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Health Workers' Knowledge, Attitudes, and Practices regarding Health Care Waste Management: The Case of Primary Public Health Care Facilities in Nifas Silk Lafto Sub City

By Fikadu Mekassa[1]

The primary objective of this study is to assess health workers' Knowledge, Attitudes, and Practice (KAP) about Health Care Waste Management (HCWM) in the Nifas Silk Lafto sub-city. A facility-based cross-sectional study of 254 healthcare workers was conducted. A stratified random sampling method and quantitative analysis were used. The overall KAP score of the study participants was 78.9% having adequate knowledge, 92.7% having a good attitude, and 63.4% having a good practice score. The highest adequate knowledge score was noted among laboratory personnel (99.7%), followed by health officers (98.4%), and the least was noted among nurses (60.5%). Cleaners had the lowest positive attitude, at 89.5%, while laboratory professionals had the highest, at 98.9%. The highest "good practice" score was among laboratory professionals (72.5%), followed by medical doctors (70.8%), while the least was among cleaners (44.2%). Information sources, the assigned infection prevention committee, educational level, work experience, working section, and healthcare workers' profession were factors associated with the KAP of healthcare workers about HCWM. Generally, the overall KAP was unsatisfactory, and a great discrepancy was seen among healthcare workers regarding their knowledge, attitude, and practice level. The government shall work on the availability of guidelines, visual aids, policy manuals, basic training, sufficient PPE, color-coded waste bins, and infrastructure for waste storage, treatment, and disposal, and studies should be conducted to overcome the problems.

Keywords*: healthcare waste; healthcare worker; knowledge; attitude; practice; waste management.*

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Introduction

Healthcare facilities are among the main industries that have improved significantly in recent decades globally (Birpnar et al., 2009). Wastes produced during medical procedures were harmful to the environment and human health (Chaerul et al., 2008). Healthcare facilities and laboratories produce waste that is referred to as healthcare waste (WHO, 2013). These wastes include things like sharp and blunt objects, blood, body parts, chemicals, pharmaceuticals, medical gear, and radioactive materials. (WHO, 2015). These substances are poisonous, risky, cancer-causing, or contagious. (Marinkovic et al., 2008). Healthcare waste is regarded as the most harmful waste in the world after radioactive waste (Arab et al., 2008). More than 85% of the waste produced by healthcare activities is hazardous and non-hazardous, and 15% of this trash is toxic and radioactive (Chartier, 2014). Healthcare waste is broken down into liquid and solid trash that comes from medical facilities and is either classified as hazardous waste or non-hazardous waste (Uwa, 2013).

According to Shinee et al. (2008), the production and disposal of HCW has become a global problem, yet management is still in its infancy (Babu, et al., 2009). WHO indicates that 10 to 25 percent of HCW produced by healthcare workers are hazardous (Chartier, et al., 2014). However, the percentages varied by nation, ranging from 20% to 75%, according to accounts from Ethiopia (Hayleeyesus and Cherinete, 2016). More than 30 dangerous blood-borne diseases have the potential to be disseminated by HCW (Sawalem et al., 2009), with HIV, HBV, and HCV infections being of particular concern because to the strong evidence of transmission through needle stick/sharp injury as a result of subpar waste management. Poor HCWM is a problem in the majority of developing countries, and according to several researchers, successful HCWM is difficult to implement due to low levels of healthcare professionals with training in waste management systems and public awareness of the issue. Additionally, activities for waste management may be hampered by the absence of an HCWM standard, legislation, and suitable options for treatment and disposal (Hossain et al, 2011). According to various research, HCWM is still in its early stages in Africa (Bendjoudi, 2009).

There hasn't been much research done on KAP dynamics and associated factor scenarios, especially in emerging nations like Ethiopia. According to reliable research, HCWM is currently insufficient in Ethiopian health institutions (Azage and Kumie, 2010). Research to date have mainly focused on waste creation and management at the facility level, leaving evaluations of KAP and its associated factors among health professionals, notably among cleaners, who play a vital role in reducing bio-hazardous associated risks, to the fore. In order to create a specific strategy to address issues related to HCW management, the results of the studies conducted were not accurately reported across the different job categories for healthcare workers (Yenesew et al., 2012). in order to create a specialized strategy to address HCW-related issues and reduce challenges caused by its improper administration. Consequently, the goal of this research was to completely close these gaps.

The main objective of this paper was to assess the knowledge, attitude, and practices about healthcare waste management and associated factors among healthcare workers at primary public healthcare facilities in Nifas Silk Lafto Sub City, Addis Ababa. The specific objective was to determine the level of knowledge and assess the level of attitude, as well as the practical and associated factors of knowledge, attitude, and practice towards HCWM among healthcare workers at primary public health care facilities in Nifas Silk Lafto Sub City. The research questions were: What is the level of HCWM knowledge among HCWs? What is the level of attitude towards HCWM among HCWs? What is the level of HCWM practice among HCWs? What are the determinants of HCWM among HCWs?

Related Literature Review

According to WHO, the person who creates each waste item should segregate it based on its potential hazard characteristics, treatment requirements, and disposal route (WHO, 2004). Each medical area should have separate designated color-coded bins for each category of healthcare trash, namely infectious waste yellow, chemical and pharmaceutical waste brown, and general waste black. Not more than three-quarters of the way full should be used for waste bags and sharp containers (WHO, 2005).

The collection period should be set and acceptable for the amount of waste, but should not exceed one day. All healthcare waste systems will require access to land for final disposal in order to remove any leftover healthcare waste materials after reduction or treatment. There are several ideal

characteristics of a landfill, including restricted access to prevent scavenging, daily soil covers to minimize foul odors, regular compaction of garbage, and isolation of waste (Annette et al., 2013). Common technologies include burning, land filling, autoclaving, and chemical treatment. India has also created a brand-new solar treatment method (Mohee, 2005).

Gupta conducted a cross-sectional survey among hospital workers at a tertiary care hospital in India in 2015; among 200 study participants, 52% had worked in a hospital for 1 to 5 years, followed by 29% for 1 year, 12.5% for 6–10 years, and 6.5 for >10 years (Gupta et al., 2015). Kumar et al. conducted a cross-sectional survey in Nainital, India, and discovered that 87.3%, 86.4%, and 85.5% of health care workers knew about HIV, Hepatitis B, and Hepatitis C transmission through HCW, respectively (Kumar et al., 2015).

In 2015, Amouei conducted a descriptive cross-sectional study in Iran; 12 %, 72 %, and 16 % of the 130 study participants had low, medium, and high knowledge of hospital waste management, respectively, whereas 16 % and 84 % had a medium and high attitude toward hospital waste management, respectively. Low, medium, and high practice were found in about 4%, 46%, and 50% of the participants, respectively (Amouei et al., 2015).

