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Observational Study on the Management of Biomedical Waste in Health Care Establishments in the City of Kisangani (Tshopo Province, Democratic Republic of Congo)

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Abstract

Introduction: The objective of this study was to observe biomedical waste management practices in health care facilities in the City of Kisangani and to identify factors associated with effective biomedical waste management.

Materials and Methods: A cross-sectional study with analytical aim was carried out among 422 professionals and managers of health care establishments in Kisangani and was conducted from June 15 to August 15, 2024 in secondary and tertiary care establishments of the city. Data collection was done through direct observations and questionnaires administered to health personnel. Frequencies and crude odds ratios (ORb) with 95% confidence intervals (CI) were calculated to assess the associations between certain factors and biomedical waste management.

Results: The results of this study show that the majority of healthcare providers have insufficient knowledge on the definition of biomedical waste management (BMWM), with 93.6% of them reporting not knowing it, and 64.5% have not been trained on MBWM. Among the trained providers, the majority (68.7%) received the training more than 36 months ago. In addition, 69.7% of providers do not apply biomedical waste sorting, and 78.2% do not have WHO recommended codified waste bags.

The infrastructure available for waste management is also inadequate, with 71.8% of providers reporting the presence of a non-functional incinerator, 71.3% indicating the presence of a functional placenta pit, ash pit and glass crusher, 69% reporting the presence of non-functional hand hygiene stations, and 77% citing the unavailability of means of transporting biomedical waste.

Finally, analysis of associated factors shows that the availability of functional incinerators (OR = 4.3; p < 0.000), placenta, ash pits and functional glass crushers (OR = 0.03; p < 0.000), means of waste transport (OR = 5.6; p < 0.000), and hand hygiene stations (OR = 0.12; p < 0.000) are strongly associated with better management of biomedical waste in health care facilities.

Conclusion: This study showed insufficient management of biomedical waste in health care facilities in the city of Kisangani. Interventions aimed at strengthening staff capacities and investing in infrastructure are necessary.

Keywords: Observational study; management; biomedical waste; health care establishments; City of Kisangani. Tshopo; DRC

Introduction

All human activity generates waste, and healthcare facilities are no exception. Consequently, healthcare waste (HCW) includes all waste produced in the fields of human and veterinary medicine [1]. In the current global context of population explosion, healthcare activities help protect health, cure patients and save lives [2]. But, lhospitals whose main function is to provide the population with comprehensive preventive and curative medical care [3], lead to an increase in the production of different types of waste responsible for a serious threat to humans and the environment [4], of which around 20% according to the WHO, where its Inappropriate management constitutes an environmental and health problem.

But 70% of this waste is infectious and responsible for serious, often incurable diseases. [2], And can potentially compromise the environment and public safety if not disposed of safely [5]. Therefore, the production of infectious health care waste (sharp, cutting and sharp objects) when poorly managed is responsible for approximately 8 to 16 million infections by viral hepatitis B, 2.3 to 4.7 million by hepatitis C and 800,000 to 1,600,000 cases of HIV/AIDS infections according to the WHO. [6], and are at the heart of the management problem in all West African countries [7].

According to new global data published by WHO and UNICEF in 2019, safe management of medical waste is non-existent or very limited in a large proportion of health care facilities (HCFs), with approximately 40% of health care facilities in developing countries not practicing biomedical waste segregation, increasing risks to health care workers, patients and surrounding communities [5]. Thus, in 2002, the results of an evaluation conducted by WHO in 22 developing countries showed that the proportion of health care establishments that do not apply appropriate waste disposal methods varies from 18 to 64% [8].

Biomedical waste management (BMWM) is a fundamental aspect of medical activities. These wastes, including sharps, infectious materials and chemical wastes, represent a significant risk to public health and the environment [9]. Due to the potentially hazardous nature of biomedical waste, its proper management is essential to prevent healthcare-associated infections, ensure staff safety and protect the environment [4]. Its negligence will significantly contribute to polluting the environment, affecting human health and depleting natural and financial resources. In many low-income countries, including the Democratic Republic of Congo (DRC), biomedical waste management infrastructure and practices are often inadequate [10].

