ORIGINAL ARTICLE

Hospital waste management and risk factors on health personnel in the health structures of Mwene-Ditu, DR Congo

John Mutombo Alabweba[1], Edouard Mbaya Munianji[2], Jean Kakese Tshimanga[3], Siméon Ajuamungu Mushosi[4], Bertin Mukuna Nyembo[5], André Mutombo Kabamba Lumanisha[6], Criss Koba Mjumbe[7]

[1]*Faculty of Public Health, University of Mwene-Ditu, Mwene-Ditu, DR Congo,*
[2]*Public Health School of Kananga, University of Kananga, Kananga, RD Congo,*
[3]*Faculty of Public Health, Official University of Mbujimayi, Mbujimayi, RD. Congo,*
[4]*Official University of Bukavu, health sciences domain/public health sector, Kadutu, BP 570, Bukavu, DRC*
[5]*Faculty of Health Sciences, National Educational University, Kinshasa, DR Congo,*
[6]*Department of Pediatrics, Faculty of Medicine, Official University of Mbujimayi, Mbujimayi, RD Congo*
[7]*Department of Public Health, Faculty of Medicine, University of Lubumbashi, Lubumbashi, RD Congo,*

ABSTRACT

Context: hospital waste is a reservoir of micro-potentially dangerous organizations likely to infect hospitalized patients, providers, surface agents and the general public.

Objective: this study aimed to assess the hospital waste management system in the health structures of Mwene-Ditu and the health risks of providers and surface staff.

Methods: It was an analytical study conducted from 01 to 30 July 2023. The study population consisted of care providers, as well as surface staff of the health structures of Mwene-Ditu. We used a simple probabilistic sampling. The minimum size of the sample was calculated using EPI Info, version 7.2.6.0 (n = 271 households, with an error margin of 0.05%). A logistic regression model was built by the step -by -step selection method with an input probability of 0.05 and 95%CI.

Results: Hospital waste management practices were Deemed safe in 62.4 % of respondents. About 68 % declared to use suitable personal protective equipment (PPE). Two risk factors were significantly associated with poor waste management: the absence of PPE (or = 5.64; CI95%: [2,29–13.89]; p <0.001) and the lack of training in hospital waste management (or = 8.25; CI95%: [2.69–25.29]; p <0.001). These results highlight the importance of capacity building and supply to equipment to improve health security.

Conclusion: The Hospital Waste Management System in Mwene-Ditu has globally safe practices, but remains faced with major challenges, including the lack of personal protective equipment and the insufficient training of involved personnel.

Corresponding Author:
CRISS KOBA MJUMBE
CRYSS_KOBA25@yahoo.fr,
+243 997125685, Lubumbashi, DRC

Keywords: *management, hospital waste, risk factors, health staff, health structures, Mwene-Ditu.*

This article is available online at: http://www.mjz.co.zm, http://ajol.info/index.php/mjz, doi: https://doi.org/10.55320/mjz.53.2.837
The Medical Journal of Zambia, ISSN 0047-651X, is published by the Zambia Medical Association

INTRODUCTION

In the current context marked by growthRapid demographic and accelerated industrial development, hospital waste management is a major public health challenge. These represent a significant risk both for the environment and for human health, because of their potentially infectious and toxic character [1].

Biomedical waste is recognized as vectors of pathogenic microorganisms likely to infect patients, nursing staff, maintenance agents and the community. In addition, wastewater from care can cause chemical, biological and bacteriological pollution of the soil and water resources [2].

Globally, around 40 % of the 560,000 health care establishments in 125 countries do not sort their waste, according to WHO. The situation is even more worrying in low and intermediate income countries, where only 27 % have basic services for the secure management of biomedical waste[3]. Studies in EthiopiaShow that 35 % of medical structures eliminate sharp waste in an unsecly manner, thus exposing staff and the population at increased risks [4].

