.75
B37-Where should medical instruments capable of causing puncture / cut to be disposed of?	227 (85.7)			2.91±0.37
B38-What is the optimum temperature for refrigerated storage of healthcare waste to be kept before collection for disposal?	52 (19.6)			3.07±1.15
B39-How much is the full maximum limit for the bin containing sharp instruments?	217 (81.9)			2.12±0.65
Overall Score (mean ± SD) [A23]				1.58+0.31

Table III: Attitudes of health staff on healthcare waste management

Attitudes	Disagree, n (%)	Neutral, n (%)	Agree, n (%)	Score (mean±SD)
C40-Improperly managed healthcare wastes may cause infection.	28 (10.6)	20 (7.5)	217 (81.9)	4.34±1.28
C41-Proper healthcare waste handling is an issue and a matter of concern.	28 (10.6)	18 (6.8)	219 (82.6)	4.34±1.28
C42-Safe healthcare waste management is an issue involving a teamwork.	30 (11.3)	18 (6.8)	217 (81.9)	4.37±1.21
C43-COVID-19 may be transmitted through healthcare wastes.	25 (9.4)	40 (15.1)	200 (75.5)	4.13±1.12
C44-Healthcare wastes do not transmit any infectious diseases.	178 (67.2)	45 (17.0)	42 (15.8)	2.10±1.37
C45-Healthcare wastes should be segregated at the point of generation.	34 (12.8)	32 (12.1)	199 (75.1)	4.11±1.26
C46-Healthcare waste segregation facilitates safe handling of wastes.	34 (12.8)	14 (5.3)	217 (81.9)	4.31±1.16
C47-Labelling healthcare waste containers do not add value to waste management.	157 (59.3)	42 (15.8)	66 (24.9)	2.34±1.48
C48-Proper healthcare waste disposal is important to prevent infection transmission.	35 (13.2)	19 (7.2)	211 (79.6)	4.21±1.32
C49-Healthcare waste disinfection can reduce the chance of contracting the infection.	24 (9.1)	19 (7.2)	222 (83.8)	4.33±1.08
C50-Wearing personal protective equipment (PPE) helps to reduce the risk of infection.	30 (11.3)	8 (3.0)	227 (85.7)	4.43+1.17
C51-Healthcare waste management adds extra burden of work.	176 (66.4)	60 (22.6)	29 (10.9)	2.03±1.18
C52-Healthcare wastes should be disinfected before disposal.	61 (23)	58 (21.9)	146 (55.1)	3.58±1.38
C53-Training can help to handle healthcare waste in a proper way.	31 (11.7)	8 (3.0)	226 (85.3)	4.34±1.18
C54-COVID-19 wastes should be mixed into general waste.	207 (78.1)	15 (5.7)	43 (16.2)	1.75±1.37
C55-Healthcare wastes are not necessary to be stored in designated storage.	195 (73.6)	23 (8.7)	47 (17.7)	1.95±1.40

Table IV: Practices of health staff on healthcare waste management

Practices (Part 1)	Never, n (%)	Sometimes, n (%)	Often, n (%)	Always, n (%)	Score (mean±SD)
D57-Do you maintain a record for healthcare waste at the point of origin?	31 (11.7)	32 (12.1)	74 (27.9)	128 (48.3)	3.13±1.03
D58-How often do you use gloves while you are working with / handling of healthcare wastes?	1 (0.4)	37 (14.0)	24 (9.1)	203 (76.6)	3.62±0.74
D59-How often do you wear a gown while you are working with / handling of healthcare wastes?	7 (2.6)	43 (16.2)	63 (23.8)	152 (57.4)	3.36±0.85
Practices (Part 2)		**Correct Answer, n (%)**			**Score (mean±SD)**
D60-"Where do you put non-infectious wastes like paper, plastic, and other supplies which are not contaminated with blood or other body fluids?		230 (86.8)			2.15±0.42
D61-Where do you put infectious wastes like cotton, gauze, and other items contaminated with blood or other body fluids?		259 (97.7)			3.02±0.15
D62-Where do you put blood or other body fluids contaminated sharp instruments?		233 (87.9)			1.22±0.64
D63-What is the best way for disposal of the healthcare waste in your region?		126 (47.5)			2.12±1.03
Overall Score (mean ± SD)					2.66+0.32

did not maintain the HCW record. While working with or handling HCW at the workplace, almost 90% of the respondents will wear hand gloves, 81.2% will wear a gown, and the remaining respondents did not use or rarely use both.

