




BMJ Open Healthcare waste management practice and its predictors among health workers in private health facilities in Ilu Aba Bor Zone, Oromia region, South West Ethiopia: a community-based cross-sectional study

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ABSTRACT

Objectives A lack of safe healthcare waste management (HCWM) practice poses a risk to healthcare staff, patients and communities. In low-income countries like Ethiopia, studies on the level of safe HCWM practices in private healthcare facilities are limited. This study was designed to assess the level of good HCWM practice and associated factors among health workers in private health facilities.

Methods An institution-based cross-sectional study was conducted in the Ilu Aba Bor zone, South West Ethiopia. A random sample of 282 health workers from 143 private health facilities was included in the study. Data were collected using a pretested structured questionnaire that included sociodemographic characteristics, healthcare factors, knowledge assessment and an observation checklist adapted from WHO guidelines. The collected data were entered into EpiData V.3.1 and analysed with SPSS V.25.0. Multivariable logistic regression analysis was used to identify factors associated with HCWM practice. Variables with a p value of <0.05 at 95% CI were declared significant.

Results More than half (58.7%) of private-sector health workers had good HCWM practice. The presence of the HCWM committee (adjusted OR (AOR)=9.6, 95% CI 4.5 to 20.6), designated healthcare waste storage site (AOR=3.0, 95% CI 1.5 to 6.5), reading the HCWM manual (AOR=4.4, 95% CI 2.2 to 9.0) and having good knowledge of HCWM (AOR=2.6, 95% CI 1.06 to 6.15) were factors associated with good HCWM practice.

Conclusion About three out of five health workers in private healthcare facilities were practising good HCWM. The presence of an HCWM committee, waste management utilities, reading HCWM guidelines and knowledge of health workers were the identified factors. Health workers should read guidelines to improve their knowledge, and the presence of committees and waste management utilities in private clinics should be followed to ensure compliance with safe HCWM practice.

STRENGTHS AND LIMITATIONS OF THE STUDY

- ⇒ This study has provided valuable evidence regarding the level of safe healthcare waste management (HCWM) practice that would support future research.
- ⇒ The study is limited to HCWM practice during routine healthcare service provision and solid waste management.
- ⇒ There is a lack of a standard measuring tool for HCWM practice.
- ⇒ The lack of expert input may lead to an underestimate or overestimate of the level of safe HCWM practice.

INTRODUCTION

In an effort to manage health issues and safeguard the public from various health dangers, healthcare facilities can generate waste¹ that could be potentially harmful to the staff of healthcare facilities, patients and the surrounding community and affect the environment when the waste is not managed properly.^{2 3} Healthcare waste (HCW) constitutes a special category of waste, and it is now well known that some types of HCW are among the most harmful and dangerous of all pollutants generated in communities.^{1 4} This waste could be sharp, non-sharp, blood, body parts, chemicals, pharmaceuticals, medical devices, radioactive materials and other biological wastes.^{5 6} According to the WHO, of the total amount of waste generated by healthcare activities, about 15% is considered hazardous material that may be infectious, toxic or radioactive.^{6 7}

In healthcare facilities around the world, relatively considerable amounts of potentially infectious and dangerous wastes are

produced each year, which is a major public health concern.^{8–11} Health facilities are responsible for ensuring that their waste handling, treatment, and disposal activities have no detrimental effects on human health or the environment.^{1 3 5} However, it appears that the fraction of waste generated by healthcare institutions has received less attention than other categories of pollution, particularly in low-income nations.^{12–15}

Healthcare waste management (HCWM) practice encompasses the following: separation of HCWs according to their category and labelling waste containers (segregation); proper protective equipment and waste transporting utility supply (collection); and secured and adequate temporary waste storage space allocation (storage), transportation, treatment and disposal activities.^{1 16 17}