In West Africa, data indicate high annual productions of biomedical waste, but above all an absence of suitable management. In Ouagadougou, this production reached between 270 and 320 tonnes per year; In Cotonou, it was estimated at 143.7 tonnes; and in Bamako, at 49.3 tonnes[5]. In Cameroon, an survey revealed that more than 36 % of the staff interviewed was unaware of the risks linked to the mismanagement of this waste[6]. In Congo-Brazzaville, if 55 % of agents recognized the importance of sorting, it was only systematic in 41 % of cases[7].

In the Democratic Republic of Congo (DRC), several studies have highlighted serious gaps in the management of hospital waste. In Lubumbashi, 73 % of the services lacked suitable trash cans, and 66 % of waste was not coveredduring their evacuation. Port of personal protective equipment (PPE) was rarely observed[8]. In Mbujimayi, only 11.8 % of establishments sorted by type of waste, and less than 50 % of providers declared to use PPE regularly (9). Human health and life are seriously threatened by medical waste, especially in low and intermediate income countries [10] and poor management of biomedical waste is often identified as one of the causes of certain infections such as hepatitis and HIV [11; 12].

In health care facilities in the city of Mwene-Ditu, it is common to observe hospital waste abandoned in the open air, sometimes piled up in inappropriate places and accessible to pets. This situation constitutes a serious health risk for the population and testifies to a deficient management system.

Despite these observations, few studies have been carried out in Mwene-DituTo systematically assess biomedical waste management practices and associated risk factors. This lack of data prevents an adapted to local health response. The objective of this study was to assess the hospital management system in health care establishments in the city of Mwene-Ditu, as well as the associated risks for providers and sanitation staff.

METHODOLOGY

It was a transversal analytical study conducted over a period of one month, from 1?to July 30, 2023, in the two health zones in the city of Mwene-Ditu, located in the province of Lomami, in the Democratic Republic of Congo. The population studied was made up of healthcare providers as well as sanitation staff working in health care establishments in the two health zones in the city of Mwene-Ditu.

A simple random sampling has been used to select the establishments and participants. In total, 33 health centers and 2 general reference hospitals were chosen randomly. In each health center, 6 service providers meeting the inclusion criteria were selected, while 36 participants (care providers and sanitation agents) were interviewed in each General Reference Hospital. This approach corresponds to a laminate random sampling, with a distribution by type of establishment.

The size of the sample was calculated using the EPI Info Software Version 7.2.6.0, considering an estimated prevalence of 20 % of gastrointestinal conditions resulting from the manipulation of hospital waste, according to a study carried out in four health establishments in Kinshasa[13]. By fixing an error margin of 5 % and a confidence level of 95 %, the minimum size obtained was 246 participants. After increase of 10 % to take into account possible non-responses, the final size of the sample was brought to 271 subjects interviewed.

In this study were included in this study all care providers and sanitation agents present in selected care establishments, having given their free and informed consent to participate. The staff were excluded at the time of the survey, not selected, or who refused to participate.

The data was collected using a structured, pre-tested questionnaire, administered face to face. They were entered in Microsoft Excel 2013 version, then imported into the EPI Info Software Version 7.2.6.0 for the analysis. The results were presented in the form of descriptive tables. Statistical analysis included the calculation of ODDS ratios (gold), 95 % confidence intervals (CI95 %) and P-Values, considering statistical significance for $p < 0.05$.

RESULTS

The socio -demographic characteristics of the respondents are presented in Table 1. The majority of the participants were Men's (61.99%). The median age was 38 years, with an interquartile interval (IQR) of 14 years. The vast majority of respondents (93.73%) consisted of nurses and sanitation staff, while doctors represented only 6.27%. Regarding seniority, 66.42% of participants have worked for more than 5 years in their health establishment. Regarding matrimonial status, 76.38% were married. In addition, 88.19% had a level of education ranging from primary to higher. The majority of respondents worked in private or denominational structures (94.10%), while 54.24% came from general reference hospitals, compared to 45.76% of health centers.