Most of the respondents have practised the right way of HCWM, which 86.8% will place non-infectious wastes in the black bin, 97.7% will place infectious wastes in the yellow bin, and 87.9% will place sharp instruments in the sharp bin. However, only less than 50% of the respondents knew that incineration is one of the best methods applied in Malaysia for the disposal of HCW.

Relationship between the socio-demographic characteristics and Knowledge, Attitudes, and Practices (KAP) on Healthcare Waste Management (HCWM)

The results of the association between the socio-demographic characteristics and KAP on HCWM among respondents are presented in Table V. The results of correlation coefficients obtained between knowledge of HCWM and the characteristics of demographics

Table V: Correlation analysis between socio-demographic characteristics and knowledge, attitudes, and practices (KAP) on healthcare waste management

Variables	Knowledge		Attitudes		Practices	
	r	Sig.	r	Sig.	r	Sig.
Gender	-0.048	0.439	0.064	0.301	-0.185**	0.003
Age	0.129*	0.035	0.079	0.201	0.080	0.195
Level of education	0.185**	0.003	-0.238**	<0.001	-0.267**	<0.001
Marital status	-0.024	0.698	-0.114	0.063	-0.039	0.524
Designation	0.183**	0.003	-0.245**	<0.001	-0.120	0.051
Job experience (year)	-0.163**	0.008	0.218**	<0.001	0.161**	0.009
Work experience during COVID-19 pandemic	0.092	0.136	-0.025	0.689	-0.017	0.780
Trained for healthcare waste management	0.151*	0.014	-0.197**	0.001	-0.148*	0.016
Received Hepatitis B vaccination	0.238**	<0.001	-0.407**	<0.001	-0.277**	<0.001
Received COVID-19 vaccination	0.017	0.779	0.133*	0.031	0.104	0.091
Accessibility of healthcare waste management guideline at health facility	0.089	0.147	-0.020	0.747	0.005	0.938
Establishment of healthcare waste management committee at health facility	0.332**	<0.001	-0.025	0.687	0.000	0.996
Involvement and experience in any needle stick / sharp injury in the last 12 months while working	-0.018	0.768	-0.033	0.597	-0.070	0.256
Sufficiency of gloves quantity at health facility	0.329**	<0.001	-0.280**	<0.001	0.113	0.066
Availability of yellow bin and sharp bin at health facility	0.209**	<0.001	-0.038	0.537	-0.156*	0.011

Note:**Significant at p<0.01; *Significant at p<0.05

are statistically significant with a very weak positive correlation for age (r=0.129, p<0.05), level of education (r=0.185, p<0.01), designation (r=0.183, p<0.01), training (r=0.151, p<0.05), Hepatitis B vaccination status (r=0.238, p<0.01), and availability of yellow bin and sharp bin at health facility (r=0.209, p<0.01) and with a very weak negative correlation for job experience (year) (r=-0.163, p<0.01). Whereas, other two characteristics of socio-demographic are associated with a weak positive correlation to knowledge on HCWM, which are HCWM committee establishment at health facility (r=0.332, p<0.01) and gloves quantity sufficiency at health facility (r=0.329, p<0.01).