Globally, safe waste management services for HCW are lacking, especially in the low-income countries.^{18–21} Globally, one in three healthcare facilities do not safely manage HCW.⁶ The management of HCWs has become one of the most critical concerns in developing because improper handling of medical waste has debilitating effects on the environment, public health, workplace safety, water quality and the large risk of spreading disease.^{10 14 15 22} HCWM in many low-income countries has often been poor, which raises concerns about the inappropriate methods employed in such states.^{9 23–25}

Even though HCW production is often lower in middle-income and low-income countries than it is in high-income countries,¹⁹ a study of 22 low-income nations raised concerns about the potential issues brought on by HCW when it was found that between 18% and 64% of healthcare institutions used ineffective waste disposal techniques.^{3 17 23 26 27} Despite the magnitude of the problem, practices, capacities and policies in many countries dealing with HCW disposal, especially in low-income nations, are inadequate and require intensification.^{15 28}

Even though healthcare is becoming increasingly important in many countries' national health policies, HCW has received insufficient attention in low-income countries.^{29–33} Some countries in Africa, including Ethiopia, Botswana, Nigeria and Algeria, do not have national guidelines in place to adhere to the correct disposal of HCW.¹⁴ This is due to the fact that health problems frequently compete with other economic areas for the limited resources available.¹⁶ Thus, the management of HCW ends up not getting the priority it deserves. Hazardous HCWs are still handled and disposed of alongside domestic waste in many low-income countries, posing a significant health risk to municipal workers, the general public and the environment,^{8 34} and HCW segregation, collection and storage in isolated areas are insufficient.³⁵

Many researchers in low-income countries have investigated the existing HCWM practices in selected healthcare centres within their countries.³⁶ A Nigerian case study revealed that the level of HCWM practice was found to be zero (ie, unsustainable).³⁴ In Ethiopia, the proportion of HCW generated in healthcare facilities ranged from 21%

to 70%.¹⁶ Inadequate HCWM, such as open dumping and uncontrolled burning in the country, raises the risk of transmission of infectious diseases like the hepatitis B virus (HBV), environmental contamination, offensive odours, and the proliferation of insects, rats and worms, all of which can be avoided with proper HCWM practices.^{12 16 18 37 38}

Lack of awareness about the health hazards of HCW, inadequate training in proper waste management, and the absence of waste management and disposal systems, insufficient financial and human resources, and the low priority given to the topic are the most common problems associated with poor HCWM practice.^{6 39–42} The capacity of a healthcare facility to effectively manage HCW is influenced by a variety of factors, such as staff commitment and work experience, knowledge and training, the presence of waste management utilities, a committed waste management team and a national regulatory framework.^{29 41 43 44}

To overcome the problems of HCW, the WHO developed the global comprehensive guidance document which addresses the regulatory framework, planning issues, waste minimisation and recycling, handling, storage, and transportation, treatment and disposal options, and training.¹⁸ In addition, as part of monitoring Sustainable Development Goal 6 on safely managed water and sanitation, the WHO/UNICEF Joint Monitoring Program⁴⁵ launched a global initiative to ensure that all healthcare facilities have adequate water, sanitation and hygiene services that include addressing HCW and is regularly reporting on the safe management of HCW as part of wider monitoring efforts on water and sanitation in healthcare facilities.⁴⁶

Although there have been improvements in the past 10 years in the management of HCW since the WHO disseminated guidance on national HCWM plans in sub-Saharan countries and low-income nations have learnt from India's experience,^{1 2 21 47} handling HCW and avoiding possible threats remain key challenges for healthcare institutions.³⁹ Many low-income countries either do not have appropriate regulations or do not enforce them,³⁰ though government commitment and support are needed for universal and long-term improvement, and some healthcare facilities do not abide to the HCWM policy of their country.^{6 22 34}

In Ethiopia, studies indicated that a 35%–40% of health workers were practising improper HCWM.^{4 29 41 44} Private healthcare facilities in Ethiopia are more important than ever to serve the community's basic health requirements and fulfil the objectives of sustainable development.³⁹ A few studies in the country found that most private healthcare facilities studied did not have waste segregation, where wastes were stored, transported, treated and disposed of wrongly.^{48 49} The level of good HCWM practice among health workers in private health facilities in Ethiopia, however, has received scant research despite the fact that these facilities serve a significant number of populations in the country.¹⁶ Hence, determining the

level of HCWM practice and identifying its predictors is important to understand the gap and strengthen the existing strategies.