Table 1. Soci -demographic characteristics of respondents

Variables studied	n=271	%	Médian [IQR]
Sex			
Masculin	168	61.99	
Feminin	103	38.01	
Age			
18 to 38 years	142	52.39	38 ans (14)
>38 years	129	47.60	
Marital status			
Unmarried (living alone) (e)	33	12.18	
Maried	207	76.38	
Education level			
No education level	32	11.81	
Primary. secondary and higher	239	88.19	
Professional category			
Doctor	17	6.27	
Cleaning staff and nurses	254	93.73	
Seniority in the heatthcare facility			
=5 ans	91	33.58	8 ans (6 ans)
=5 ans	180	66.42	
Staff affiliation to the healthcare facility			
Public	16	5.90	
Private and faith-based	255	94.10	
Number of staff surveyed by facility category			
Health centers	124	45.76	
General referral hospitals	147	54.24	

Distribution of respondents according to the management of hospital waste (Table 2). As illustrated by Table 2, 62.36 % of respondents claimed to adopt safe management of hospital waste,While 37.63 % practiced management deemed dangerous. However, only 7.75 % of respondents declared that they had received specific training on hospital waste management. Regarding material resources, 68.27 % used receptacles and boxes for collection, while 31.73 % used plastic trash cans. The majority (90.04 %) of respondents said they were using personal protective equipment (PPE) such as mask, gloves, boots and apron when handling waste, while 9.96 % did not take any PPE.

In terms of elimination, 54.24 % used burial and 45.76 % in incineration. Very little (8.11 %) declared to carry out a prior chemical treatment of infectious waste.

The health risks perceived by the respondents were high: the spread of diseases (89.66 %), respiratory problems (90.04 %), injuries or cuts (84.87 %) and eye irritation (84.13 %) were among the major concerns.

- Sure management: Includes training on waste, selective sorting, PEP, labeling of trash cans, compliance with regulations and elimination by burial or incineration.
- Dangerous management: absence of PPE, unstopped trash cans, lack of training, non-compliance with regulations, use of non-covered pits.

Table 2. Distribution of respondents according to the management of hospital waste

Variables studied	n = 271	%
Waste management		
Safe management	169	62.36
Dangerous management	102	37.63
Staff trained in hospital waste management		
Yes	21	7.75
No	250	92.25
Materials used to manage waste		
Plastic bins and containers	86	31.73
Containers and cartons	185	68.27
Personal protective equipement used during waste handling		
None	27	9.96
Mask, gloves, boots, gowns	244	90.04
Treatment of infectious waste with chemicals before disposal		
yes	22	8.11
No	249	91.88
Waste disposal methods		
Burial	147	54.24
Incineration	124	45.76
Risk factors		
Disease transmission		
Yes	243	89.66
No	28	10.34
Occurrence of respiratory issues		
Yes	244	90.04
No	27	9.96
Injuries/ cuts		
Yes	230	84.87
No	41	15.13
Eye irritation		
Yes	228	84.13
No	43	15.87

After bivariate analysis (Table 3); The relationship was statistically significant between the propagation of diseases, the occurrence of respiratory problems, the existence of injuries, eye irritation and waste management in the health structures of the city of Mwene-Ditu. There was also a statistically significant relationship between non -trained staff on waste management, providers who used personal protective equipment and hospital waste management. So health professionals not trained and providers who did not use personal protective equipment was 8.25 and 5.64 times likely to practice dangerous management of hospital waste in relation to other categories. The unintended respondents were 15.60 times likely to dangerously manage hospital waste compared to the surveyed respondents.