Sabageh et al. conducted a cross-sectional survey in Nigeria in 2015, finding that only 50.8 % knew about color-coding, 37.2 % knew about segregation, and 45.0 % knew a lot about healthcare waste management. Approximately 45.5% had a positive attitude about healthcare waste management, while 54.5% were negative. About 40.3% practiced waste segregation, 47.6% worked in facilities with a documented healthcare waste management policy, 31.4% had received healthcare waste management training, and 35.6% used open dumping, followed by burning (23%) and burial (19.9%) (Sabageh et al., 2015). In 2015, Azuike et al. conducted a cross-sectional survey in Nigeria with 331 HCPs that showed that 96.7% have a tertiary education and 0.9% have an elementary education. Approximately 93% of healthcare workers were knowledgeable of the dangers of healthcare waste. Sharps disposal into the safety box was widespread (Azuike et al., 2015).

Hayleeyesus et al. (2014) at Adama City health care institutions in Ethiopia analyzed the rate of health care waste generation and management. They showed that 75% of HCPs are aware of different types of healthcare waste, but only 37% are aware of the color-coding method, and only

28% are aware of the) existence of HCWM guidelines. Furthermore, only 31% of HCPs had received training on safe HCWM procedures. (Hayleeyesus and Cherinete, 2016) A cross-sectional study on disease transmission with healthcare waste conducted in Gondar, Ethiopia, in 2012 by Yenesew et al. revealed that 30% had higher, 38.1% moderate, and 31.9% lower knowledge; however, 77.7%, 17.3%, and 5% had low, moderate, and high knowledge on healthcare waste types, color-coding containers for healthcare waste, and the responsibility of healthcare waste segregation, respectively. About 96.9% of HCWs did not have access to any guidelines, and 53.1% did not receive any HCW training. 25% of people had needle sticks or sharps injuries in the last 12 months. 31.5% of health care workers said they practice healthcare waste management, and 93% used gloves when handling medical waste. Only 40.8% of responders sterilized and disinfected infectious waste before discarding it, 31.9% separated wastes by kind at the site of generation, and 88.5% placed healthcare wastes in waste bins (Yenesew et al., 2012).

The study included 351 healthcare professionals working in 14 distinct healthcare settings. The knowledge, attitude, and practice ratings for healthcare personnel were 193 (55%), 218 (62.1%), and 277 (78.9%), respectively. In terms of confounding variables, study participants with >10 years of work experience were 4.28 times more likely to have appropriate knowledge scores than those with 1 to 5 years of work experience. Working 8 or more hours per day increased the likelihood of having a positive attitude by 7, 6, and 6.6 times, respectively, compared to working fewer hours. Similarly, having all three color-coded bins in the department/health care delivery sections was 4.55 times more likely to help health care professionals achieve an adequate practice score, and working hours per day and attitude scores were both significantly correlated with cleaners' practice scores ($p = 0.014$ and $p = 0.034$, respectively) (Deress et al., 2019).

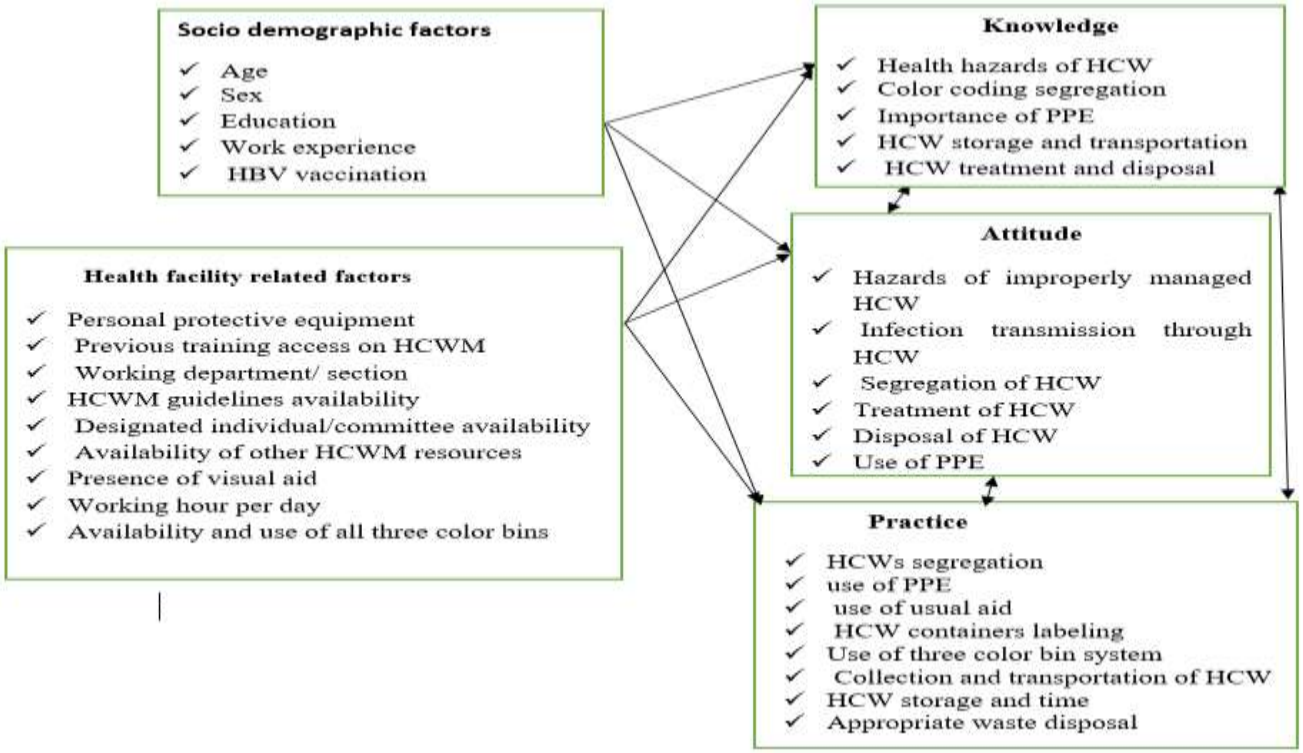
Similarly, Haylamicheal et al.'s study in Hawassa City on the assessment of HCWM showed only one HCF has a complete color-coding system (yellow, black, and safety box). Even at that facility, general waste is frequently mixed with infectious waste. In addition, the majority of HCFs did not practice waste segregation, use safety boxes, use open plastic containers for transportation, use low-combustion, single-chamber, and brick incinerators as a treatment method, were exposed to open dumping of incinerated ash, provided no vaccinations or immunizations to all staff, and from 25% to 100% faced needle-stick injuries at least once in their lives (Haylamicheal et al., 2011).