METHODS

Study design and setting

An institution-based cross-sectional study was conducted in Ilu Aba Bor Zone private healthcare facilities from 3 June 2021 to 16 August 2021. Ilu Aba Bor Zone is one of the 20 zones of Oromia regional state, situated in the southwest of the region and located at a distance of about 600 km from Addis Ababa, the capital city of Ethiopia. The Ilu Aba Bor Zone has 1 town administration and 13 rural districts with a total population of 1 271 609.⁵⁰ In the zone, there is 1 referral hospital, 1 district hospital, 41 health centres, 276 health posts, 143 private health facilities and 481 private health workers.

Study population

The study populations were all health workers in the selected health facilities, working for at least six months in the facilities prior to the data collection period. A study population of 481 health professionals has been deduced from the 143 private health facilities from which the sample size of 282 was taken.

Sample size and sampling procedure

The sample size (n) was determined using the single population proportion formula, considering a 95% confidence level, a 5% margin of error (d), and taking the proportion (p) of proper HCWM practice to be 78.9%

from the study in Gondar.⁴⁴ These assumptions are substituted in the following formula:

$$n = (Z/2)^2 pp(1p) = (1.96)^2 * 0.789(0.789) = 256$$

$$d^2(0.05)^2$$

By considering a 10% non-response rate, the final sample size was 282. All private health facilities in the Ilu Aba Bor Zone administration were included in this study. The respondents were stratified by type of health facility (rural drug vendor, lower clinic, medium clinic and pharmacy), and using a proportional size allocation, a sample was drawn from each stratum by using a simple random sampling technique using the list of health workers in the register of employees in each health facility as a sampling frame (figure 1).

Data collection procedures

Structured and pretested questionnaires were used to collect data through face-to-face interviews. Five environmental health professionals were recruited for data collection after 2 days of training on the data collection process. The questionnaire consisted of questions related to sociodemographic characteristics, health facility-related factors, knowledge assessment questions, and an observation checklist to assess HCWM practice, which was adapted from previous similar studies and WHO HCWM guidelines.^{1 18 41 44}

Knowledge of HCWM was assessed by 10 knowledge-related (yes/no) questions. A score of 1 was given for a 'yes' response and 0 for a 'no' response. Accordingly, the knowledge score ranges from 0 to 10. Healthcare professionals were deemed to have good knowledge of HCWM