In the DRC, biomedical waste management poses particular challenges due to lack of infrastructure, insufficient training of staff and scarce financial resources [1, 11, 12]. Often, waste is incinerated within the medical structure itself, with all the consequences that this uncontrolled operation entails [11, 13].

Despite this perspective, this study was conducted in Kisangani city, where health services are facing these challenges. The main objective was to observe biomedical waste management practices in health care facilities in Kisangani city and to identify factors associated with effective biomedical waste management.

Observasional Framework

This study was conducted using a direct observation protocol in a representative sample of health care facilities in the city of Kisangani, Democratic Republic of Congo. The observation focused on daily practices in biomedical waste management, including sorting, storage, treatment, transportation and disposal of biomedical waste.

Methodology

Study framework

The study was conducted in Kisangani, a city located in the Tshopo Province in the north-east of the DRC. This city has five health zones, including general referral hospitals, health centres, the Cinquantenaire Provincial Hospital and university clinics. This city, like many other cities in sub-Saharan Africa, faces considerable challenges in terms of health infrastructure, waste management and access to basic resources to ensure the safety of patients and staff.

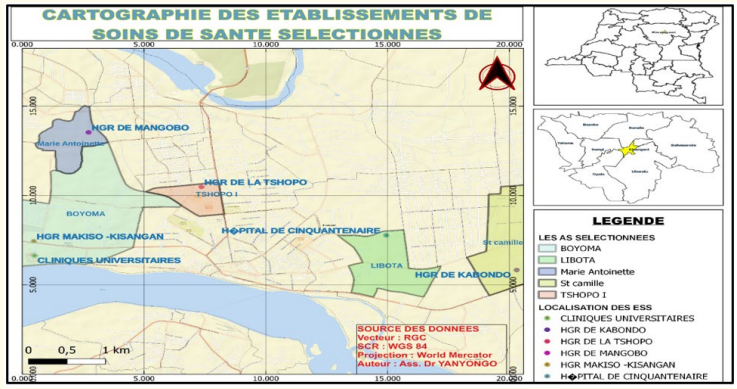


Figure 1: Study setting. This figure shows the health care facilities, including CLINIQUES UNIVERSITAIRES, HGR de la TSHOPO, HGR de KABONDO, HGR de MANGOBO, HGR MAKISO-KISANGANI and HOPITAL DE CINQUANTENAIRE which are identified as priority study sites. These health care facilities are located in the Democratic Republic of Congo (DRC), in the province of Tshopo, specifically in the city of Kisangani.

Type and period of study

This was a cross-sectional study with analytical aims for a period oftwo months, from June 15 to August 15, 2024.

Population and study sample

The study involved a representative sample of 422 healthcare providers and managers of healthcare facilities. The selection of respondents was made by simple random sampling among the staff of secondary and tertiary hospitals in the four health zones of the City of Kisangani. The respondents included doctors, nurses, nursing assistants and biomedical waste managers.

Data collection

Data were collected using two main methods:

- Direct observation: Investigators observed waste sorting, storage methods, transportation and disposal of waste.
- Guided interview using a structured questionnaire: A questionnaire was administered to 422 healthcare personnel to assess their level of knowledge and perception of biomedical waste management.

This questionnaire included questions about training, availability of infrastructure, daily practices and challenges encountered.

Variables studied

The main variables studied included:

- The dependent variable: Good waste management (Yes/No)
- Independent Variables:
  - Knowledge of GDBM: Training received, understanding of waste management protocols.
  - GDBM practices: Waste sorting, disposal of sharp objects, waste incineration, availability of coded containers.
  - Infrastructure: Availability of incinerators, placenta pits, ash pits, glass crushers, hand washing stations and means of transportation for biomedical waste.

Data analysis

Data were analyzed using STATA 13 software. Frequencies and crude odds ratios (ORb) with 95% confidence intervals (CI) were calculated to assess associations between selected factors and biomedical waste management.