In Ethiopia, research to date have mostly focused on waste generation rates instead of assessing health care workers' KAP across their job categories about HCWM in order to build a unique strategy to solve issues related to HCW mismanagement. This research thereby closes these gaps.

Figure 1

A Conceptual Framework

Conceptual Framework



Source: Own design based on literature

Method of the Study

A cross-sectional study design and quantitative data collection method based on facilities were used. It took place in Ethiopia's capital city, Addis Ababa, at NSL sub city, from April 1 to April 30, 2022 G.C. All healthcare workers in the sub-city's eight primary public HCFs are considered part of the population, which is sampled at random. Using Kish Leslie's formula for proportionate cross-sectional studies, the sample size of 254 healthcare workers was calculated (Kish Leslie, 1965).

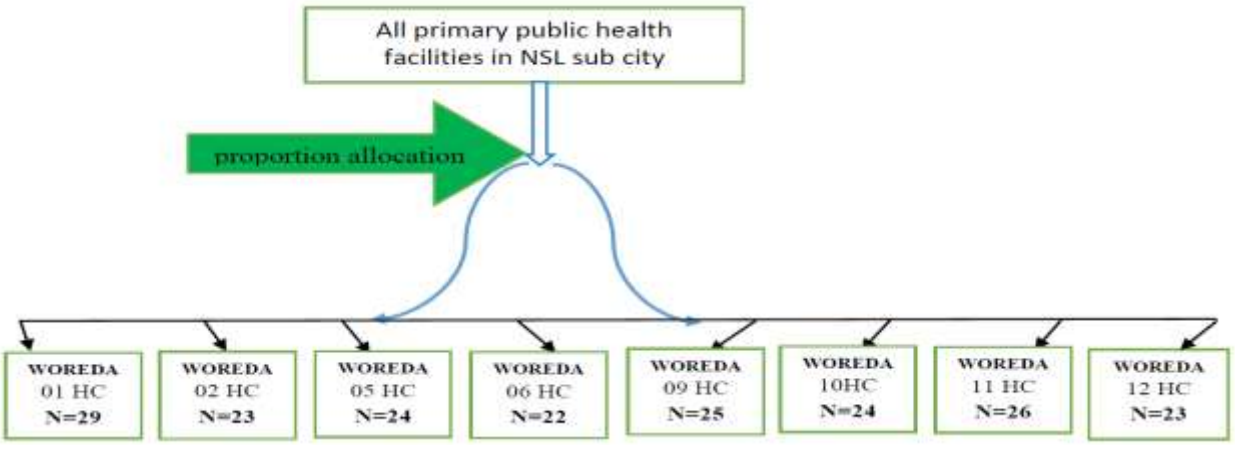
Sample size, (N) = $\frac{(\mathbf{Z}\,\boldsymbol{\alpha}/2)2\mathbf{pq}}{\boldsymbol{\sigma}2}$

The following assumptions are considered: Z score, $\boldsymbol{z}\alpha/2 = 1.96$; prevalence p= 33% (adopted from study on health care waste management and risk factors among healthcare professionals in Hawassa city, Ethiopia), a precision= α = 5% and non-response rate of 10%. Since the total population was less than 10,000, reduction formula was used.

All primary public HCFs in the NSL sub city were included in this study. Proportionate stratified random sampling was used based on information from the NSL sub-city health office about the number of health workers.

Figure 2

A Schematic Presentation of Sampling Procedure



Source: Own design

Data Collection Tools

A semi-structured questionnaire and an observational checklist adapted from World Health Organization (WHO) HCWM rapid assessment tools were used to investigate overall knowledge, attitude, and practice of HCWM (WHO, 2004) using the English language. The questionnaires and observation checklists were validated by conducting a pilot test with 20 health workers in the Akaki Kality sub-city, which was not included in the final analysis. Finally, the tools were conducted on 254 healthcare workers in the Nifas Silk Lafto sub-city primary public health centers. A Cronbach's alpha coefficient test was used for an internal consistency checkup.

Method of measurement (scoring)

Each questionnaire had five sections—sociodemographic, knowledge, attitudes, practice, and a practice check list—and was closed-ended. Each multiple-choice question in the knowledge and practice sections had three or four possible answers, and the scores were dichotomized into "1 point" or "0 point," with "1 point" denoting a correct or expected response and "0 point" denoting a "wrong," "unsure," or "unexpected" response. Although attitude questions are given numerical values of 1, 2, 3, 4, and 5 for the five-point Likert scale responses "strongly disagree," "disagree," "neutral," "agree," and "strongly agree," respectively. The categories "strongly disagree," "disagree," "neutral," "agree," and "strongly agree" were each reverse-coded as 5, 4, 3, 2, and 1 for the questions and statements with negative wording that were scored.

Data Processing and Analysis

Data was entered into Excel that was complete and consistent. After that, it was imported into SPSS 26.0 and STATA 16.0 for analysis. The background information of the respondents, their perceptions of the HCWM dimensions, and their general knowledge, attitude, and practice of HCWM were all analyzed using descriptive statistics like frequency, mean, and correlation analysis. Regression analyses (bivariate and multivariate) were then used to find predictor factors that were significantly associated with the outcome variables. Ultimately, based on the data, judgments and suggestions were made.

Ethical Considerations

Ethical approval letter was written from YOM Postgraduate College of department of project planning and management to NSL sub city and official letters were written for all HCFs and permission was obtained.

Result and Discussion

Socio Demographic and HCFs- Related Results

From the eight HCFs located in the Nifas Silk Lafto sub-city, 254 individuals were included. Their ages ranged from 22 to 57 years old, falling into the age groups of 20 to 30 years old (56.1%), 30 to 40 years old (37.4%), and above 40 years old (6.5%). 165 of them (67.07%) were female, while the remaining 81 (33.3%) were male. Of the study's respondents, 159 (65%) had degrees, 37 (15.0%) had diplomas, 13 (5.3%) had certificates, and 25 (10.2%) had completed their secondary and primary schooling. 82.52% of people had the hepatitis B vaccine. 84.2% had undergone healthcare waste management training, and 3 (1.22%) had encountered a needle stick injury in the previous year.