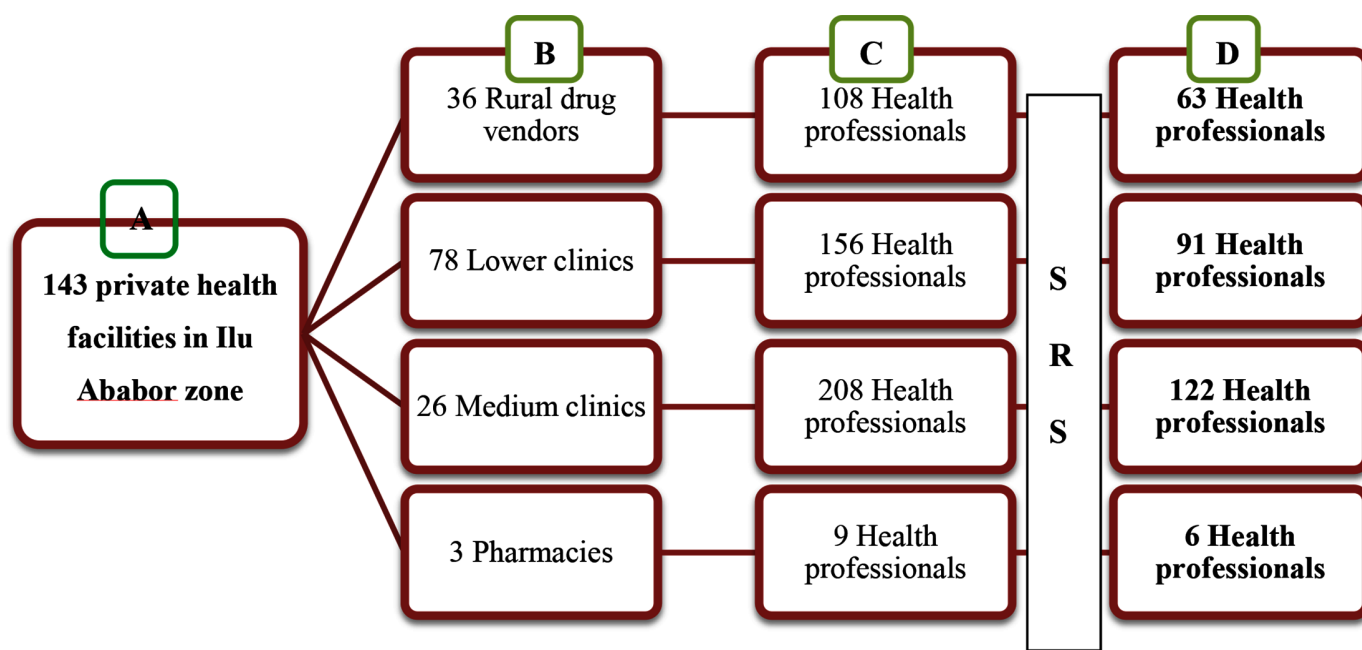


Figure 1 Schematic presentation of the sampling procedure.

Lane 'A' indicates the total number of private health facilities. Lane 'B' indicates the types and number of health facilities in the zone. Lane 'C' indicates the total number of health professionals in the respective health facility. Lane 'D' indicates the number of health professionals included in the study. SRS, simple random sampling.

if they scored a median score or higher on the knowledge assessment questions. Otherwise, they were considered to have poor knowledge of HCWM.^{29 39 41 51}

The HCWM practices of the participants were assessed by 16 practice-related questions. Accordingly, healthcare workers were deemed to have good HCWM practices if they scored a mean score or higher on the evaluation questions relating to these practices. Otherwise, they were considered to have poor HCWM practice.^{41 42 44 52}

Data processing and analysis

The collected data were cleaned, coded, and entered into EpiData V.3.1 before being exported to SPSS V.25.0 for analysis. The variables were summarised using descriptive statistics such as frequencies and proportions. A simple logistic regression model was used to identify the association between the explanatory variables and HCWM practices. After checking for assumptions, variables with a p value less than 0.2 in bivariate binary logistic regression were taken to multivariate binary logistic regression analysis. Adjusted ORs (aOR) with their 95% CI) were used to determine the significance of predictors at a p value of <0.05. Hosmer and Lemeshow goodness of fit (p=0.542)⁵³ was used to assess the model's fitness.

Patient and public involvement

Patients and the public were not involved in the design, conduct, reporting or dissemination plans of this research.

RESULTS

Sociodemographic characteristics of participants

A total of 264 health workers participated in the study, giving it a 93.6% response rate. Most of them (76.5%) were male. The mean (\pm SD) age of the respondents was 35.16 (\pm 10.6). Most of them (59.8%) were married, and the majority (65.2%) of respondents were nurses. More than half (58.7%) of the health workers have a diploma, and half (50.4%) are working in medium clinics (table 1).

