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Healthcare Waste Management Practices and Associated Factors in Private Clinics in Addis Ababa, Ethiopia

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ABSTRACT

BACKGROUND: Healthcare waste management requires special attention and every healthcare teams should be involved in handling of wastes at point of generation. However, less attention is given to healthcare waste management in Ethiopia and there is no evidence about healthcare waste management practices in private clinics in Addis Ababa. Accordingly, this study was conducted to assess healthcare waste management practices and associated factors in private clinics in Addis Ababa, Ethiopia.

METHODS: A health facility-based cross-sectional study was conducted in 278 randomly selected private clinics in Addis Ababa. Data were collected using questionnaire and observational checklists. Multivariable binary logistic regression analysis was used to identify factors associated with healthcare waste management practices on the basis of adjusted odds ratio (AOR) with 95% confidence interval (CI) and *P*-values <.05.

RESULT: Results showed that 61.2% of the surveyed clinics had poor healthcare waste management practices, out of which, 56.8% had poor waste segregation practice, 55.0% had poor waste collection practice, 85.6% had poor waste transportation practice, 63.3% had poor waste storage practice, 61.9% had poor waste treatment, and 57.9% had poor disposal system. Healthcare waste management practice in the surveyed clinics was significantly associated with presence of guidelines (AOR: 1.98, 95% CI: 1.06, 3.69), budget allocation (AOR: 2.05, 95%, CI: 1.20, 3.49), and inspection by the regulatory bodies (AOR: 2.47, 95% CI: 1.26, 4.84).

CONCLUSION: Healthcare waste management practice was poor in the surveyed clinics. This suggests that the healthcare industries in the studied region may create health treats to healthcare workers, waste handlers, patients, the community, and the environment at large. The following key elements are needed to improve healthcare waste management practices in private clinics: promoting practices that reduce the volume of waste generated and ensure proper waste segregation; developing strategies and systems, as well as strong oversight and regulation, to incrementally improve waste segregation, destruction, and disposal practices with the ultimate goal of meeting national and international standards; and selecting safe and environmentally-friendly management options, to protect people from hazards when collecting, handling, storing, transporting, treating or disposing of waste.

KEYWORDS: Health clinic, low-income countries, Ethiopia

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Background

Healthcare waste is becoming a global public health concern, particularly in developing countries. Healthcare wastes include all the waste generated by healthcare establishments, research facilities, and laboratories as well as the waste produced in the course of healthcare undertaken in the home (such as dialysis, insulin injections, etc.).[1] Healthcare waste production is steadily increasing around the world. Healthcare waste generation rates, on the other hand, are typically lower in developing and poor countries than in developed countries.[2] For example, all categories combined, a university hospital in a high-income country can produce up to 10 kg of waste per bed per day.[3] The average rate of healthcare waste generation in Africa is 0.8 kg/bed/day,[4] with Ethiopia producing an average of 1.1 kg/bed/day.[5] Furthermore, an estimated 16 billion injections are given worldwide each year, but not all needles and syringes are properly disposed of.[6] About 85% of the waste generated by healthcare activities is general, non-hazardous waste that is comparable to household waste. The remaining 15% is classified as hazardous material, which could be infectious, chemically reactive, or radioactive.[6]

Poor healthcare waste management can put health care workers, waste handlers, patients, and the general public at risk of infection, toxic effects, and injuries, as well as polluting the

environment.[7] Sharp injuries from unsafe injections, for example, resulted in 33 800 new human immunodeficiency virus (HIV) infections, 1.7 million hepatitis B infections, and 315 000 hepatitis C infections in 2010. A person who receives one needle stick injury from a needle used on an infected source patient has a 30%, 1.8%, and 0.3% chance of contracting hepatitis B, hepatitis C, or HIV, respectively.[6]

It is critical that all medical waste materials be properly managed to avoid health risks to the healthcare workers, waste collectors, the general public and the environment.[8] However, in developing countries, particularly in Africa, including Ethiopia,[9,10] healthcare waste has not gotten the attention it deserves. As a result, waste cleaners, waste pickers, collectors, and recycling waste operators may contract disease.[11] This is due to a lack of resources in African countries, which makes healthcare waste management a low priority[12] and hazardous and medical wastes are rarely separated and are frequently mixed with non-infectious waste, resulting in a much higher real quantity of hazardous waste.[13,14]

Healthcare waste management includes all activities and processes involved in waste minimization, segregation of wastes, packaging, storage, transportation, treatment, disposal and measures for emergency situations in all healthcare facilities.[15,16] However, healthcare waste management receives less attention in Ethiopia, particularly in private healthcare facilities, and there is limited evidence on healthcare waste management practices. Accordingly, this study was conducted to assess healthcare waste management practices and associated factors in private clinics in Addis Ababa, Ethiopia.