Results

Socio-professional characteristics of respondents

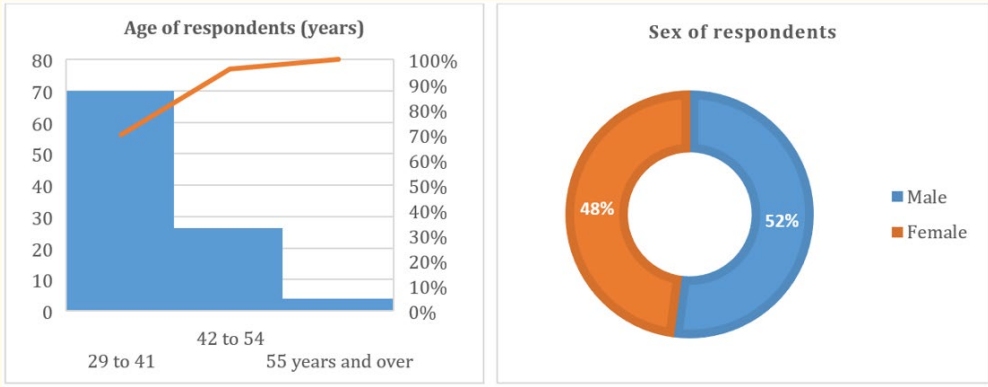
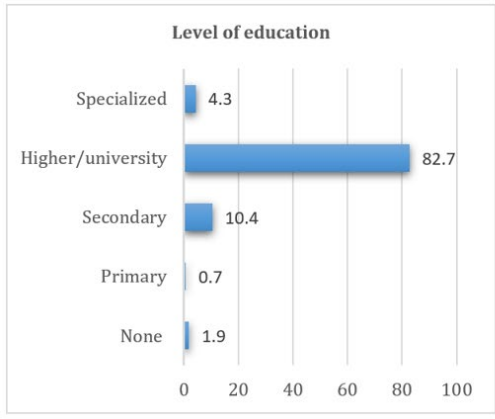


Figure 2: Distribution of respondents by age group. ***Figure 3:*** Distribution of respondents by gender.



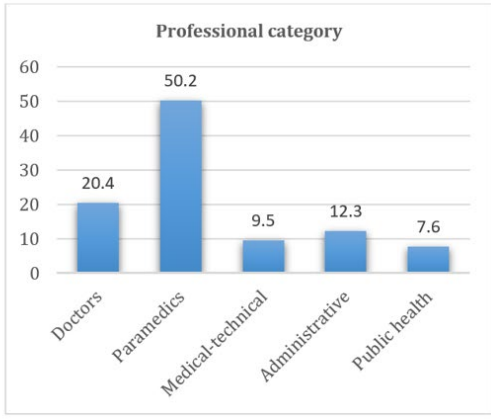


Figure 4: Distribution of respondents by marital status. ***Figure 5:*** Distribution of respondents by professional category.

The results of these figures 2, 3, 4, and 5 show that the majority of the respondents observed had an age varying between 29 and 41 years, with an average of 40 ± 9 years, of the male sex (52.1%,). About 82.7% of the respondents had a higher or university level of education, and belonged to the paramedical category mainly including nurses and health technicians (50.2%).

Knowledge and training on biomedical waste management

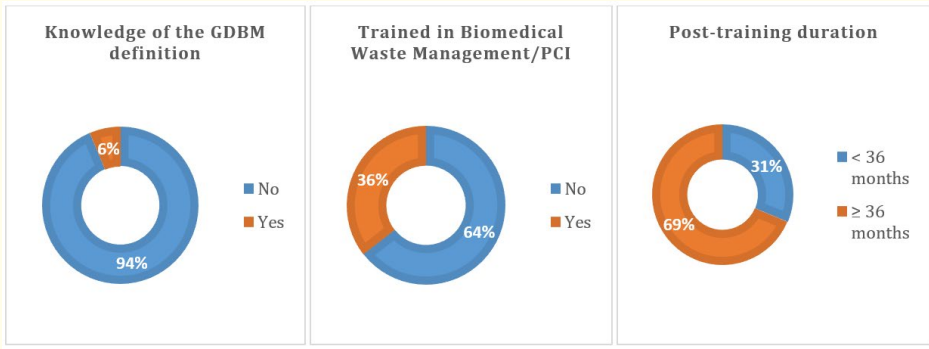


Figure 6: Distribution of service providers according to their knowledge and training on the GDBM.

The results of this Figure 6 reveal that healthcare providers' knowledge of the definition of biomedical waste management (BMWM) is very limited, with 93.6% reporting not knowing it. Furthermore, training in MBWM or infection prevention and control (IPC) remains insufficient, with only 35.5% of providers having received training, compared to 64.5% who had not. Of those who were trained (n = 150), the majority (68.7%) received this training 36 months or more ago.