Healthcare facility-related factors

The study showed that 113 (42.8%) health workers reported that there was enough personal protective equipment and other supplies for HCWM in their facilities. One hundred twenty-four (43%) of healthcare workers had a HCWM team/committee. However, only one-third of the participants (33.3%) had training on HCWM practices (table 2).

Knowledge-related characteristics of health workers

The majority of respondents (83%) responded that improper colour coding of waste bins increases the risk of injury. More than half (52.3%) of health professionals in private health facilities responded that HCW should not be segregated at the point of waste generation. One in five (19.3%) health workers replied that the safety box should be filled more than the recommended line. Using the knowledge-based questions to measure the knowledge level of healthcare workers about HCWM practices,

Table 1 Sociodemographic characteristics of health workers in private health facilities in Ilu Aba Bor Zone, South West Ethiopia, 2021

Variables	Categories	n (%)
Age (years)	18–25	112 (42.4)
	26–35	64 (24.2)
	36–45	26 (9.8)
	46 and above	21 (7.9)
Sex	Male	202 (76.5)
	Female	62 (23.5)
Level of education	Diploma	155 (58.7)
	First degree	93 (35.2)
	Second degree	13 (4.9)
	Others	3 (1.1)
Marital status	Married	158 (59.8)
	Single	104 (39.4)
	Widowed	2 (0.8)
Healthcare facility type	Medium clinic	26 (18.2)
	Small clinic	78 (54.5)
	Pharmacy	3 (2.1)
Professional category	Rural drug vendor	36 (25.2)
	Nurse	172 (65.2)
	Midwife	39 (14.8)
	Health officers	35 (13.3)
	Medical doctors	11 (4.2)
	Pharmacist	7 (2.7)
Work experience (years)	0–5	122 (46.2)
	6–10	87 (32.9)
	>11	55 (20.8)
Health worker affiliation	Medium clinic	133 (50.4)
	Small clinic	80 (30.3)
	Pharmacy	35 (13.2)
	Rural drug vendor	16 (6.1)

we found that 178 (67.4%) healthcare employees had a good understanding of these practices (table 3).

HCWM practice of health workers

Of the 264 participants, only 141 (53.4%) always used gloves while handling HCW. The majority (64.8%) of health workers fill safety boxes above the recommended level. About 90% were wearing an apron or gown while handling HCW. However, nearly half of the participants (49%) filled the infectious safety box more than three-quarters of the time. Similarly, about 45% of the study participants had no guidelines supporting the HCWM practice. One hundred eighty-one (68.6%) of the respondents used gloves during the handling of HCW. Forty-one (15.5%) of the respondents had practised inappropriate disinfecting techniques on reusable materials. Two hundred seven (78.4%) of the respondents put HCW in designated containers. Only 58 (22%) of the healthcare workers transported HCW to final disposal sites by covering the waste container (table 4).

Factors associated with HCWM practice

HBV vaccination status, history of a sharp injury, presence of a visual aid or instruction near waste disposal, presence of a designated HCW storage site, presence of a

Table 2 Healthcare facility-related characteristics of private health facilities in Ilu Aba Bor Zone, South West Ethiopia, 2021

Variables	n (%)
Presence of enough PPE and other supplies for safe HCWM	
Yes	113 (42.8)
No	151 (57.2)
Presence of coded waste containers in the facility	
Yes	208 (78.8)
No	56 (21.2)
Training on HCWM	
Yes	88 (33.3)
No	176 (66.7)
Presence of HCWM enforcing committee	
Yes	124(47)
No	140(53)
Presence of safety box in each procedure room	
Yes	211 (79.9)
No	53 (20.1)
Presence of functional incinerator	
Yes	168 (63.6)
No	96 (36.4)
Presence of HCWM manual or guideline	
Yes	146 (55.3)
No	118 (44.7)
Presence of HCWM system	
Yes	214 (81.1)
No	50 (18.9)
HCWM, healthcare waste management; PPE, personal protective equipment.	

functional HCWM committee, having ever read a manual about HCWM, training in HCWM and knowledge are all associated with proper HCWM practice in the bivariate binary logistic regression.