Methods

Study design and setting

A health facility-based cross-sectional study with structured observation was conducted in private healthcare facilities in Addis Ababa, a capital city of Ethiopia in May, 2021. According to the Addis Ababa city Food, Medicine & Healthcare. Administration & Control Authority report, there are 12 public hospitals, 98 public health centers, 268 specialty clinics, 318 medium clinics, and 152 primary clinics, with 738 private clinics in the city.

Sample size determination and sampling procedures

Sample size was calculated using WHO's service availability and readiness assessment (SARA) sample size formula,[17] with the following assumptions: proportion of health facilities with good healthcare waste management practice = 50% since there were no similar studies in the area, total number of private clinics (N) = 738, level of significance (α) = 5%, 95% confidence interval (standard normal probability), *z*: the standard normal tabulated value, margin of error (e) = 5%, and a non-response rate of 10%. With this assumption, the final sample size was 278. All sub cities in Addis Ababa were considered for sampling. First, we chose 5 sub cities out of 10 using a simple random sampling technique. We allocated equal number of private clinics to each sub city. Finally, we selected 278 private clinics using a systematic random sampling technique.

Measurement of study variables

The outcome variable of this study was healthcare waste management practice. Healthcare waste management practice was taken as "good" if the total sum of the "Yes" responses for the practice questions to each functional elements of waste management was ≥ 75% and was taken as "poor" if the sum is <75%.[18]

Data collection procedures

Data were collected using a structured questionnaire and observational checklist adapted from WHO guideline for healthcare waste management.[2,15] The data collection tool was organized based on the functional elements of waste management, that is, segregation, collection, storage, transportation, treatment, and disposal. Moreover, the tool contains general information related with waste management, such as budgeting, presence of guidelines and training manuals, supervision, presence of waste management committee, and availability of waste management utilities. Data were collected by interviewing a person assigned to coordinate environmental health services in each clinic and observing the healthcare waste management system in each clinic. The tool was pre-tested in 2 private clinics out of Addis Ababa to ensure consistency and completeness of the questionnaire. A 1 day training was given on the data collection tool, data collection procedures, and ethical issues. Supervisors closely supervised the data collection process and checked completeness of the collected data on daily basis.

Data processing and analysis

Data were entered in to EPI-INFO version 7 and exported to statistical packages for social sciences (SPSS) version 25 for analysis. For most variables, data were presented by frequencies and percentages. Univariable binary logistic regression analysis was used to select variable for the final model on the basis of *P*-value less than .2. Multivariable binary logistic regression analysis was employed to identify variables associated with healthcare waste management practices on the basis of AOR with 95% CI and *P*-value <.05. Model fitness was checked using Hosmer-Lemeshow test.

Ethical approval

Ethical approval was obtained from the institutional review board of Addis Ababa Medical and Business College (Reference number: AAMBC/Stu/10296/14).

Result

Healthcare waste management related conditions

Data were collected from 278 private clinics. According to the findings, 201 (72.3%) of the clinics had healthcare waste management guidelines. The licensed technical manager was in charge of supervision of general waste management practices in 224 (80.6%) of the clinics. Sixty-four (21.6%) of the clinics had waste management committees. One hundred and forty-one (50.7%) of the clinics had a training manual. Two hundred and eleven (75.9%) of the clinics provided adequate waste management utilities (such as gloves, waste bins, disinfectant, eye goggles). Two hundred and thirty-three (83.8%) of the clinics reported that workers used personal protective equipment at all times while handling wastes and 182 (65.5%) of the clinics reported that budget is not separately allocated for healthcare waste management (Table 1).

Table 1. Healthcare waste management related conditions in private clinics in Addis Ababa, Ethiopia, May 2021, n = 278.