Table 3. Bivariated analysis on hospital waste management

Variables étudiées	Gestion des déchets hospitaliers		OR	IC à 95%	p-value
	Sûre (oui) n=169	Dangereuse (non) n=102			
Disease transimmion					
Yes	163	80	7.47	[2.91- 19.15]	0.00
No	6	22			
Injuries/ cuts					
yes	162	68	11.54	[4.88 - 27.38]	0.00
No	7	34			
Eye irritation					
yes	149	79	2.16	[1.12 - 4.18]	0.01
No	20	23			
Respiratory problems					
Yes	158	86	2.67	[1.18 - 6.01]	0.01
No	11	16			
Staff trained on waste management					
No	165	85	8.25	[2.69 - 25.29]	0.001
Yes	4	17			
Equipements de protection					
Mask, gloves, boots, gowns	162	82	5.64	[2.29 - 13.89]	0.001
None	7	20			
Waste disposal methods					
Incineration	83	64	0.57	[0.34 - 0.94]	0.02
Burial	86	38			
Education level					
Primairay. secondary and higher	165	74	15.60	[5.28-46.09]	0.001
Any level	4	28			

The logistical regression (Table 4) is noted the statistically significant association between respondents who did not use personal protective equipment, non -trained staff on hospital waste management and hospital waste management. Therefore, the respondents who did not use personal protective equipment and unspoken staff on hospital waste management were likely to dangerously manage hospital waste compared to other categories.

Painting 4: Multi -varied analysis by logistics regression

DISCUSSION

One of the strengths of this study is the parallel of the results obtained with those of the regional and international literature, which allows a better contextualization of the practices observed in Mwene-Ditu care establishments. This comparative approach strengthens the validity of the observations, while highlighting the similarities and differences from one context to another.

In addition, the data shows a significant prevalence of secure practices in health workers (62.36 %), in

Risk factors	ORa	IC à 95%	Coefficient	S. E	p
Disease transimmion (yes or No)	0.4675	[0.2128- 4.9249]	0.85601	0.4537	0.0652
Occurrence of respiratory problems (yes or no)	0.4240	[0.2256- 0.7968]	-0.8580	0.3218	0.7077
Presence of of injuries (yes or no)	0.4675	[0.2338- 0.9349]	-0.7603	0.3535	0.6315
Use of personel protective equipement during waste handling (yes or no)	8.4856	[3.2338- 1.9349]	-0.9603	0.4536	0.0019
Staff trained on waste management (yes or no)	2.4675	[1.2338- 3.9349]	-0.1.1202	1.0017	0.0479
Education level (yes or no)	0.2456	[0.4523- 4.4859]	1.01412	13.9141	0.6202
Eye irritation)	0.9838	[0.5063-1.9118]	-0.0163	0.3389	0.9616
CONSTANCY			0.3254	0.3478	0.3495

particular with regard to the wearing of personal protective equipment (97.41 %). This high rate of use of PPE, although positive, raises a significant question: how to explain such a conformity in terms of protection, while only 7.75 % of health workers benefitted from training on hospital waste management?

This paradox could be explained by several Hypotheses: It is possible that practices are influenced by strict institutional instructions on the use of PPE, or by the pressure of peers in the working environment. Another possibility is that some agents have acquired these practices by observation or experience in the field, without formal training. These elements suggest that good practice does not always result from training, but can be influenced by behavioral or organizational factors.

Despite the richness of the data collected, this study presents certain limits which should be recognized:

- dependence on self -depressed data: the responses of health workers were essentially based on personal declarations, which can introduce a bias in social desirability or memory. Certain real behaviors could differ from those reported.

- Low training rate: although this element is an important result, it limits Also the in -depth analysis of the effect of training on large -scale practices.

Close geographic focus: The study was limited to Mwene-Ditu's health areas, which can restrict the generalization of results to other urban or rural areas with different contexts (infrastructure, health policies, human resources ...).

Despite these limits, this study makes a significant contribution to the understanding of hospital waste management practices in the context of limited resources. It also highlights the importance of continuing education and institutional policies to improve health security.

In general, health workers in hospital waste management was safe in 62.36%. Our results corroborate those of a study conducted in Egypt in which most health workers had satisfactory practice scores[14].

Most health workers had good knowledge, especially on the level of health risk. Similar results have been reported in other studies where most health workers were aware of the risk of dangers such as injuries, infections (HIV/AIDS, hepatitis B and C) and environmental pollution caused by poor hospital waste management[15]. The preliminary training on the management of hospital waste that most health workers had received in part this high knowledge.