Furthermore, 178 (86.41%) and 26 (63.41%) healthcare professionals and cleaners, respectively, confirm the availability of sufficient quantities of gloves and heavy-duty gloves at their health facilities. Similarly, 29 (72.5%) of cleaners knew about the availability of heavy-duty gloves, boots, and aprons, whereas 181 (87.9%) of HCPs reported the presence of three color-coded bins (black, yellow, and safety). The majority of respondents were working at OPD 120 (48.8%), delivery 29 (11.8%), laboratory 28 (11.4%), and emergency 39 (15.9%), whereas 29 (12.2%) were working in laundry and other sections. 63 (25.6%) of respondents have 1–5 years of working experience, 142 (57.7%) have 6–10 years, and 41 (16.7%) have more than 10 years of working experience. 231 (93.9%), 10 (4.1%), and 5 (2.0%) were working 8 hours, less than 8 hours, and more than 8 hours per day, respectively.

Similarly, 112 (45.5%) were nurses, 10 (4.1%) were medical doctors, 29 (11.8%) were midwives, 6 (9%) were medical laboratory technicians, 38 (15.5%) were health officers, and 40 (16.3%) were cleaners professionally. 178 (76%) of healthcare workers get access to guidelines, while 59 (24%) do not get access in their working section. 159 (65%) respondents had knowledge. 87 (35% of the healthcare workers) had no knowledge of whether the assigned individual or committee was

available or not in their facility. About 101 (41% of healthcare workers) use guidelines as sources of information; 90 (36.5%) access information from training; and the rest, 55 (22.5%), use their friends as their information sources.

KAP Score Results

78.9% had adequate knowledge about HCWM, 92.7% had a positive attitude, and 63.4% practiced. Laboratory personnel had the highest adequate knowledge score (99.7%). This is followed by health officers (98.4%), and nurses received the least (60.5%). Laboratory professionals had the highest positive attitude score of 98.8%, while cleaners had the lowest positive attitude score of 89.5%. In terms of practice scores, laboratory professionals (72.5%) had the highest scores, followed by medical doctors (70.8%), and cleaners (44.2%) had the lowest practice scores.

Table 1

Study Participants Over All KAP Percentage Distribution About HCWM Results at Health

Category	Knowledge		Attitude		Practice	
	Adequate	Inadequate	Adequate	Inadequate	Adequate	Inadequate
Doctors	7 (64.5 %)	3(35.5%)	9(95.6 %)	1(4.4 %)	7 (70.8 %)	3 (29.2 %)
Nurse	68 (60.5 %)	43(39.5%)	102(90.9 %)	10(9.1%)	74(66.1 %)	38(33.9 %)
Midwife	28(95.2%)	1(4.8%)	28(97.4%)	1(2.6 %)	19(67.0 %)	10(33.0 %)
Laboratory	16(99.7%)	1(0.3%)	16(98.9 %)	1(1.1 %)	12(72.5 %)	5(27.5 %)
Health officer	37(98.4%)	1(1.6%)	37(97.4 %)	1(2.6 %)	26(67.3 %)	12(32.7 %)
Cleaners	38(94.6%)	2(5.4%)	36(89.5 %)	4(10.5 %)	18(44.2%)	22(55.8%)
Total	194(78.9%)	12(21.1%)	228(92.7%)	18(7.3%)	156(63.4%)	90(36.6%)

Source: - Own Computation

Knowledge result

Among the 246 study participants, 189 (86.8%) of the respondents correctly identified the time infectious waste is held before being treated or disposed of within 24–48 hours, and 185 (75.2%) correctly identified the internationally accepted biohazards symbol. 182 (74%), 179 (72.8%), and 230 (93.1%) of the respondents were aware of the yellow bin for infectious waste; the black bins were for noninfectious waste and the safety box for puncture- or cut-causing disposal, respectively.

Table 2

Frequency Distribution of Respondent's Knowledge Results Among Each Knowledge Item Question at Health Facilities

S.N	Assessment of healthcare professionals' knowledge	Doctors		Nurse		Midwife		Lab		Ho		Cleaner	
		Yes	%	Yes	%	Yes	%	Yes	%	Yes	%	Yes	%
13	Does your HCF generate healthcare wastes?	10	100	98	87	27	93	17	100	38	100	40	100
14	Do you have knowledge about HCWM?	10	100	98	87	29	100	16	94.1	38	100	37	92.5
15	Is there any health-related hazard associated with HCW?	8	80	81	72	27	93	17	10	38	100	33	82.5
16	Is sharp or needle-stick injury a concerning issue?	9	90	112	100	27	93	17	100	38	100	40	100
17	Is wearing personal protective equipment minimize infection risk?	10	100	102	91	29	100	17	100	38	100	40	100
18	Do all HCW are hazardous (infectious)?	3	30	25	22	9	31	0	0	12	31.7	10	25
19	Are materials contacts with body fluids regarded as HCW?	9	90	93	83	28	96	17	100	38	100	34	85
20	Do you have knowledge about color coding waste segregation?	9	90	97	87	28	96	17	100	38	100	40	100
21	Should containers of infectious waste be labeled by biohazard symbols?	10	100	102	91	28	96	17	100	38	100	40	100
22	Should HCW be segregated according to categories at its generation?	9	90	101	90	27	93	17	100	38	100	40	100
23	Do disinfecting infectious HCW minimize infection transmission?	10	100	103	92	29	100	17	100	38	100	36	90
24	Does closing needed healthcare waste containers while transport?	9	90	85	76	25	86	17	100	38	100	33	82.5
25	Is securing needed to store HCW until treatment and disposal?	10	100	112	100	27	93	17	100	38	100	34	85
26	Do you know methods of HCW disposal?	9	90	85	76	27	93	17	100	38	100	40	100

Source: Own Computation

Attitudes Results

232 (94.3%), 245 (99.6%), and 241 (98%) respondents agreed that HIV, HBV, and HCV were transmitted through contaminated wastes and body fluids, respectively. 231 (93.9%) respondents agreed that properly disposing of HCW aids in the prevention of infectious disease transmission, and 218 (88.5%) and 232 (94.3%) respondents agreed that HCW should be separated and handled safely at the source of generation. Furthermore, laboratory professionals have the highest score (98.9%), midwives and health officers have similar attitudes (97.4%), and cleaners have the least favorable attitude (89.5%) towards HCWM. However, in order to compare the results with other empirical studies discussed in the following chapter, the Likert scale items were converged or categorized into three Likert scales (disagree, neutral, and agree).