Multivariate logistic regression analysis was conducted to identify the independent predictors of HCWM practice among health workers in private health facilities using the backward stepwise method involving four steps, which indicated that having a HCWM committee, a manual or guideline related to waste handling, the presence of a designated waste storage site and participants' knowledge about HCWM were significantly associated with HCWM practice at a p value less than 0.05.

Accordingly, the odds of good HCWM practices were about 9.6 times (AOR=9.6, 95% CI 4.5 to 20.6, $p<0.001$) higher in health workers who had a HCWM committee than in those who did not have one. The odds of healthcare workers where there was a designated waste storage site were three times (AOR=3.0, 95% CI 1.5 to 6.5, $p=0.003$) more likely to practise good HCWM than those not using

Table 3 Knowledge on HCWM among health workers of private clinics in Ilu Aba Bor Zone, South West Ethiopia, 2021

Variables	n (%)
Improper colour coding on waste bin increases the risk of injury.	
Yes	219 (83)
No	45 (17)
Improper HCW disposal contributes to disease transmission.	
Yes	163 (61.7)
No	101 (38.3)
HCW should be segregated at the point of waste generation.	
Yes	126 (47.7)
No	138 (52.3)
Wearing personal protective equipment reduces the risk of acquiring infections.	
Yes	237 (89.8)
No	27 (10.2)
General wastes should be placed in a black-coloured container.	
Yes	228 (86.4)
No	36 (13.6)
Infectious wastes should be placed in a yellow-coloured container.	
Yes	195 (73.9)
No	69 (26.1)
Sharp HCWs should be placed in a safety box.	
Yes	242 (91.7)
No	22 (8.3)
Safety box should not be filled more than three-fourths.	
Yes	213 (80.7)
No	51 (19.3)
The maximum storage time of any HCW is 24 hours.	
Yes	197 (74.6)
No	67 (25.4)
Hepatitis B and C can be transmitted from unsafe HCWM practice.	
Yes	207 (78.4)
No	57 (21.6)
Knowledge about HCWM	
Good	178 (67.4)
Poor	86 (32.6)
HCW, healthcare waste; HCWM, healthcare waste management.	

the incinerator. This study also found that the odds of healthcare workers who had read HCWM manuals or guidelines were about four times (AOR=4.4, 95% CI 2.2 to 9.0, $p<0.001$) more likely to have good HCWM practice than their counterparts. The odds of healthcare workers who had good knowledge of HCWM practice were 3.6

Table 4 HCWM practice among healthcare workers of private clinics in Ilu Aba Bor Zone, 2021

Variables	Categories	n (%)
Always uses gloves while handling HCW	Yes	141 (53.4)
	No	123 (46.6)
Separation of HCWs according to their category	Yes	195 (73.9)
	No	69 (26.1)
Use a designated waste container for disposing of HCW	Yes	207 (78.4)
	No	57 (21.6)
Filling safety box up to the recommended line	Yes	93 (35.2)
	No	171 (64.8)
Puts sharp HCWs in a safety box	Yes	205 (77.6)
	No	59 (22.4)
Put general (non-infectious wastes) in a black container	Yes	162 (61.4)
	No	102 (38.6)
Appropriate reusable instruments disinfection steps	Yes	223 (84.5)
	No	41 (15.5)
Separate HCW transportation to a disposal site	Yes	208 (78.8)
	No	56 (21.2)
Closing HCW containers while transporting	Yes	206 (78)
	No	58 (22)
HCW collection within 24 hours	Yes	210 (79.5)
	No	54 (20.5)
HCWM practice	Good	155 (58.7)
	Poor	109 (41.3)
The overall safe HCWM practice among health workers working in private health facilities in this study was 58.7%. HCW, healthcare waste; HCWM, healthcare waste management.		

times (AOR=3.6, 95% CI 1.7 to 7.7, p=0.001) more likely to have good HCWM practice than those who had poor knowledge of HCWM (table 5).