The similar observation was made by Doylo T et al., In 2019. Among the people involved in their study, 47.7 % and 42.3 % of respondents had good knowledge and good practices in terms of medical waste management. The authors justify these good knowledge and practices by the working training courses that have been organized in the study environment[16].

In this study, the minority of respondents (7,75%) had received training on hospital waste management. Like our study, the results of the study conducted in Nigeria by[17]; indicated that the staff was little trained in the management of medical waste [17].

In a situation where care establishments are unable to obtain basic medical equipment, financing may be not available for the training of people responsible for medical waste management.

Although one cannot overestimate the importance of training in the management of medical waste, certain previous studies have highlighted the non-compliance with standards by designated institutions and other stakeholders [18].

The study conducted in Ethiopia reported that 53.1 % of healthcare professionals did not have any training on hospital waste management and that only 31.5 % of them practiced the safety of hospital waste[19]. This result is incomparable to other Studies conducted in India where most health professionals

comply with the rules and standards prescribed by the hospital. This could be due to the budget allocation of health establishments, the accessibility of medical waste management documents and training during employment.

In this sense, several researchers have proposed the intensification of the training of all health workers by emphasizing the implications of good hospital waste management on human and environmental costs and risks. Most health workers believe that a strict application of standards supplemented by continuing education is essential for good waste management[20].

In addition, training on biomedical waste management is considered essential to the success of any waste management program, it improves the knowledge of health workers, increases their cooperation with the programs of Hospital waste and it also has an impact on their practices in terms of hospital waste management [21].

Health workers who have received training on hospital waste management were more likely to have safe practices. This can be explained by the fact that they are able to put into practice what they have learned. Our results also corroborate the conclusions of a similar study conducted in Ethiopia, which revealed that health workers trained in medical waste management were more likely to have satisfactory management practices[19].

In this study, most health workers (97.41%) carried appropriate personal protective equipment (gloves, boots and aprons), which presages good management practice because this minimizes the risk of contact with waste. Our results corroborate those of the study conducted in Ethiopia by[19]; who reported that the majority of Respondents (93.1 %) had used gloves when handling medical waste.

On the other hand, our results do not corroborate those of a study conducted in a Tanzanian municipality in which most health workers did not carry appropriate personal protective equipment [22].

It was noted in this study that, the propagation of diseases (or = 7.47), the occurrence of respiratory disorders (or = 2.67), the existence of injuries (or = 11.54); eye irritation (gold = 2.16). The absence of training on hospital waste management (OR = 8.25), the lack of schooling (or = 15.60) were risk factors linked to waste management in Mwene-Ditu care.

These results are not identical to those found by the various studies which have shown that knowledge on the type of medical waste and the transmission of diseases by contact with infectious waste had an influence on practice medical waste management. The respondents who had higher and/or moderate knowledge on the type of medical waste was 6.38 and 3.64 times more inclined to practice medical waste than those who had low knowledge of the type of medical waste. In addition, this result indicated that those who had higher and/or moderate knowledge on diseases transmitted by contact with infectious waste was likely to have good hospital waste management practices [2].

The study by Dengela TA et al. In Ethiopia reported that, the lack of knowledge on the various methods of treatment of medical waste, the lack of knowledge on waste management and health professionals who had not received training/orientation on those practical were less likely to ensure effective management of medical waste compared to their counterparts[23].

Some studies have Reported to the results contrary to ours by indicating that the regular training of health professionals on medical waste management had a significant impact on infectious medical waste management practices[2].

In addition, the study carried out in the city of Hawassa in Ethiopia[24] and that conducted by Muluken A et al in 2013[19] also indicated that those who underwent training on medical waste management were 2.29 times more favorable to apply medical waste management practices than their counterparts.

The study of [5] in Saudi Arabia revealed that health care providers having received training on waste management had 3.49 times luck to have good waste

management practices in health establishments than other providers [5]. This result is confirmed by a study carried out in Nigeria by Muluken A et al in 2013 claim that health professionals with a level of High studies had 3.10 and 4.95 times more likely to practice the safe management of medical waste than those who had little studied[19].