Table 3

Depicts the Frequency Distribution of Study Participant Attitudes

S.N	Your opinion/belief on the following statements?	DA	N	A
34	Infection may cause by HCW if improperly managed	3(1.22%)	9(3.66%)	234(95.12%)
35	Properly handling HCW is our issue and concern	6(2.44%)	15(6.10%)	225(91.46%)
36	The issue of safe HCW management need team work	1(0.41%)	4(1.63%)	241(97.97%)
37	Healthcare wastes can transmit HIV	6(2.44%)	8(3.25%)	232(94.31%)
38	PEP can help to prevent acquiring of HIV infection	0	2(1.22%)	243(98.78%)
39	Healthcare wastes may transmit Hepatitis B virus	0	1(0.41%)	245(99.59%)
40	Healthcare wastes may transmit Hepatitis c virus	0	5(2.03%)	241(97.97%)
41	Healthcare wastes cannot transmit any infectious diseases	0	17(6.91%)	229(93.09%)
42	HCW should be segregated at generation as their categories	3(1.22%)	25(10.16%)	218(88.62%)
43	Segregation of HCW facilitate handling of waste safely	1(0.41%)	13(5.28%)	232(94.31%)
44	Labeling of HCW containers don't add any value to HCWM	0	28(11.38%)	218(88.62%)
45	Proper disposal of HCW prevent transmission of infection	4(1.63%)	11(4.47%)	231(93.90%)
46	Disinfection HCW can minimize contact with Infections	0	0	264(100%)
47	personal protective equipment wearing can minimize infection risks	0	8(3.25%)	238(96.75
48	Healthcare waste management increase work burden	52(21.1%)	10(4.07%)	184(74.80%)
49	Disinfecting Bio hazardous wastes should be important before disposal	4(1.63%)	31(12.60%)	211(85.77%)
		10.9%	25.4%	63.7%

Source: - Own Computation

Respondents Practice about Segregation, Collection and Transportation of HCW

At locations where health care services are provided, 183 (80.8%) healthcare workers employ training or job assistance. 165 (80.10%) and 193 (93.69%) HCPs consistently utilized gloves and gowns when handling or working with medical waste, respectively, regardless of PPE. Similar to this, 32 (80%) cleaners gathered waste within 24 hours of generation, but only 16 (40%) and 17 (42.5%) used lid waste containers and transported waste in accordance with segregation, respectively. All 40 (100%) cleaners decontaminated waste before disposing of it with the advised percent of chlorine solution.

181 (87.9%), 184 (89.3%), and 190 (92.2%) of HCPs used three color-coded bins at their office or department, classified trash as its category, and adhered to the color-coding segregation technique, respectively. 177 (85.9%) of HCPs accurately labeled health care waste containers. Also, 203 (98.5%) HCPs were able to dispose of sharp objects in safety boxes, 145 (70.4%) were able to separate non-infectious garbage into black waste bins, and 148 (71.8%) were able to discharge flood infected waste into yellow bins.

Individual Practice Observation

At the moment of generation, 174 (84.5%) HCPs were categorizing HCW and using safety boxes that were all labeled "biohazard," while 171 (83.3%) of the waste containers were properly tagged. Gloves and gowns were the PPE that were worn by 159 (77.2%) and 205 (99.5%) HCPs, respectively. Also, 39 (18.9%) and 32 (15.5%) of them disposed of mixed rubbish into yellow and black bins, despite 201 (97.6%) and 184 (89.3%) of them using yellow and black waste containers at their respective work areas or departments, respectively. 179 HCPs (86.9%) did not fill their waste containers more than 3/4 of the way. While working or handling medical waste, 30 cleaners (or 75% of them) use heavy-duty gloves, 17 (42.5%) wear an apron, and only 4 (10%) wear boots.

Within 24 hours, all of them (100%) gather trash, and 30 (75%) use the advised chlorine solution to clean reusable items. Moreover, 32 (80%), 35 (87.5%), and 28 (70%) of cleaners' transport waste in open buckets without lids, whereas only 1 (2.5%) cleaner transports waste in a covered bucket.

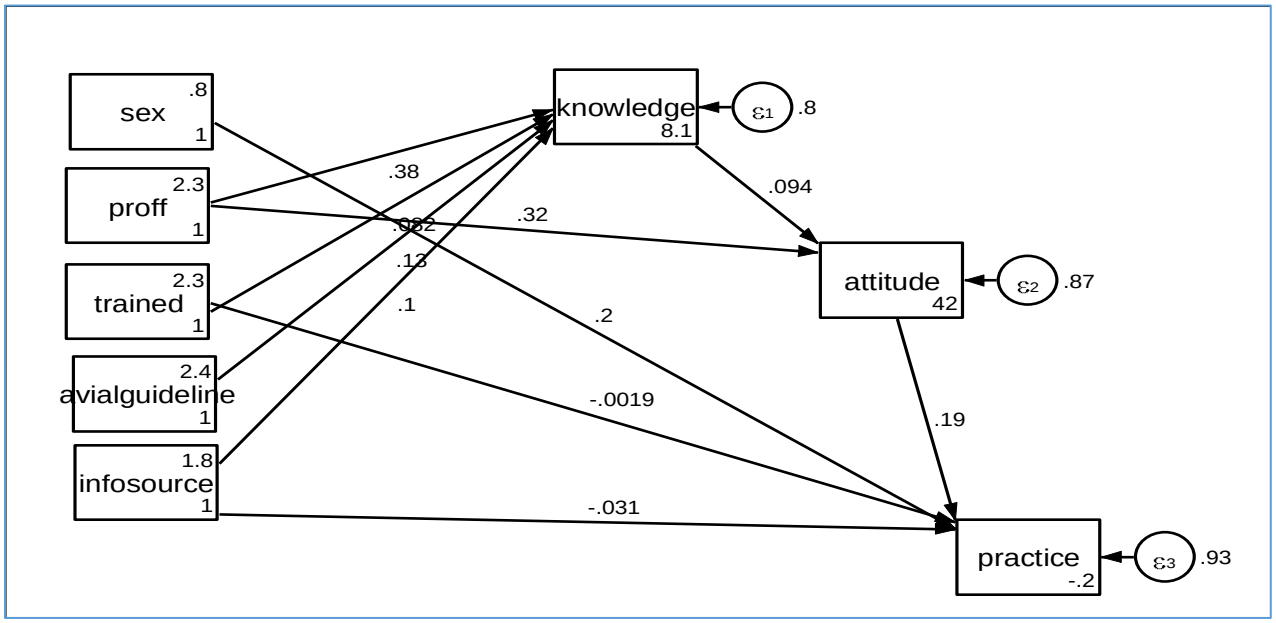
Facility Observational Result

There are no designated spaces for trash storage in any healthcare facility (100%) and all temporary storage is done in puncture-resistant containers. 100% of facilities used chemical, sterilizing, and incineration processes. In all institutions, there was an incinerator made of local bricks, however only 1 (12.5%) of the health facilities had fencing around them to keep out illegal visitors. As a method of waste disposal, 5 (60%); 2 (25%); and 2 (15%) of the facilities employed placenta pits, needle and placenta pits, and ash and placenta pits, respectively. All facilities performed open-air dumping, which was against the law, and burned waste in the incinerator regardless of whether it was advised to burn, bury, composite, recycle, or utilize other methods.