Furthermore, the relationship between attitudes on HCWM and the socio-demographic characteristics are statistically significant with a very weak positive correlation for job experience (year) (r=0.218, p<0.01) and COVID-19 vaccination status (r=0.133, p<0.05). While for education level (r=-0.238, p<0.01), designation (r=-0.245, p<0.01), HCWM training (r=-0.197, p<0.01), and sufficiency of glove quantity at health facility (r=-0.280, p<0.01) are associated with a very weak negative correlation to attitudes of the respondents on HCWM and only Hepatitis B vaccination status is significantly associated with a weak negative correlation (r=-0.407, p<0.01).

Moreover, the correlation results obtained between practices on HCWM and socio-demographic characteristics have indicated that gender (r=-0.185, p<0.01), education level (r=-0.267, p<0.01), training for HCWM (r=-0.148, p<0.05), Hepatitis B vaccination status (r=-0.277, p<0.01), and availability of yellow bin and sharp bin at health facility (r=-0.156, p<0.05) are significantly associated with a very weak negative correlation. There is only job experience (year) that is significantly associated to practices on HCWM with a very weak positive correlation (r=0.161, p<0.01).

DISCUSSION

Waste materials produced in healthcare facilities whether from diagnostic or curative patient treatment, presents a significant health hazard to healthcare providers, patients, the general public, and the environment. If the waste is not properly segregated, collected, stored, transported, treated, and disposed of using acceptable procedures, it will result in serious public health and environmental issues. The responsibility for managing healthcare waste (HCW) rests on the facility occupant. The awareness and practices of healthcare personnel regarding healthcare waste management (HCWM) are crucial for effective waste management.

Knowledge of health staff

An appropriate HCWM practice is requires an adequate knowledge among clinic health staff. 75% or around 199 out of 265 of health staff as the participants has good knowledge score for part 1 and part 2 questions about HCWM. This is better than 56.8% and 45% studies conducted in Ethiopia and Nigeria, respectively (25,26). A better result was found with 96% of the participants in Pakistan had good knowledge score (27). Only 76.6% of the health staff has knowledge of colour coding segregation which is lower than 77.2% and 92.3% of report from Ethiopia and India (25,28). About 86.8%, 88.3%, and 85.7% of the health staff as the participants were able to determine that general waste, infectious waste, and sharp waste must be placed in black, yellow, and sharp bin, respectively. Furthermore, more than 90% of the study participants were able to determine

the biohazard symbol which is better than to the two studies in India (54.4% and 85.5%) (29,30). The reasons knowledge of health staff in Perak could be considered good and better than the participants in some studies are because of variations in the facilities' access to and use of waste management guidelines, the provision of training opportunities for healthcare facilities, variations in national health sector strategies, or variations in the study participants' academic performance.

Attitudes of health staff

The overall attitude score was favourable and satisfied with 75.5%. This study was better than a study from Debre Markos (62.1%) and Gondar Town (59.9%) in Ethiopia (25,31). This could be due to methodological difference or commitment of health staff for waste management. With regard to waste segregation and treatment, about 75.1% and 55.1% study participants agreed that HCW should be segregated at the source and disinfected before disposal, respectively. A similar study was found higher agreement in India in which about 88.1% study participants agreed on segregation of HCW at the source (28).

Practices of health staff

At average, the health staff score was 80.4% which could be considered adequate and satisfied, which also better than study conducted in Ethiopia with 78.9% (25). However, a better result was found from Pakistan where 94.3% of the study participants had adequate practice (27). This could be due to lack of training, health staff commitment, motivation, and enforcement from responsible bodies or might be ignorance of health staff for HCWM.

The association between the socio-demographic characteristics and KAP

In addition, the present study aims to reveal the level of preparedness of the staff members in facing the future pandemic in terms of knowledge, attitudes, and practices (KAP) and prove that several socio-demographic attributes can influence the HCWM of the health facility as contributing factors. The study has found that gender criteria is not significantly correlated to the knowledge of HCWM, $r(263)=-0.048$, $p=0.439$. This finding did not align with the previous studies such as Al-Mohrej et al. (32), Bawazir et al. (33), and Limon et al. (34) that reported the gender criteria were significantly associated with knowledge. The lack of significant correlation between gender and HCWM knowledge in this study may be due to differences in sample demographics, study setting, or methodological factors compared to previous studies. Previous studies may have worked in regions or contexts where cultural, educational, or occupational factors influenced knowledge differently between genders, potentially due to differing access to HCWM training or information.