The possible explanation may be that trained health professionals allow them to use the tool according to their needs. This underlines the need for prior and continuous training on the prevention and control of infections for health care providers.

This study revealed that the unintended respondents were more inclined to have dangerous waste management practices compared to those who were educated. A result which is understandable given a diploma generally offers a better opportunity to acquire in -depth knowledge of waste management.

LIMITS

This study has certain limits to be taken into consideration. First, the data collected is based on self-rapported declarations, thus exposing the results to a social desirability bias, where respondents can overestimate their good practices. Second, research was conducted in a limited geographical area (Mwene-Ditu's health structures), which restricts the generalization of conclusions to other regions of the Democratic Republic of Congo or other contexts. Finally, the study did not evaluate the real quality of the use of PPE, which is an important element to understand their true effectiveness.

CONCLUSION

The hospital management system is a major concern for health and surface staff of Mwene-Ditu's health structures. Although Mwene-Ditu's health structures have safe practices in their hospital waste management, the lack of personal protection equipment by certain respondents, and unleised staff in hospital waste management, remain challenges to be met. Hence the need on the one hand, to set up a program of Continuing education for staff involved in waste management, and on the other hand, to ensure regular and sufficient supply of personal protective equipment.

Funding

There were no external funds for this research.

Ethical approval and consent to participate

Before its implementation, the research protocol was submitted to the Ethics Committee of the Official University of Mbujimayi for approval before their inclusion in the study, the participants received a detailed explanation of the study objectives, potential and disadvantages. Participants were free to give their consent, verbally or in writing, in an enlightened and voluntary manner. Consequently, the confidentiality of the information collected will be guaranteed in accordance with the free and informed consent model.

Contributions from authors

All the authors have read and approved the final manuscript. Concept and design of the study, JMA, RMN, EMM, AMM, CKM and BMN.Data collection, JMA, RMN, EMM and JKT. Contribution to the analysis and interpretation of the data, as well as to the writing of the original manuscript, RMN, JMA, EMM and CKM, SAM. Contribution to the conservation of JMA, RMN data, and EMM. Contribution to writing, revision and publishing, JMA, RMN, EMM, CKM, BMN, AMM and SAM. Final manuscript for critical review and approval.

REFERENCES

1. World Health Organization (WHO). Insalubrity of the environment causes 12.6 million deaths per year [press release]. Geneva: WHO; 2016 \[Cité 2023 August 29].
2. Wasee Q, Hassan G, Baba A, Kadri SM, Nazi K. Awareness of the staff of the SMHS government hospital to the management of biomedical waste. JKPRACTIONER. 2007; 14 (1): 60-6.