WASTE MANAGEMENT RELATED VARIABLES	FREQUENCY	PERCENT
Presence of healthcare waste management guidelines		
Yes	201	72.3
No	77	27.7
Supervision of overall waste management by the licensee		
Yes	224	80.6
No	54	19.4
Presence of waste management committee or delegated staffs		
Yes	64	21.6
No	218	78.4
Presence of training manual		
Yes	141	50.7
No	137	49.3
Allocation of adequate waste management utilities		
Yes	211	75.9
No	67	24.1
Use of personal protective equipment at all times while handling wastes		
Yes	233	83.8
No	45	16.2
Healthcare workers trained about healthcare waste management in the last 1 year		
Yes	31	11.2
No	247	88.8
Budget allocation		
Yes	96	34.5
No	182	65.5

Waste segregation practice

From the total surveyed clinics, 162 (58.3%) used 3 bin systems to collect healthcare wastes by type. Hazardous waste containers were also labeled in 141 (50.7%) of the clinics. One hundred and twenty-two (43.9%) of the clinics posted standardized healthcare waste segregation procedures. Seventy-one (25.5%) of the clinics labeled waste containers with the start date of accumulation. Overall, 120 (43.2%) of the clinics had good waste segregation practice (Table 2). Figure 1 also depicts the photos that were used to sort wastes by type.

Waste collection practices

One hundred and forty-eight (53.2%) of the clinics collected healthcare wastes before 3/4th of the safety box was full, and 146 (52.5%) of the clinics used proper labeling to identify the source and category of wastes. Waste containers were properly tied in 44 (15.8%) of the clinics. The overall healthcare waste collection practice was not good in 153 (55%) of the clinics (Table 3). Figure 2 depicts photos of materials used to sort wastes into categories.

Waste transportation practices

From the surveyed clinics, 200 (71.9%) of the clinics had cleaning agents and disinfectants and 26 (9.4%) of the clinics covered their waste containers during transportation. Five (1.8%) of the clinics had different transporting materials for different categories of wastes. Sixteen (5.8%) of the clinics had trolley/wheel barrow and 2 (0.7%) of the clinics were linked with the sewerage lines. The overall waste transporting practice was poor in 238 (85.6%) of the clinics (Table 4).

Waste storage practice

One hundred and five (37.8%) of the clinics had room/area for temporary storage of healthcare wastes. From those clinics with temporary storage area/room, 28 (26.7%) of the storage areas were away from public and food sources. Eighty-eight (83.8%) of the storage areas were not easily accessible and cleanable, 98 (93.3%) of the rooms were not secured and lockable, and 100 (95.2%) of the clinics had no separate room for hazardous waste accumulation. The overall waste storage

practice was poor in 176 (63.3%) of the clinics (Table 5). Figure 3 shows photo of waste storage practice in the surveyed clinics.

Waste treatment practice

Two hundred and nineteen (78.8%) of the clinics used burner made from barrel/drum to incinerate solid medical wastes. One hundred and thirty-eight (49.6%) of the clinics used disinfecting agents for liquid medical wastes. The overall healthcare waste treatment practice was poor in 172 (61.9%) of the surveyed clinics (Table 6). Figure 4 shows sample photos of incinerators used to treat dry and infectious wastes.

Table 2. Waste segregation practice of private clinics in Addis Ababa, Ethiopia, May 2021, n=278.

WASTE MANAGEMENT PRACTICE RELATED VARIABLES	FREQUENCY	PERCENT
Overall waste segregation practice		
Good	120	43.2
Poor	158	56.8
The clinic uses 3 bin system		
Yes	162	58.3
No	116	41.7
Posted standardized procedures for segregation process		
Yes	122	43.9
No	156	56.1
Hazardous waste containers are labeled		
Yes	141	50.7
No	137	49.3
Marking of waste containers with accumulation start date		
Yes	71	25.5
No	207	74.5

Waste disposal practice

One hundred and seventy (61.2%) of the clinics used sewerage system for liquid waste disposal. Fifty-one (14.4%) of the clinics had placenta pit and 180 (64.7%) of the clinics emptying ash from the incinerator regularly (Table 7). Figure 5 shows sample placenta pit and open dumping of wastes.

Factors associated healthcare waste management practice

Table 8 shows that presence of guidelines, inspection by regulatory bodies, and budget allocation were significantly associated with healthcare waste management practices in the private clinics. The odds of good healthcare waste management practices was 2.0 times higher in clinics which had healthcare waste management guidelines (AOR: 2.0, 95% CI: 1.1, 3.7). Inspection by regulatory bodies increased the odds of proper healthcare waste management practices by 2.5 (AOR: 2.5, 95% CI: 1.3, 4.8). The odds of having good healthcare waste management was 2.0 times higher in private clinics who allocated budget for waste management (AOR: 2.0, 95% CI: 1.2, 3.5).

