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Management of Biomedical Waste in the South of the Democratic Republic Congo: Current Situation

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Effective management of biomedical waste is mandatory for healthy human beings and a safe environment. Poor management of biomedical waste is a community health problem. This article reviews the methods of biomedical waste management. The management of biomedical waste is a significant challenge in the south of DR Congo in terms of the implementation of the types of bins, the concentration of bleach used and the method of waste disposal. Staff training and awareness of waste management waste is of great interest to the community and the associated employees.

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1. INTRODUCTION

During the process of delivering healthcare, healthcare facilities (HCFs) can generate waste and by-products [1]. Medical solid waste is considered disposed waste generated by health protection, diagnosis, treatment, dental and scientific research [1-3]. Proper disposal of healthcare waste has become a global concern due to public health risks [4]. Mismanagement of healthcare waste is a problem, especially in most developing countries [5]. In most African countries, healthcare waste management needs to be better monitored or even neglected [6-11]. Thus, this study aimed to assess the practice of HCWM and potential challenges in the southern provinces of DR Congo.

2. METHODS

This is a cross-sectional study carried out in public and private medical structures in the southern provinces (Upper Katanga, Upper Lomami, Lualaba, and Tanganyika) of the Democratic Republic, a country in Central Africa. A total of 14 structures were visited. Sheets were received and using Epi info 7.3 and Microsoft Office Excel 2013, and the results are presented in pie chart and histogram form.

3. RESULTS AND DISCUSSION

A a total of 6,228 responses were gathered from different medical structures, and the analysis is provided in the following paragraphs.

Fig. 1 shows that 49.9% of structures visited were Health Centers, 28.3% were polyclinics, 12.6% were General Reference Hospitals, and 9.1% were Reference Health Centers. In addition 59.37% of staff had already undergone at least one biosafety training.

The observation thus made shows an increased number of first-line structures, an observation also made by Chenge et al. [12], in Kisangani in the Democratic Republic of Congo and likewise Samuel Bosongo et al. [13] affirms, that the services of doctors on the front line constitute a de facto situation, unplanned and unsupported, which is mainly due to the need for the professional integration of doctors because this phenomenon does not correspond to health policy since front-line service is delegated to nurse practitioners [14].

From this table As displayed in Table 1, one can see that the use of trash cans according to the principle of waste sorting was not yet perfectly implemented in the medical structures visited. The presence of all types of trash cans was estimated at 4610, which is the small value which provides information on the presence of trash cans, i.e., 74.0%. Thus, 26% of our structures did not include all types of trash cans. Also, the collection bags in the bins for soiled and unsoiled objects was present in 67.75% of all bins and only 66.87% of the bins for sharp objects contained bleach.

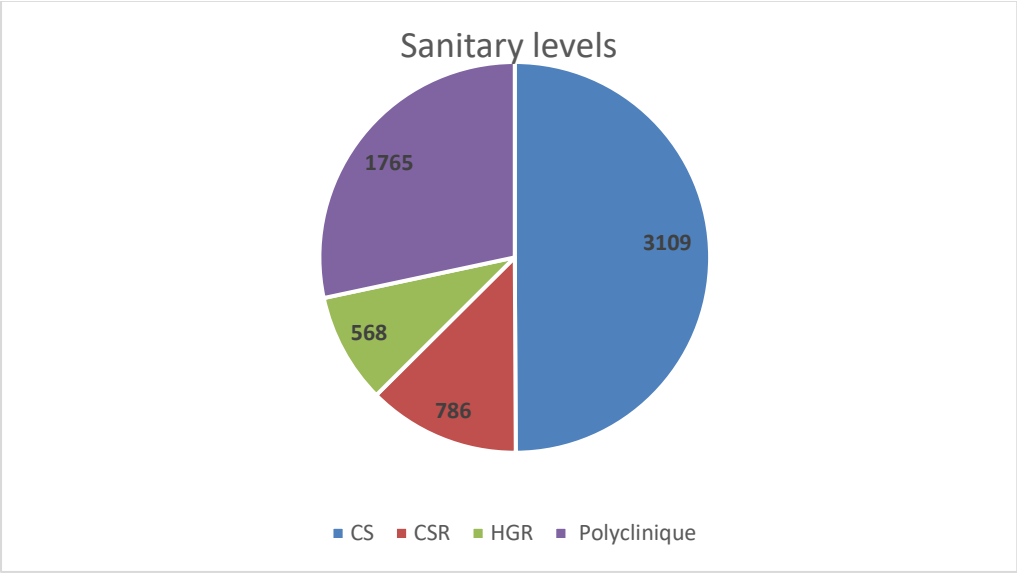


Fig. 1. Sanitary level of structures and training in biosafety

Table 1. Type of bins used

Trash cans	Presence	Absence	Presence of sachets	Containing bleach
Unsullied objects	5,108	1,220	4302	
Tainted objects	4,986	1,342	4220	
Sharp objects	4,610	1,718		4,165