Mediation Analysis (Direct and Indirect Effect of Variables on KAP)

Figure 3

Diagram of Structural Equation Model (SEM) Of Variables.



Source: - Stata Output

*Note that '**info source'** is designated for source of information about healthcare waste management, '**Proff'** for professions of the healthcare workers which are either Doctors, nurse, laboratory, cleaners; '**trained'** for training access on health care waste management; and '**availguideline'** availability of guideline for availability of working.*

As shown in Table 4 below, the structural equation model in the case of knowledge healthcare workers' profession (PV of 0.000) and availability of guidelines (PV of 0.049) had positively and significantly affected their knowledge. The profession (PV of 0.000) of the healthcare workers also had a positive and significantly affected their attitude at the 95% level of confidence. As their education level increases by one level, their knowledge increases by 0.38058 standards, and by availing themselves of one guideline in their working section, their knowledge increases by 0.12528 standards. Likewise, both sex and attitude had positive and statistically significant effects on the practice level of the healthcare workers at the 95% level of confidence.

Table 4

Structural Equation Model in Case of Knowledge

Total effects						
		OIM				
Standardized	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Structural						
knowledge <-						
infosource	.1031052	0.633417	1.63	0.104	-.0210421	.2272526
proff	.3805896	0.064549	6.71	0.000	.2693977	.4917815
trained	.0819346	.0645493	1.27	0.204	-.0445798	.208449
avialguideline	.1252851	.0637219	1.97	0.049	.0003924	2501778
-cons	8.082452	.5598643	14.44	0.000	6.985138	9.179766
practice <-						
attitude	.1857169	.0671334	2.77	0.006	.0541378	.317296
infosource	-.0311274	.0696258	-0.45	0.655	-.1675915	.1053368
sex	.1956064	.0677045	2.89	0.004	.0629081	.3283047
trained	-.0018976	.0689667	-0.03	0.978	-.1370699	.1332747
-cons	-.2017883	3.003005	-0.07	0.946	- 6.08757	5.683994
attitude <-						
knowledge	.0935778	.0705398	1.33	0.185	-.0446777	.2318332
proff	.317754	.0663411	4.79	0.000	.1877278	.4477802
-cons	42.45089	2.299989	18.46	0.000	37.94299	46.95878
var(e.knowledge) var(e.practice)	.8015426 .9273823	.0472241 .0328347			.7141292 .8652095	.899656 .9940227
var(e.attitude)	.866462	. 0427787			.7865463	.9544974
LR test of model	Vs. saturated:	ch2(8) =	23. 7,	prob	> ch2=	0.0026

Source: - Stata Output

Accordingly, the mediator (attitude) and sex had a directly positive and significant effect on the practice of HCWs; as their attitude increases by one level, their practice level increases with a value of 0.1557488 standards, but the availability of guidelines, respondents' profession, and knowledge of HCWM had no direct effect on the practice of HCWs at the 95% level of confidence, respectively. The availability of guidelines had a direct and significant impact, whereas previously-taken training and information sources had no significant effects on the respondents' knowledge. Similarly, the profession of the respondents directly and significantly affects the attitude, but the availability of guidelines, previous training, and sources of information for the respondents had no direct effect on the attitude of the healthcare workers at the 95% level of confidence.

Table 5

Direct Effects of Variables in Case Of KAP

Direct effects						
		OIM				
	Coef.	Std. Err.	Z	P>z	[95% Conf.	Interval]
Structural						
knowledge <-						
infosource	.0893558	.0552898	1.62	0.106	-.0190102	.1977218
proff	.5865665	.0975712	6.01	0.000	.3953304	.7778025
trained	.4247964	.3361273	1.26	0.206	-.234001	1.083594
avialguideline	.6643354	.3424601	1.95	0.052	-.004874	1.337545
practice <-						
knowledge	0	(no path)				
attitude	.1557488	.0570726	2.73	.006	.0438887	.267609
infosource	-.0169252	.0378634	-0.45	0.655	-.0911361	.0572857
sex	.4777795	.1693313	2.82	.005	.1458963	.8096627
proff	0	(no path)				
trained	-.0061726	.2243393	-0.03	0.978	-.4458695	.4335243
avialguideline	0	(no path)				
attitude <-						
knowledge	.0700081	.0529501	1.32	.186	-.0337722	.1737884
infosource	0	(no path)				
proff	.3663757	.0816069	4.49	0.000	.2064292	.5263224
trained	0	(no path)				
avialguideline	0	(no path)				

Source: Stata Output

Accordingly, the profession of the respondents has indirectly and significantly affected their practice, but knowledge, previous training, the availability of guidelines at their work section, and their sources of information had no significant effects; as their profession increases by one level, their practice level increases by 0.06345 standards. The attitude level and sex of the respondents had no effect on the practical level of the participants indirectly. On the other hand, the profession previously has taken training, and the availability of guidelines and sources of information had no effect indirectly on the knowledge of the respondents.

Table 6

Indirect Effects of Variables in Case Of KAP

Indirect effects						
		OIM				
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Structural						
knowledge <-						
infosource	0	(no path)				
proff	0	(no path)				
trained	0	(no path)				
avialguideline	0	(no path)				
practice <-						
knowledge	.0109037	.0082469	1.32	0.186	-.00526	.0270673
attitude	0	(no path)				
infosource	.0009743	.0010168	0.96	0.338	-.0010186	.0029673
sex	0	(no path)				
proff	.0634583	.0260302	2.44	0.015	.01244	.1144766
trained	.0046318	.0053466	0.87	0.386	-.0058473	.015111
avialguideline	.0072655	.0071574	1.02	0.310	-.0067628	.0212938
attitude <-						
knowledge	0	(no path)				
infosource	.0062556	.006113	1.02	0.306	-.0057256	.0182369
proff	.0410644	.031801	1.29	0.197	-.0212645	.1033933
trained	.0297392	.0325526	0.91	0.361	-.0340628	.0935411
avialguideline	.0466489	.0426574	1.09	0.274	-.0369581	.1302559

Source: - Stata Output

Both the profession and the availability of guidelines at work had a positive impact, but previous training and sources of information had no significant effects on the knowledge of HCWs. Similarly, knowledge, taking training, and the availability of guidelines and information sources for the participants had no significant effect, whereas the respondents' profession had a positive and significant effect on their attitude level. Furthermore, sex, profession, and attitude level had positive and significant effects, but knowledge, taking training, the availability of guidelines at the working section, and the information sources of the study participants had no significant effects on their practice level of healthcare waste management at 95% confidence. As their profession increases by one level, their attitude, knowledge, and practice level increase by 0.07000, 0.58656, and 0.06345, respectively, as shown in table 7 below.