DISCUSSION

WHO has prepared HCWM guidelines to ensure good HCWM practice.¹⁸ Moreover, the Ethiopian Food and Drug Administration authority and Ministry of Health have prepared a working guideline that describes different types of HCW and their risks.⁵⁴ HCWM is a public and environmental health concern worldwide, particularly in low-income countries, and can affect all individuals including healthcare providers.²²

This study has provided valuable evidence regarding the level of HCWM practice and the possible associated factors among health workers in private health facilities based on the recommended HCWM process (segregation, collection, storage, transportation, treatment and disposal) that would support existing policies and future research. Accordingly, it was found that 58.7% of the healthcare workers in private health facilities had good HCWM practices. This finding is consistent with other studies conducted in Addis Ababa, Ethiopia⁴ and South Africa.⁵¹

Table 5 Factors associated with HCWM practices among health workers of private health facilities in Ilu Aba Bor Zone, South West Ethiopia, 2021

Variables	HCWM practice		COR (95% CI)	AOR (95% CI)	P value
	Good	Poor			
HCWM committee					
Yes	110	14	16.6 (8.6 to 32.08)	9.6 (4.5 to 20.6)	0.000*
No	45	95	1	1	
Vaccinated for HBV					
Yes	45	45	1	1	0.349
No	110	64	1.7 (1.02 to 2.8)	1.4 (0.7 to 3.1)	
History of sharp injury					
Yes	59	26	0.5 (0.3 to 0.8)	0.5 (0.24 to 1.07)	0.076
No	96	83	1	1	
Presence of designated waste storage site					
Yes	91	21	5.3 (3.04 to 9.3)	3.0 (1.5 to 6.2)	0.003*
No	64	86	1	1	
Visual aid near waste storage					
Yes	132	82	1.9 (1.02 to 3.5)	1.2 (0.47 to 2.8)	0.747
No	23	27	1	1	
Ever read a manual on HCWM					
Yes	119	27	10.0 (5.6 to 17.8)	4.4 (2.2 to 9.0)	0.000*
No	36	82	1	1	
Training on HCWM					
Yes	70	18	4.2 (2.3 to 7.5)	1.3 (0.6 to 2.9)	0.562
No	85	91	1	1	
Knowledge about HCWM					
Good	119	59	2.8 (1.6 to 4.7)	3.7 (1.7 to 7.8)	0.001*
Poor	36	50	1	1	
*Statistically significant association at a p value of less than 0.05. AOR, adjusted OR; COR, crude OR; HCWM, healthcare waste management.					

However, the result of this study was lower than those of other studies done in Bahir Dar (65%),⁴¹ Pakistan (66.6%)⁵⁵ and Nigeria (78.4%).²⁰ The findings may differ as a result of the difference in healthcare system policy, the application of the standard guidelines, and the different levels of regulatory body oversight and control over the private healthcare facilities' use of HCWM practices assessment tools in the various studies. Additionally, it could be attributed to the disparity in the healthcare system or policy as well as the attitude of the healthcare planners towards the practice of HCWM. This may also be justified by the fact that staff members in private healthcare facilities are uninformed about best practices for managing HCW.⁴¹

The result of the current study was higher than those of other studies conducted in Gondar, Ethiopia,⁴⁴ Burundi⁵⁶ and Bangladesh.⁵⁷ The possible reasons for this variation could be the difference in the study period since the current study was carried out recently, where the healthcare management practice is improving due to the increased awareness and attitude of the healthcare workers due to information, education and communication. Another possible justification for this variation could

be the use of different HCWM practice assessment tools across different studies, the study setting (private health-care facilities), the sample size used and the knowledge of the study participants.