Discussion

This study was conducted to assess healthcare waste management practices in private clinics in Addis Ababa city, Ethiopia and found that 61.2% of the clinics had poor healthcare waste management practices, out of which, 56.8% had poor waste segregation practice, 55.0% had poor waste collection practice, 85.6% had poor waste transportation practice, 63.3% had poor waste storage practice, 61.9% had poor waste treatment, and 57.9% had poor disposal system. This suggests that private clinics in Addis Ababa did not meet the WHO recommendations for medical waste management,[2,15] which is in agreement with reports of studies in Africa. For instance, a systematic review conducted to assess solid medical waste management practices

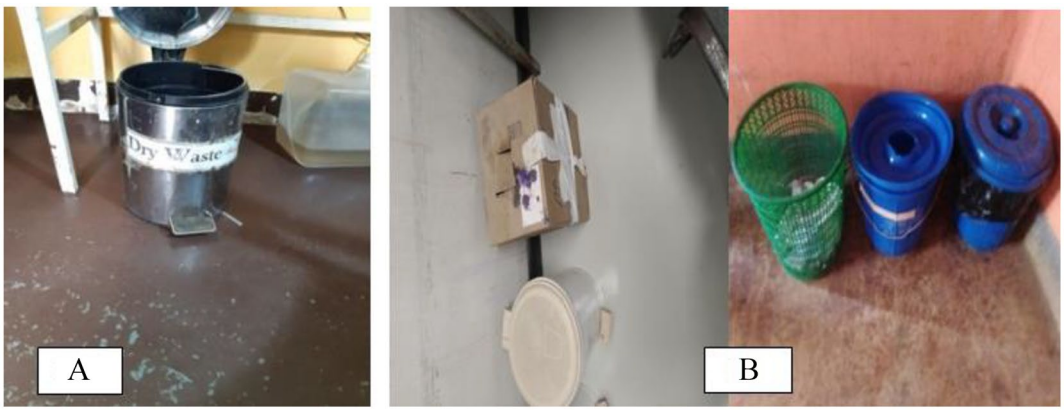

Figure 1. Photos to show (A) good waste collection and segregation bins and (B) improper waste collection and segregation bins.

in Africa reported that only 6 countries broadly met half of the WHO's 10 recommendations.[19] Similarly, a study done in Kumasi, Ghana reported that the composition of the hazardous healthcare waste far exceeded the WHO's threshold of within 10% to 25% as a result of inadequate segregation.[20] The level of healthcare waste management practices reported in the current study was also lower than findings of studies in Bahir Dar, Ethiopia (reported 65.3% good healthcare waste management),[21] Nigeria (reported 62% good healthcare waste management),[22] and Uganda (reported 74.0% satisfactory healthcare waste management practices).[23] The poor healthcare waste management practice in the studied region might be explained by absence of waste management and disposal systems in the city, insufficient financial and human resources and low priority, and inadequate training. Moreover, most of the healthcare facilities had no specific healthcare waste management frame-work or guidelines and did not comply with best practices and this may contribute to suboptimal healthcare waste management and may compromise the prevention of disease transmission as discussed in different studies in Africa.[20,24]

This study showed that 43.2% and 38.1% of the clinics had good waste segregation and treatment practices, respectively which were lower than the study done in Nigeria in which 70% and 81% of the study facilities had good waste segregation and treatment practices, respectively.[25] Low or absence segregation of healthcare wastes by type was also reported in other studies in Adama city, Ethiopia[26] and in Kumasi, Ghana.[20] The aggregate collection of wastes using a single container in the study clinics could be due to lack of awareness of the health hazards associated with aggregate collection of all wastes due to waste collectors are mostly recruited from the low educational level in Ethiopian context and the clinics might not provide adequate training for these group of workers.

This study found that labeling of wastes was reported in 52.5% of the clinics, availability of cleaning agents or disinfectants in 71.9% of the clinics, and availability of temporary storages area in 37.8% of the clinics. These findings are higher than findings of a study in Myanmar, which reported labeling of wastes by category in 12.8% of the surveyed facilities, availability of cleaning agents or disinfectants in 60%, and availability of temporary storages areas in 16% of the surveyed facilities.[27] This difference might be due to ownership (private vs government) of the health facilities that private health facilities effort to win the government competitive market and low number of customers and professionals in private sectors.