Table 7

Total Effects of Variables in Case Of KAP

Total effects						
		OIM				
	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Structural						
knowledge <-						
infosource	.0893558	.0552898	1.62	0.106	-.0190102	.1977218
proff	.5865665	.0975712	6.01	0.000	.3953304	.7778025
trained	.4247964	.3361273	1.26	0.206	-.234001	1.083594
avialguideline	.6663354	.3424601	1.95	0.052	-.004874	1.337545
practice <-						
knowledge	.0109037	.0082469	1.32	0.186	-.00526	.0270673
attitude	.1557488	.0570726	2.73	.006	.0438887	.267609
infosource	-.0169252	.0378634	-0.45	0.655	-.0911361	.0572857
Sex	.4777795	.1693313	2.82	.005	.1458963	.8096627
Proff	.0634583	.0260302	2.44	0.015	.01244	.1144766
trained	-.0061726	.2243393	-0.03	0.978	-.4458695	.4335243
avialguideline	.0072655	.0071574	1.02	0.310	-.0067628	.0212938
attitude <-						
knowledge	.0700081	.0529501	1.32	.186	-.0337722	.1737884
infosource	.0062556	.006113	1.02	0.306	-.0057256	.0182369
Proff	.3663757	.0816069	4.49	0.000	.2064292	.5263224
trained	.0297392	.0325526	0.91	0.361	-.0340628	.0935411
avialguideline	.0466489	.0426574	1.09	0.274	-.0369581	.1302559

Source: - Stata Output

Interpretation and Discussions

Only 75.6% of healthcare workers, according to this study, have access to visual aids or guidelines at work, which is significantly better than the findings of studies done in Nigeria (54%; Sabageh et al., 2015); Debre Markos Town (54%; Deress et al., 2019); and Gondar Town (3.1%; Yenesew et al., 2012). This was most likely a result of the location and time of data management and collecting, of the work done by the infection prevention committee, of volunteerism, and of the HCWs' internal motivational processes. Hospitals and other HCFs have a responsibility to safeguard the environment and advance public health (Uddin MN, et al., 2014). In comparison to research conducted in India (44.3%), Bangladesh (61.1%), Debremarkos (368.8%) (Deress et al., 2019), Gondar town (46.9%) (Azage and Kumie, 2010), and Adama town (31.9%), only 84.1% of respondents participated in HCWM or related training (Hayleeyesus and Cherinete , 2016).

HBV vaccination was advised to reduce threats to occupational health (Chartier et al., 2014). Only 82.5% of the study subjects received an HBV vaccination. This result was lower than the study conducted in India (95%) (Amouei et al., 2015) and in Iraq (85.5%) (Mane V et al., 2016), but higher than the result of the study in Debre Markos, 29.0% (Deress et al., 2019), and Addis Ababa city administration's hospitals, 24.6% (Kedija, 2015). This could be caused by a lack of facility commitment, a tight budget, or a vaccination shortage. Waste handlers are required to receive HCWM training as a nationwide requirement (FMoH, 2008.). In comparison to studies conducted in Nigeria (31.4%) (Sabageh et al., 2015) and Gondar, Ethiopia (53.1%), 84.1% of health care personnel received training (Azage and Kumie, 2010). In the previous 12 months, 9.2% of healthcare professionals were exposed to needle stick injuries, which was nearly three times better than studies done at DebreMarkos (24.5%) and Gondar Town (30.8%) and five times better than Nigeria (51%) (Sabageh et al., 2015). (Azage and Kumie , 2010).

Knowledge of the Study Participant

The overall adequate knowledge of the study participant was 78.9%, which was better than the study done in Nigeria (45%; Sabageh et al., 2015) and in Ethiopia at Debre Markos Town (55% Deress et al., 2019), but lower than the study conducted in Kolkata, India (98.21%; Ray et al., 2014). About 93.5% knew their facilities generate healthcare wastes, which was more or less

comparable with the study conducted in India (89.5%; Mane V et al., 2016), but higher than the study conducted in Iran (47%; Amouei et al., 2015); and Debre Markos, Ethiopia (84.8%; Deress et al., 2019).

Nationally, three color-coded waste containers were recommended (black, yellow, and safety boxes for general, hazardous, and sharp waste, respectively). (FMoH, 2008.). 93.1% of the study participants had good knowledge of segregating wastes following the color-coding principle, which was almost similar to the study conducted in India, where 92.3% had good knowledge (Karmakar., 2016), but higher than the 77.2%, 37%, and 17.5% of the studies conducted in Ethiopia at Debre Markos, Adama, and Gondar towns, respectively (Hayleeyesus and Cherinete, 2016). This distinction was due to a sufficient supply of waste bins, safety boxes, personal protective equipment, adequate training, the active work of infection prevention committees, and strong support from facility leaders and the government.

In this study, 74.8%, 74.4%, and 93.1% of the study participants correctly identified the yellow bin, black bin, and safety box for disposal of infectious, general/noninfectious, and sharp material according to their categories, respectively, which was higher than the study conducted in Iran with 48.2% (Amouei et al., 2015). Infectious waste containers must be marked with an internationally recognized biohazard symbol (Chartier et al., 2014; FEPA, 2004). 92.7% of healthcare workers correctly identified waste containers labeled with the biohazard symbol, which was higher than 54.4% and 53.6% of the studies conducted in India (Radha, R., 2012) and Ethiopia at Debre Markos Town, respectively (Deress et al., 2019). Infectious wastes should only be kept for a maximum of 48 hours (two days) (Chartier et al., 2014; FEPA, 2004). 76.8% of the study participants have knowledge about how long the infectious wastes in HCFs were stored before being treated and disposed, which was higher than the study conducted in India (36.5%) (Radha, 2012) and Ethiopia at Debre Markos Town (10%) (Deress et al., 2019).