Biomedical waste management practices

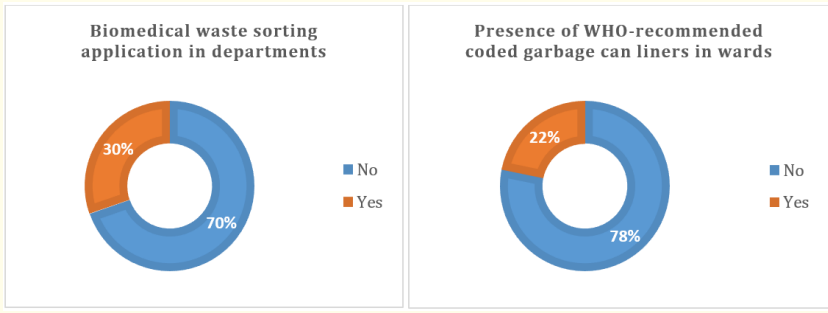


Figure 7: Distribution of providers according to the practice of GDBM in health care establishments.

The results of this Figure 7 indicate that the majority of healthcare providers do not apply sorting of biomedical waste in their services (69.7%,). Furthermore, the presence of codified waste bags, as recommended by the WHO, is also low, since 78.2% of providers indicate that they do not have them.

The photos below illustrate some of the trash cans observed in the HGR of Makiso – Kisangani.

Figure 8: In the emergency room.

Figure 9: Public discharge.

Available infrastructure

Variable	*Frequency (n=422)*	*Percentage*
Presence of a Functional Incinerator		
No	303	71.8
Yes	119	28.2
Presence of a placenta pit, ash pit and functional glass crusher		
No	301	71.3
Yes	121	28.7
Existence of functional hand hygiene stations in the ESS		
No	291	69
Yes	131	31
Availability of DBM transport means		
No	325	77
Yes	97	23

Table 1: Distribution of providers according to the available infrastructure useful for GDBM in healthcare establishments.

The results of this table 1 show that 71.8% of providers reported the presence of a non-functional incinerator in health care facilities (HCFs). Similarly, infrastructure such as placenta pit, ash pit and glass crusher are not functional in HCFs according to 71.3% of providers. Furthermore, 69% mentioned the presence of non-functional hand hygiene stations. Furthermore, 77% admitted the unavailability of means of transporting biomedical waste in HCFs.

The images below illustrate some of the available infrastructure observed in a few selected establishments:

Incinerators

Figure 10: Makiso General Reference Hospital – Kisangani. ***Figure 11:*** University Clinic.

Placenta pit

Figure 12: University Clinic.

Glass crusher

Figure 13: University Clinic (Functional). ***Figure 14:*** Makiso-Kisangani General Reference Hospital (Non-functional).

Factors associated with better waste management

Associated factors	***GDBM in ESS***				
	All	***Bad***	***Good***	***Orb (IC95)***	***p. value***
Presence of a Functional Incinerator	**422**	**314**	**108**		
No(%)	303 (71.8)	251 (79.9)	52 (48.2)	4.3 (2.61 – 7.03)	< 0.000
Yes (%)	119 (28.2)	63 (20.1)	56 (51.8)		
Presence of a placenta pit, ash pit and functional glass crusher	**422**	**314**	**108**		
No(%)	301 (71.3)	195 (62.1)	106 (98.1)	0.03 (0.004 – 0.12)	< 0.000
Yes (%)	121 (28.7)	119 (37.9)	2 (1.9)		

Availability of DBM transport means	**422**	**314**	**108**		
No(%)	325 (77)	269 (85.7)	56 (51.9)	5.6 (3.2 – 9.3)	< 0.000
Yes (%)	97 (23)	45 (14.3)	52 (48.1)		
Existence of functional hand hygiene stations in the ESS	**422**	**314**	**108**		
No(%)	291 (69)	191 (60.8)	100 (92.6)	0.12 (0.5 – 0.38)	< 0.000
Yes (%)	131 (31)	123 (39.5)	8 (7.4)		

Table 2: Analysis of factors associated with GDBM in health care facilities.