In this study, 88.5% of the clinics used either local brick incinerators or barrel/drum made incinerators as a major treatment options for dry wastes and majority of the facilities were not in good working condition. This finding is in line with findings of a study in Tanzania, where 70% of incinerators in the surveyed facilities are not in good working conditions.[28] These incinerators didn't meet the minimum standards of temperature monitoring, air pollution control, air inlet, distance from the health facility, and all other characteristics set by WHO and Ethiopian food and drug administration (EFDA)[29,30] and are often operated under suboptimal conditions and may release

Table 3. Waste collection practices of private clinics in Addis Ababa, Ethiopia, May 2021, n=278.

WASTE MANAGEMENT PRACTICE RELATED VARIABLES	FREQUENCY	PERCENT
Overall waste collection practice		
Good	125	45.0
Poor	153	55.0
Timely collection of waste containers before 3/4th is filled		
Yes	148	53.2
No	130	46.8
Proper labeling of sources and categories of wastes		
Yes	146	52.5
No	132	47.5
Waste containers are properly tied/sealed off		
Yes	44	15.8
No	234	84.2

Figure 2. Photos showed (A) improper waste collection bins and (B) good waste collection bins.

Table 4. Waste transportation practice of private clinics in Addis Ababa, Ethiopia, May 2021, n = 278.

WASTE MANAGEMENT PRACTICE RELATED VARIABLES	FREQUENCY	PERCENT
Overall waste transportation practices		
Good	40	14.4
Poor	238	85.6
Availability of appropriate Trolley/cart/wheel barrow		
Yes	16	5.8
No	262	94.2
Containers are covered during transportation		
Yes	26	9.4
No	252	90.6
Different transporting materials for different waste categories		
Yes	5	1.8
No	273	98.2
Space for cleaning vehicles and linked with sewerage lines		
Yes	2	0.7
No	276	99.3
Availability of cleaning agents and disinfectants		
Yes	200	71.9
No	78	28.1

Table 5. Waste storage practice of private clinics in Addis Ababa, Ethiopia, May 2021, n = 278.

WASTE MANAGEMENT PRACTICE RELATED VARIABLES	FREQUENCY	PERCENT
Overall waste storage practice		
Good	102	36.7
Poor	176	63.3
Availability of room/area for storage		
Yes	105	37.8
No	173	62.2
The room is away from food sources and public entrants (n = 105)		
Yes	28	26.7
No	77	73.3
The room is easily accessible and cleanable (n = 105)		
Yes	17	16.2
No	88	83.8
The room is secured and lockable (n = 105)		
Yes	7	6.7
No	98	93.3
The room has separate class for hazardous wastes (n = 105)		
Yes	5	4.8
No	100	95.2

harmful substances into the environment due to inadequate incineration.

This study revealed that only 14.4% of the clinics had ash/placenta pits, which is lower than the proportion of clinics which had ash/placenta pits in Bench Maji, Ethiopia (ie, 40%) as reported by Meleko et al,[31] which may be due to the services provided by these 2 primary healthcare centers and size as well as number of service users to the facility. As delivery is mandatory services in the health centers and optional in private clinics, health centers have to dig placenta pits.

In this study, 72.3% of the clinics posted standardized procedures for healthcare waste management, which is higher than what healthcare facilities in Pakistan did (ie, 41%) as reported by Khan et al[32] and government health centers in Addis Ababa (60%).[33] This variation could be due to the fact that the effort done by the private health sectors to win a competitive market and close supervision and enforcement of the regulatory bodies on private health facilities, that is, inspection and feedback were given by the regulatory body for 78.4% of the clinics in this study to adhere with standards. The current study also revealed that presence of guidelines or manuals and inspection or

Figure 3. Sample photo of not well fenced waste storage practice.

feedback from regulatory bodies were the significant predictor for proper healthcare waste management practices in private clinics. This finding is supported by studies done in India.[34,35] This might be because of the fact that both supportive supervision and presence of guidelines increased the knowledge and adherence of health professionals for waste management.

The current study depicted that private clinics which allocated budget for waste management had good healthcare waste management practice than those did not have it. This finding is supported by studies in Nigeria.[34,35] This might be due to the

Table 6. Waste treatment practices of private clinics in Addis Ababa, Ethiopia, May 2021, n = 278.