In any case, an effort is still to be made so that 26% of structures that do not bring together all types of trash can respect the sorting of hospital waste, which is an operation that is essential to guarantee the safety of medical staff, and patients., the entire elimination chain and guaranteeing public health in general. because Health professionals are required to sort hospital waste by separating biological materials from contaminated medical equipment distinguishing hazardous waste from non-hazardous waste. Thus, each type of waste must be deposited in a specific bin, the capacity and shape adapted to the particularities of each waste (sharp, liquid, soft, bulky, etc.) [15].

And BMW's basic management principle is Reduce, Reuse and Recycle – the 3Rs. Moreover, separating the different types of waste generated contributes to reducing the risks resulting from poor management by BMW. When waste is disposed of, there is an increased risk of mixing waste such as sharps and general waste. Because if they are not adequately separated, syringes and needles discarded in hospitals will likely be reused [16].

Thus, waste must be sorted into containers at the source of its production, and according to Annex, the container used must be labelled. The annexes to the BMW (Management and Handling) Rules 1998, which initially numbered ten, have now been reduced to four [17]. This involves using bins of different colours for waste disposal. Colour is an important indicator for the separation and identification of different categories of waste in appropriately coloured containers. They should be properly and labelled according to where they were generated [18,19].

Regarding the bleach used in sharps bins, the decreasing distribution in the percentage of concentrations used was 0.5%, 10%, 1% and 0.05%. However, the appropriate concentration of sodium hypochlorite required to disinfect general liquid biological waste is 5,000 ppm, or approximately 0.5%. For biological waste containing a high organic load (e.g., blood, proteins or lipids), the appropriate concentration of sodium hypochlorite is 10,000 ppm or 1% [20]. This disparity observed in Table 2 reveals the lack of formulation of phlebotomists who use bleach without knowing its composition and method of preparation. Healthcare facilities need an operational strategy to train stakeholders involved in producing medical waste to manage this critical problem. Because inappropriate

Table 2. Concentration of bleach in the sharps bin

Bleach % Concentration	NOT	%
0.05	647	15.3
0.50	1,366	32.3
1	1,023	24.2
10	1,184	28.2
Total	4220	100

Table 3. Waste disposal techniques used

Landfill: 2823 (45.32%) **Person trained: 1009: 35.74%**						**Incineration: 3405(54.67%)** **Person trained: 1181: 34.68%**		
Depth Well	**NOT**	**%**	**Blanket Waste**	**NOT**	**%**	**Incineration temperature**	**NOT**	**%**
2 m	1326	46.9	**Nothing**	1665	**58.9**	**100**	2058	60.44
5 m	1294	45.8	**active lime**	51	**1.8**	**500**	1340	39.35
10 m	120	4.2	**Hydrated lime**	189	**6.7**	**1000**	5	0.14
> 10 m	83	2.9	**Ash**	918	**32.5**	**> 1000**	2	0.07

employee behaviour and improper methods of medical waste disposal in hospitals can increase serious health risks and environmental pollution due to the contagious nature of the waste [21].

Two waste disposal techniques were used: burial in 45.32% of cases and incineration in 54.67%. 35.74% of the staff of structures using landfills and 34.68% of those using incineration had already received training.