The results of this table 2reveal that the availability of functional incinerators (OR = 4.3; p < 0.000), a functional placenta, ash pit and glass crusher (OR = 0.03; p < 0.000), means of waste transportation (OR = 5.6; p < 0.000) and hand hygiene stations (OR = 0.12; p < 0.000) were strongly associated with better biomedical waste management in ESS.

Discussion

Knowledge on Biomedical Waste Management (BWM) and training

The results of this study show that 93.6% of healthcare providers had insufficient knowledge about GDBM, and 64.5% did not receive specific training. These results suggest not only a low knowledge of key concepts of GDBM, but also a lack of recent training, which could affect the effective implementation of good practices for biomedical waste management and infection prevention. Indeed, This situation is worrying and in line with several previous studies which have reported a lack of adequate training of health personnel on the management of biomedical waste, because Good GDBM requires active participation of all stakeholders and synchronization between governmental and non-governmental organizations, health care facilities and health personnel [14].

A study conducted in Cameroon by Nfor et al. in 2020 revealed that more than 70% of health workers had not been trained in GDBM, which compromised the implementation of safe practices. There therefore appears to be a recurring need for capacity building in this area [15, 16]. This situation is also in contrast to studies conducted in other developing countries, such as India, Bangladesh and Turkey, where similar levels of inadequate knowledge have been reported among health personnel [17-19].

Biomedical waste sorting practices and use of codified equipment

In this study, only 30.3% of providers reported sorting biomedical waste and 21.8% used coded bags according to WHO recommendations. These results highlight low adherence to good biomedical waste management practices among healthcare providers, which could compromise the safety of care and increase the risks of contamination and pollution.

These figures are comparable to those found by Harhay et al. in 2019 who showed that in several developing countries, health facilities had sorting and coded bag use rates below 40%, indicating poor implementation of safety and risk management standards. Similarly, this highlights the lack of resources and awareness among health care providers about the importance of sorting [20]. In addition, This trend towards not sorting waste in the health care facilities studied is similar to observations made by Stephen T. Odonkor and Tahiru Mahami [19], Koffi N.et al. [22], which had respectively indicated that 71.1% of the staff of the Regional Hospital Center and 60% of the staff of Cocody did not ensure the sorting of waste as soon as it was produced. However, they were in contradiction with the WHO report on WASH, where approximately 60% of health establishments had at least one sorting system, generally for sharps and cutting waste than for infectious waste [23].

Availability of Infrastructure for GDBM

The results of this study reveal that the presence of non-functional incinerators, placenta pits, glass crushers, non-functional hand hygiene stations, and means of transportation is widespread, affecting more than 70% of healthcare facilities respectively. These results highlight serious gaps in terms of biomedical waste management infrastructure and measures to prevent healthcare-associated infections, which could increase the risks of contamination and compromise the safety of care provided [24].

These findings are similar to the results of the study by Gupta et al. in India in 2018, where it was observed that more than 60% of facilities lacked adequate infrastructure for GDBM [25]. The lack of these infrastructures limits the capacity to manage waste securely and increases the risks of contamination [22, 26-28].

Factors associated with GDBM in healthcare settings

This study showed that the presence of functional incinerators (OR = 4.3; $p < 0.000$), placenta, ash pits and glass crushers (OR = 0.03; $p < 0.000$), waste transport facilities (OR = 5.6; $p < 0.000$), and hand hygiene stations (OR = 0.12; $p < 0.000$) were strongly associated with better GDBM.

These results are consistent with the observations of Abor and Bouwer, Ndiaye et al. and Kubali et al. who demonstrated that establishments with better infrastructure had better compliance with waste management practices [29, 26, 30]. The significant odds ratio obtained in the current study (e.g., OR = 4.3 for the presence of an incinerator) confirms that the availability of infrastructure has a considerable impact on the quality of GDBM.

Conclusion

This study highlighted significant gaps in biomedical waste management in health care facilities in Kisangani city, highlighting the need for a comprehensive, multi-sectoral approach to address the challenges of biomedical waste management in resource-limited areas.

There is an urgent need to strengthen staff capacities through regular training and improve infrastructure for biomedical waste management.

Structured interventions, based on WHO recommendations, are essential to ensure more effective management of biomedical waste, thereby reducing risks to public health and the environment.

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