WASTE MANAGEMENT PRACTICE RELATED VARIABLES	FREQUENCY	PERCENT
Overall waste treatment practice		
Good	106	38.1
Poor	172	61.9
Types of treatment options for dry waste used		
Local brick built incineration	27	9.7
Burner made from barrel/drum	219	78.8
Burning in the field	32	11.5
Availability of disinfecting agents for liquid waste		
Yes	138	49.6
No	140	50.4

Figure 4. Sample photos of (A) unacceptable incinerator and (B) acceptable incinerator used to treat dry and infectious wastes.

Table 7. Waste disposal practices of private clinics in Addis Ababa, Ethiopia, May 2021, n = 278.

WASTE MANAGEMENT PRACTICE RELATED VARIABLES	FREQUENCY	PERCENTAGE
Overall waste disposal practice		
Good	117	42.1
Poor	161	57.9
Use sewerage system for liquid waste disposal		
Yes	170	61.2
No	108	38.8
Availability of placenta pit/ash pit		
Yes	51	14.4
No	227	81.7
Emptying ash from incinerator regularly		
Yes	180	64.7
No	98	35.3

Figure 5. Sample photos of (A) substandard placenta pit and (B) open field disposal of wastes.

Table 8. Factors associated with healthcare waste management practices in private clinics in Addis Ababa, Ethiopia, May 2021, n = 278.

VARIABLES	HEALTHCARE WASTE MANAGEMENT		COR (95% CI)	AOR (95% CI)
	GOOD	POOR		
Presence of guidelines				
Yes	87	114	2.3 (1.2, 4.1)	2.0 (1.1, 3.7)*
No	19	56	1.0	1.0
Inspection by the regulatory bodies				
Yes	93	121	2.5 (1.3- 4.8)	2.5 (1.3, 4.8)**
No	15	49	1.0	1.0
Presence of waste management committee				
Yes	30	30	1.8 (1.0, 3.3)	1.6 (0.8, 2.9)
No	75	138	1.0	1.0
Presence of training manuals				
Yes	22	17	2.3 (1.2, 4.6)	2.0 (1.0, 4.2)
No	86	153	1.0	1.0
Budget allocation				
Yes	48	48	2.0 (1.2, 3.3)	2.0 (1.2, 3.5)**
No	60	121	1.0	1.0

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; COR, crude odds ratio. Hosmer-Lemeshow goodness of fit test = 0.752.
*$P < .05$. **$P < .01$.

fact that budget is the basic tool to be well equipped, trained and standardized. Failing to budget waste management in the healthcare industries causes shortage in waste facilities handling equipment and supplies and absence of training programs for staff, resulting in poor knowledge and practices of waste collectors.[36] It is documented that budgeting environmental health services in the healthcare industries improves service provisions.[37]

As a limitation, we didn't estimate the waste generation rate in each clinic. Moreover, we didn't investigate healthcare waste related infections and injuries among healthcare workers and waste handlers. Therefore, further research should be done to estimate the generation rate and to assess health problems associated with poor management of healthcare wastes in the area.

Conclusion

Suboptimal practice of waste segregation, waste collection, waste storage, waste transportation, waste treatment, and disposal was reported in the surveyed clinics. This suggests that the healthcare industries in the studied region may create health treats to healthcare workers, waste handlers, patients, communities, and the environment at large. The private clinics need to improve the waste management practices using the following key elements: promoting practices that reduce the volume of wastes generated and ensure proposer waste segregation; developing strategies and systems along with strong oversight and regulation to incrementally improve waste segregation, destruction and disposal practices with the ultimate aim of meeting national and international standards; building a comprehensive system, addressing responsibilities,

resource allocation, handling and disposal; and selecting safe and environmentally-friendly management options, to protect people from hazards when collecting, handling, storing, transporting, treating, or disposing of waste. Government commitment and support is needed for universal, long-term improvement, although immediate action can be taken by respective healthcare facilities. Moreover, researches need to explore innovative solutions that can effectively manage healthcare wastes in the area.

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Author Contributions

BW designed the study protocols, facilitated the data collection and analyzed the collected data. ZG supervised the overall work and prepared the manuscript. BG and ZNM reviewed the protocol. All the authors read and approved the final manuscript.

Ethics Approval and Consent to Participate

Ethical clearance was obtained from the Institutional Review Board of Addis Ababa Medical and Business College. There were no risks due to participation in this research project, and the collected data were used only for this research purpose. Verbal informed consent was obtained from the clinic heads. The information collected from each household kept with complete confidentiality.

Consent Publication

This manuscript does not contain any individual person's data.

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Availability of Data and Material

Data will be made available upon requesting the primary author.

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