Attitude of the Study Participant

The overall positive attitude of study participants was 92.7%, which was twice as high as studies done in Nigeria (45.5%), Zambia (34%); DebreMarkos (62.1%) (Deress T, et al., 2019); and Gondar towns, Ethiopia (59.9%) (Yenesew et al., 2012), but lower than studies conducted in

Tripura, India (96.8%) (Leonard, 2022). This gap might be due to academic differences, training toward HCWs' perceptions, accessibility of operational manuals at working sections, or national policy or regulation toward HCWM. This study result showed that about 94.3%, 99.9%, and 97.7% of the study participants agreed that HIV, HBV, and HCV were transmitted through contaminated healthcare wastes, respectively, which was higher than the study finding in Nainital, India, of 87.3%, 86.4%, and 85.5% (Kumar et al., 2015) and at DebreMarkos Town, Ethiopia, of 92%, 91.7%, and 76.9%. This study revealed 88.1% of the study respondents segregate waste at the point of generation before disposal, which is equal to the study conducted in India (88.7%) and higher than the 86.3% done at Debre Markos Town, Ethiopia (Deress et al., 2019).

Study Respondents Practical Score

The overall practice score of this study's respondents was 63.4%, which was higher than the studies conducted at the same time and in different countries in Iran (50%) (Amouei et al., 2015), Nigeria (40.5%) (Sabageh et al., 2015), and Gondar, Ethiopia (33% Yenesew et al., 2012), but lower than the study conducted at DebreMarkos Town (78.9%) (Deress et al., 2019). This gap could be caused by a lack of supplies, a lack of motivation among HCPs, a lack of active committee functioning, a lack of incentives and job satisfaction, a lack of governmental support and mentorship, a lack of higher officials' commitment and enforcement, work experience, academic differences, a lack of training, a lack of awareness, and the lack of updated guidelines and policies. Waste was separated at the source using different color-coded waste bins (Chartier, 2014). 92.2% of healthcare professionals segregate waste by following color-coded waste bins, which was better than the studies conducted in India (80.6%) (Karmakar, 2016) and Nigeria (21.7%) (Uchechukwu, et al., 2017). Specifically, 98.5% of healthcare professionals segregate sharp materials into safety boxes. This result was higher than the study conducted in Nigeria (71.9%) (Azuike et al., 2015) and in Debre Markos Town (83.4%) (Deress et al., 2019).

Gloves, heavy-duty gloves, boots, and aprons must always be worn while handling or working with HCW (Chartier, 2014). This study result showed 88.3% of HCPs use gloves, 75% of cleaners always wear heavy duty gloves, 47.5% wear aprons, and 70% wear boots while handling or working with healthcare waste, which was lower than the national guideline expectations. This may be due to a lack of knowledge, experience, work burden, training, or academic factors. During

24 to 48 hours of service delivery, waste was collected, transported in closed containers, and sorted (Chartier, 2014; FMoH, 2008). Yet, only 80%, 40%, and 42.5% of states collected and transported lidded garbage containers on schedule and in accordance with their segregation, respectively, falling short of the criteria of the national guidelines. This is probably brought on by a dearth of suitable waste transportation tools, a busy workload, or a lack of awareness of the value of trash segregation.

Waste Treatment and Disposal in HCFs

Hazardous HCWs should be stored in a separate central storage area prior to treatment and disposal, as should HCWs treated onsite using methods such as incineration, sterilization, and chemical disinfection; infectious HCWs should not be stored for more than 48 hours (FMoH, 2008). According to the study findings, all health care facilities (100%) had no central storage areas prior to treatment and disposal; two facilities stored infectious waste for more than two days; and all healthcare facilities used onsite treatment methods, but the incineration found in all facilities was not standardized; some lacked closing doors and separated pit ash; and were not fenced and restricted from unauthorized persons.

Associated Explanatory Variables with KAP of the Respondents

With a statistical significance value of 0.0344, those with a BSc or higher in education had better understanding about healthcare waste management than those with a diploma or certificate. This was presumably because they participated in higher education, learned material relevant to their career, and worked in departments, which increased their knowledge.

The occupations of the workers have a highly significant association (PV = 0.0001), which may be due to their closer relationship to daily HCW generation than others, their greater training and access to information, the fact that instruction, job aids, and guidelines are not equally available at the working site, and the fact that they have different perspectives on the benefits of using PPE to reduce infection risk and waste segregation based on their category.

Likewise, working divisions with healthcare waste management (PV = 0.0057) Also, there are considerable connections between the respondents' knowledge and working hours (PV = 0.0290),

the availability of guidelines (PV = 0.0268), the assigned committee (PV = 0.0265), practice (PV = 0.0010), and attitude (PV = 0.0000). The availability of guidelines, a positive outlook, actively participating in a designated infection prevention committee that promptly monitors and assesses the level of knowledge and practice of HCWs, the availability of PPE in sufficient numbers, and timely attendance at training are possible explanations.

On the other hand, the knowledge and educational level of the healthcare workers have a strong statistically significant (PV = 0.0000) association with their attitude. In parallel, sex (PV = 0.0179), working department (PV = 0.293), information sources (PV = 0.0246), guidelines availability (PV = 0.0436), and HCW practice (PV = 0.0027) have a direct and significant association with attitude. This may be due to enrollment in higher education, timely training, and the accessibility of information sources, the availability of instruction or job aids on site, well-trained employees, and the support of an actively working infection prevention committee. Directly or indirectly, good knowledge and a positive attitude affect the practice of the HCW among healthcare workers have a statistically significant association with the practice of the HCWs' knowledge (PV = 0.0010) and attitude (PV = 0.0027).

Conclusion and Recommendations

According to the study, healthcare workers had adequate knowledges (78.9%), a positive attitude (92.7%), and adequate practice (63.4%). Among the three, the practice score was low. Similarly, this low result was also scored among cleaners (44.2%), nurses (66.1%), and midwives (67%). Similarly, the lowest knowledge score was obtained among nurses (60.5%) and medical doctors (64.5%). In addition, the good attitude of the study participants was scored among cleaners (89.5%) and nurses (90.9%). Educational and informational sources, the assigned committee, and the profession of the respondents had statistically significant associations with the respondents' knowledge; experience, working conditions, and educational level of the respondents also had a statistically significant effect on the attitude of the healthcare workers. In addition, both the attitude and sex of the study participants had a statistically significant effect on the practice level of the healthcare workers at a level of 95% confidence with a PV of 0.05 marginal error.

The government shall work on the knowledge, perception, and practice of the HCWs, upgrading their educational level, availing of guidelines, visual aids, policy manuals, and other necessary

reference materials at the working sites, actively functioning assigned infection prevention committees, providing basic training and creating self-awareness, sufficient PPE, color-coded waste bins, gloves, boots, and biohazard symbols, and a standardized waste storage, treatment, and disposal area regarding effective healthcare waste management. In addition, further, more comprehensive studies should be conducted to overcome the problems.

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