For the burial, the depths of the wells were respectively distributed 46.9% for two meters deep, 45.8% for five meters, 4.2% for ten meters and 2.9% for more than 10 meters. Waste coverage at the end of the day was not done in 58.9%, 32.5% resorted to ashes, 6.7% to slaked lime and 1.8% to quicklime. As for incineration, 60.44% of the structures incinerated at a temperature around 100°C, 39.55% around 500°C, 0.14% around 1000° and 0.058% at more than 1000°C, Most medical waste is incinerated a short-lived practice due to environmental considerations. The combustion of solid and regulated medical waste generated by health care creates many problems. Medical waste incinerators emit toxic air pollutants and ash residues, which are the primary source of dioxins in the environment. The International Agency for Research on Cancer, a branch of the WHO, has recognized the carcinogenic potential of dioxins and classified them as carcinogenic to humans [22]. This is indeed the case of our structures which use makeshift incinerators using gasoline or fuel oil as fuel [23]. Good practice requires electric incineration which produces almost no smoke and at a temperature above 1000°C, one of the only technologies capable of correctly treating all types of medical waste, and it has the advantage of significantly reducing the volume and weight of treated waste [24]. Indeed, incineration at low temperatures (less than 800°C) or when plastic materials containing polyvinyl chloride (PVC) [25], constituting most of the bottles used in hospitals, is incinerated, it forms hydrochloric acid (responsible for acid rain), dioxins, furans and various other toxic air pollutants. They are found in emissions and residual ash and fly ash (transported by the air and effluent gases leaving the incinerator chimney). Optimization of the process can reduce the formation of these substances if incineration only takes place at temperatures above 800°C [26]. Low-level, long-term exposure to dioxins and furans can cause damage to the immune system and developmental abnormalities of the nervous system, endocrine system and reproductive functions in humans. A high intensity and short exposure [27].

As for the burial of waste, it was carried out for a long time in a precarious manner, without any constraint or control of the different categories of stored and buried waste. The consequences are severe soil and water pollution, and olfactory or visual nuisances. In our situation, it is appropriate to observe that most of the landfill pits are less than 5 meters, and the waste is not covered for the most part and those who can use it mainly use ash, which, unfortunately, suffers from a problem supply as is the case for lime. Ideally, the pit should be lined with low permeability materials, such as clay, to prevent pollution of shallow groundwater and fenced off so that waste pickers cannot access it. Medical care waste must be immediately buried under a layer of soil after each unloading [28]. For increased health protection (in the event of an epidemic, for example) or the suppression of odours, it is suggested that lime be poured over the waste [29]. The pit should be sealed when filled [30].

Note also the poor training of staff assigned to waste management, training estimated at around 35% only. Yet the most essential criteria in the process of medical waste management in an environment are qualified personnel, health facility infrastructure and waste control and the most efficient hospital is determined [31].

Although the quantification of waste is not yet practical in our hospitals, it should be clarified that the quantity and composition of medical waste may vary depending on the level of activity of the establishment generated, the type of installation, size, location, policies, waste management method, technology, waste regulations, infrastructure, as well as development levels of countries [32,33].

4. CONCLUSION

Medical waste management must be considered not only in terms of environmental impact and potential long-term health effects but also in society's future energy needs. The highlight of BMW's management is that "the success of BMW's management depends on segregation at the point of generation". Thus, the proper identification, separation and disposal of biomedical waste is healthcare professionals' ethical and social responsibility.

It should be mandatory for health facilities to train their health staff in accredited training centres,

and this should not become just a one-time activity but rather a continuous process.

A more coordinated effort by pollution control authorities and better training of health workers and administrators are needed.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