3. World Health Organization (WHO). Management and treatment of medical waste. Geneva: WHO; 2020. P. 24-29.
4. Meleko a, Tesfaye T, Henok A. Assessment of Medical Waste Generation Rate and Management System in Health Centers of Bench Sheko Zone.ETHIOP J Health SCI. 2018; 28 (2): 125-34. DOI: 10.4314/EJHS.V28i2.4.
5. Bdour an, Tarawneh Zs, Al-Momani Ms, El-Mashaleh M. Assessment of Medical Waste Management Practice: A Case Study of the Tabuk Regional Healthcare System, Saudi Arabia. Int J about Health Res. 2015; 25 (6): 590-602.
6. Ndié J. Study of the management of hospital waste in the reference health structures of the North Cameroon region. EUR SCI J. 2016; 12 (11): 364-76.
7. Mokoko JB, Atipo Ibara Bi, Mimiese JF, Iloukou PJ, Takale R. Management of hospital waste and biomedical equipment at the Brazzaville University Hospital. Public health. 2018; 19 (2): 5-11.
8. Samba CK, Ilunga WN, Ilunga JK, Banza Vu, Nyundo PK, et al. Management of medical care waste in maternities in the Kenya health area in Lubumbashi, Democratic Republic of Congo. Revi Congol. 2021; 1: 1-8.
9. Bukasa JC. Management of Biomedical Waste in the Motherity of the City of Mbuji-Mayi/Democratic Republic of Congo. About Water SCI Public Health Territory Intell J.2018; 2 (1): 12-7.
10. Chepchirchir C. Health and Human Life Are Seriously Threatened by Medical Waste, Especially in Low- and Middle-Income Countries. J Global Health Rep. 2021; 5 \: E2021054. DOI: 10.29392/001c.25441.
11. Oumar M, Coulibaly CA, Keïta S, Diarra B. Evaluation of the management of biomedical waste at the reference health center of commune I in Bamako (Mali) in 2021. Mali Public Health. 2022; 2: 30-7.
12. Ministry of Public Health (DRC). Biomedical waste management plan. Kinshasa: MSP; 2016.
13. Kasuku W, Bouland C, Brouwer ch, Mareschal B, Mulaji C, et al. Study of the health and environmental impact of hospital waste in 4 hospital establishments in Kinshasa (DRC). Environment, Engineering & Development. 2016; 9: 1-9.
14. Hakim Sa, Mohsen A, Bakr I. Knowledge, Attitudes and Practices of Health-Care Personal in Dealing With Medical Wasts at Ain Shams University HospitalS, Cairo. East Mediterr Health J. 2014; 20 (5): 347-54.
15. Pandit NB, Mehta HK, Kartha GP, Choudhary SK.Management of Biomedical Waste: Awareness and Practices in A District of Gujarat. Indian J Public Health. 2005; 49 (4): 245-7.
16. Doylo T, Alemayehu t, Baraki N. Knowledge and Practice of Health Workers About Healthcare Waste Management in Public Health Facility in Eastern Ethiopia. J Community Health. 2019; 44 (2): 284-91.
17. Uzochakwu BSC, Ughasoro MD, Etiaba E, Okwuosa C, Envuladu E, Onwujekwe Oe. Health Care Financing in Nigeria: implications for Achieving Universal Health Coverage. Niger J Clin Pract. 2015; 18 (4): 437-44.
18. Hangulu L, akintola O. Perspectives of Policy-Makers and Stakeholders on Medical Waste Management in Community-Based Care in South Africa: A Qualitative Study. BMC Health Serv res. 2017; 17: 290. DOI: 10.1186/S12913-017-2220-X.
19. Muluken Ay, Haimanot GM, Woldeyohannes SM. A Cross-Sectional Study of Factors Associated With Health Care Professionals' Perception of Risk in Medical Waste Management in Health Facilities of Gondar City, Northwest Ethiopia. Int J Infect Control. 2012; 8 (4):1-8.
20. Rajan R, Robin Dt, Vandanarani M. Biomedical Waste Management in Ayurvedic Hospitals - Current Practices and Future Prospects. J ayurveda integr med. 2018; 9 (2): 153-7. DOI: 10.1016/J.JAIM.2017.01.008.

21. Kumar R, Samrongthong R, Shaikh Bt. Knowledge, Attitudes, and Practices of Healthcare Workers Regarding Infectious Waste Handling in Tertiary Care HospitalS of a Metropolitan City. J Ayub Med Coll Abbottabad. 2013; 25 (1-2): 109-12.
22. Kuchibanda K, Mayo aw. Public Health Risks Associated With the Co-Disposal of Medical Waste With Municipal Solid Waste in Shinyanga Municipality, Tanzania. Scientificworldjournal. 2015; 2015: 981756. DOI: 10.1155/2015/981756.
23. DEGENA TA, Sorato MM. Healthcare Waste Management Practice and Associated Factors Among Healthcare Workers in Public Healthcare Facilities of Southwest Shewa Zone, Oromia, Ethiopia. Waste Manag Res. 2024; 42 (4): 321-34. DOI: 10.1177/0734242 x231197536.
24. Solomon D. Healthcare Waste Management in Ethiopia in 2005: An Overview. Addis Ababa: Ministry ofLabor and Social Affairs; 2005.