Nevertheless, the findings indicated that the demographic attributes such as age, level of education, designation, job experience, training, and others of the respondents affected their knowledge of HCWM. For instance, the younger the age, the better the knowledge compared to the older person (34). This is supported by researchers such as Beier and Ackerman (35), and Laor et al. (36) who believe that age may influence knowledge on the proper disposal of HCW. Additionally, the relationship analysis results show that the participants' educational attainment has also a substantial impact on their level of knowledge—the more educated a person is, the more knowledgeable they are about properly disposing of HCW. Both studies have also corroborated this conclusion by concluding that an individual's understanding of managing HCW increases with their educational attainment (35,36).

This study also found that work experience is significantly correlated with KAP among health staff and becomes a contributing factor in acceptable waste management; more experience in managing HCW is more efficient and increases KAP among health staff. A study conducted by Yousaf (37) supports this finding with concluded that experience is one of the main contributing factors affecting KAP, and a high level of experience causes more knowledge and awareness. Apart from work experience, this research revealed that adequate training in HCWM would help health staff increase their understanding and improve KAP. This is in line with the previous research, which found that effective and structured training significantly improves health staff knowledge and awareness of HCWM, leading to safer disposal of waste (38,39). Based on the overall results from this study as well, a staff's KAP definitely must need to be remediated and continued from time to time even though at this period it is post-pandemic COVID-19. This is because there are still KAP results that need to be improved and it is seen that it is not strong enough to face the emergence of a pandemic in the future which may be worse. If HCWM during non-pandemic times cannot be carried out well and regularly, what will happen at a critical time like that, maybe HCWM will become a mess and will have a greater impact on everyone. Lessons learned during the pandemic should make the management system of a health facility better and be prepared in any situation, not only for the health staff on duty but also for all bodies responsible in managing waste from production to disposal.

CONCLUSION

The knowledge, attitude, and practices (KAP) about healthcare waste management (HCWM) are influenced by several key factors, such as education level, job title, experience, and training. Although the majority of the participants have working experience during the pandemic, there are still have weaknesses among these health personnel that need to be improved in managing healthcare waste (HCW) due to the results

obtained from this study have not yet shown a truly excellent level of KAP. To enhance the awareness and practices of HCWM at the health clinics in Larut, Matang, and Selama (LMS), Perak, it is recommended to offer continuous and comprehensive training to both healthcare and non-healthcare personnel from various departments.

Moreover, several other essential requirements must also be met to manage the waste effectively during the future pandemics. These include the implementation of a comprehensive waste management strategy, the provision of appropriate equipment, the committed workers, and the establishment of rigorous monitoring and supervision protocols. Indirectly, with better planning, adequate and appropriate handling and disposal of HCW will possibly help to prevent any hazards, unwanted infection, adverse health, and environmental consequences. The findings in this study may alert and help responsible bodies and policymakers to improve and revise the related guidelines and procedures that can be efficiently applied to the whole health facilities throughout Malaysia.

This study was conducted with two limitations that had a slight impact. First of all, since the COVID-19 pandemic happened a few years ago, the researcher was unable to visit and see the real events that happened from the aspect of healthcare waste management (HCWM) and the good practices of the staff during that time in all clinics involved and disposal as well, due to government restrictions such as Malaysian Movement Control Order (MCO). Secondly, there are unintentionally unstudied healthcare waste (HCW) procedures such as active case detection (ACD) activity for COVID-19 that are usually performed outside the clinic (in-situ) by primary teams such as in schools, prisons, detention centers, and others. As a result, the researcher cannot find out how was implemented exactly. Therefore, it was suggested for future studies to conduct site visits and site interviews in more detail and thoroughly by increasing the involvement of the management places, especially when a pandemic occurs.

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