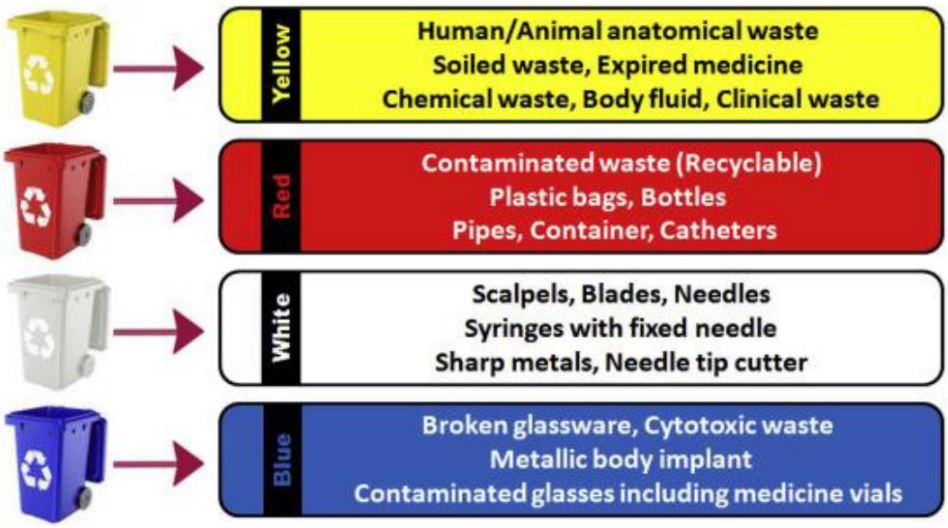
REFERENCES

1. Yazie TD, Tebeje MG, Chufa KA Healthcare Waste Management Current Status and Potential Challenges in Ethiopia: A Systematic Review. BMC Res. Ratings. 2019;12:285.
   DOI: 10.1186/s13104-019-4316-y. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
2. Hasan MM, Rahman MH Assessment of Healthcare Waste Management Paradigms, and Its Suitable Treatment Alternative: A Case Study. J. Approx. Public Health. 2018;2018:6879751.
   DOI: 10.1155/2018/6879751 [PMC free article] [PubMed] [CrossRef] [Google Scholar]
3. Dehghani MH, Ahrami HD, Nabizadeh R, Heidarinejad Z, Zarei A. Medical Waste Generation and Management in Medical Clinics in South of Iran. MethodsX. 2019;6:727–733.
   DOI: 10.1016/j.mex.2019.03.029. [PMC free article] [PubMed] [CrossRef] [Google Scholar]
4. Meleko A, Adane A. Assessment of health care waste generation rate and evaluation of its management system in Mizan Tepi University Teaching Hospital (MTUTH), Bench Maji Zone, Southwest Ethiopia. Ann Rev Res. 2018;1:1–9. [Google Scholar]
5. Azage M. Healthcare waste management practices among healthcare workers in healthcare facilities of Gondar town, Northwest Ethiopia. Health Sci J. 2013;7:315–326. [Google Scholar] [Ref list]
6. Debalkie D, Kumie A. Healthcare waste management: The current issue in Menellik II Referral Hospital, Ethiopia. Curr World Approx. 2017;12:42–52.
   DOI: 10.12944/CWE.12.1.06. [CrossRef] [Google Scholar] [Ref list]
7. Sawalem M, Selic E. Hospital waste management in Libya: A case study. Waste Management. 2009;29:1370– 1375.
   DOI: 10.1016/j.wasman.2008.08.028. [PubMed] [CrossRef] [Google Scholar] [Ref list]
8. Bendjoudi Z, Taleb F, Abdelmalek F, Addou A. Healthcare waste management in Algeria and Mostaganem department. Waste Management. 2009;29:1383– 1387.
   DOI: 10.1016/j.wasman.2008.10.008. [PubMed]
9. Olufunsho A, Aishat AA, Azuka CO. Assessment of medical waste management in seven hospitals in Lagos, Nigeria. BMC Public Health. 2016;16:269.
   DOI: 10.1186/s12889-016-2916-1. [PMC free article] [PubMed] [CrossRef] [Google Scholar] [Ref list]
10. Mbongwe B, Mmereki BT, Magashula A. Healthcare waste management: Current practices in selected healthcare facilities, Botswana. Waste Management. 2008;28:226–233.
    DOI: 10.1016/j.wasman.2006.12.019. [PubMed] [CrossRef] [Google Scholar] [Ref list]
11. Manga VE, Forton OT, Mofor LA, Woodard R. Healthcare waste management in Cameroon: A case study from the south-western region. Resour Conserv Recycl. 2011;57:108–116.
    DOI: 10.1016/j.resconrec.2011.10.002. [CrossRef] [Google Scholar] [Ref list]
12. Chenge M, Van der Vennet J, Porignon D, Luboya N, Kabyla I, Criel B. The health map of the city of Lubumbashi, Democratic Republic of Congo. Part I: Problems of health coverage in Congolese urban areas. [Health map of Lubumbashi, Democratic Republic of Congo. Part I: Problem of health coverage among urban Congolese. Global Health Promotion. 2010;17:63-74. (In French)
    Available:https://doi.org/10.1177/1757975910375173
13. Bosongo S, Chenge F, Mwembo A, Crielnt B. The influence of the services of doctors at the first line of care on the integrated health district system in Kisangani, Democratic Republic of Congo: A qualitative study. Pan African Medical Journal. 2021;39:article 215.
    Available:https://doi.org/10.11604/pamj.2021.39.215.25737
14. Bosongo SI, Mukalenge FC, Tambwe AM, Criel B. [Medical providers at the first line of care in the city of Kisangani in the Democratic Republic of Congo: Towards a typology]. African Journal of Primary