A number of factors associated with HCWM practice were identified in this study. Accordingly, it was found that health workers in private health facilities that had a HCWM committee had about a 10-fold improvement in good HCWM practice compared with those that did not have any. Similarly, health workers who had ever read manuals or guidelines regarding HCWM had about four times as many good practices as their counterparts. This finding was also observed in a study in Bahir Dar.⁴¹ This may be due to the fact that committee members advised healthcare professionals on the value of HCWM practices or because they read the manuals and instructions for the HCWM protocol to enhance their prior practice. In other words, the presence of a committee and guidelines can easily encourage or motivate healthcare workers to manage HCW appropriately. It is also because health workers who read guidelines have better content knowledge, which leads to good HCWM practices.

The odds of healthcare workers who had good knowledge of HCWM having good HCWM practices were about five times higher than those who had poor knowledge of HCWM. This finding is consistent with the finding of a study conducted in Gondar,⁴⁴ in which HCWM knowledge plays a role in the proper handling of waste.⁴² This could be because knowledgeable health workers would better practice segregation of waste, which in turn determines the waste disposal system, thereby increasing good practice.

This study revealed that the odds of good HCWM practice among healthcare workers who had designated HCW storage sites were three times higher than those who had no designated HCW storage sites. The presence of a designated HCW storage area can easily encourage healthcare workers to practise good HCWM practices.

The limitations of this study are that it is focused only on health workers in private health facilities and HCWM practices during routine healthcare service provision, which is also limited to solid HCWM. The cross-sectional design of this study precluded drawing causal inferences between explanatory factors and HCWM practice among health workers in private healthcare facilities. The absence of a common assessment tool for HCWM practices and the lack of expert input may lead to an underestimate or overestimate of the level of safe HCWM practices. In particular, in the local context, it proved challenging to obtain previous publications on the practices of HCWM in private healthcare facilities.

This study may further motivate the researchers working in the related field to focus their studies on the wide range of assessments of HCWM practice among health workers in public health institutions for sustainable healthcare supply chain performance and HCWM strategy,^{58 59} and more research directions like HCWM (collection, storage and transportation of HCWs) during

health outbreaks can be explored since health outbreaks are always leading to explosive growth in the quantity of infectious wastes.^{47 60} Moreover, more elaborative studies that are initiated by policy makers, environmental health representatives, healthcare authorities and HCW handling firms to set up a sustainable waste disposal system,³¹ liquid waste management practices, waste recycling practices and the sustainability of safe HCWM practices can be explored.

CONCLUSION

The study revealed that about three in five healthcare workers had good HCWM practice. The presence of a functional HCWM committee, reading manuals or guidelines regarding HCWM, the presence of waste management utilities and knowledge about HCWM were the identified factors associated with good HCWM practice. Private healthcare facilities should prioritise strategies for the formation of an HCWM committee, providing health workers with manuals and guidelines related to HCWM, and planning training or an orientation programme for their staff on HCWM. Health workers should be encouraged to read guidelines to improve their knowledge and should abide by the standard guidelines provided by the WHO and the Ethiopian Ministry of Health. HCWM practice among health workers should be closely monitored throughout the HCWM framework—waste segregation, collection, storage, transportation, treatment and disposal activities.

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Patient and public involvement Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval This study involves human participants and was approved by Ethical clearance and approval to conduct the research were obtained from the Ethical Review Board (reference number: RCS/034/2021 of the College of Health Science, Mettu University. An official letter was written to the Iluababor Zone health department and, consequently, to each selected private health facility. The research was carried out following the 1964 Helsinki Declaration. Informed consent was obtained from participants prior to the interview and observation, and

the participants were assured that the information would be kept confidential and secure. The names of the study participants were not included in the questionnaire, and participation in this study was absolutely voluntary. Participants gave informed consent to participate in the study before taking part.

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Data availability statement Data are available upon reasonable request.

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