Health Care and Family Medicine. 2021; 13:a2617. (In French)
Available:https://doi.org/10.4102/phcfm.v13i1.2617

15. Control of transport risks related to waste disposal in the healthcare system with a two-tier waste collection network. [Sep; 2022];Li H, Hu Y, Lyu J, Quan H, Xu X, Li C. Math Probl Eng. 2021;2021: 1–10. [Google Scholar]
16. Self-reported healthcare waste segregation practice and its correlate among healthcare workers in hospitals of Southeast Ethiopia. Sahiledengle B. BMC Health Serv Res. 2019;19:591. [PMC free article] [PubMed] [Google Scholar] [Ref list]
17. Biomedical waste management guidelines 2016: what's done and what needs to be done. Singhal L, Tuli AK, Gautam V. Indian J Med Microbiol. 2017;35:194–198. [PubMed] [Google Scholar] [Ref list]
18. Bansod HS, Deshmukh P. Biomedical Waste Management and Its Importance: A Systematic Review. Cureus. 2023 Feb 3;15(2):e34589.
DOI: 10.7759/cureus.34589
PMID: 36874306; PMCID: PMC9981497.
19. Lee SM, Lee D. Effective Medical Waste Management for Sustainable Green Healthcare. Int J Environ Res Public Health. 2022 Nov 10;19(22): 14820.
DOI: 10.3390/ijerph192214820
PMID: 36429539; PMC ID: PMC9690095
20. Singhal L, Tuli AK, Gautam V. Biomedical waste management guidelines 2016: What's done and what needs to be done. Indian J Med Microbiol. 2017 Apr-Jun;35(2):194-198.
DOI: 10.4103/ ijmm.IJMM_17_105
PMID: 28681805.
21. Hossain M., Santhanam A., Norulaini N., Omar A. Clinical Solid Waste Management Practices and Its Impact on Human Health and Environment: A Review. Waste Management 2011;31:754– 766.
DOI: 10.1016/j.wasman.2010.11.008. [PubMed] [CrossRef] [Google Scholar]
22. Gautam V, Thapar R, Sharma M. Biomedical waste management: Incineration vs. environmental safety. Indian J Med Microbiol. 2010 Jul-Sep; 28(3):191-2.
DOI: 10.4103/0255-0857.66465
PMID: 20644303.
23. WHO (World Health Organization) Healthcare Waste; 2018.
[(accessed on 21 January 2022)].
Available:https://www.who.int/en/news-room/fact-sheets/detail/health-care-waste
[Ref list]
24. Singhal L, Tuli AK, Gautam V. Biomedical waste management guidelines 2016: What's done and what needs to be done. Indian J Med Microbiol. 2017 Apr-Jun;35(2):194-198.
DOI:10.4103/ ijmm.IJMM_17_105
PMID: 28681805.
25. Ara S, Khatun R, Uddin MS. Urbanization challenge: Solid waste management in Sylhet City, Bangladesh; 2021.
26. Senjen R, Illuminato I. Nano and biocidal silver: extreme germ killers present a growing threat to public health; 2009.
27. Visvanathan C, Adhikari R, Ananth AP. 3R Practices for municipal solid waste management in Asia; 2018.
28. Study on the results of the treatment of waste from health care activities with infectious risks in France: Year 2011 and outlook for 2012.
29. Cholera Operational Procedures Kit action against Hunger, 2023 - 102 rue de Paris 93100 MONTREUIL, France.
Available:www.actioncontrelafaim.org
30. Medical waste management manual International Committee of the Red Cross 19, avenue de la Paix 1202 Geneva, Switzerland © ICRC; May 2011.
31. Çelik S, Peker İ, Gök-Kısa AC, Büyüközkan G. Multi-criteria evaluation of medical waste management process under intuitionistic fuzzy environment: A case study on hospitals in Turkey. Socioecon Plann Sci. 2023 Apr;86 :101499.
DOI: 10.1016/j.seps.2022.101499
Epub 2022 Dec 16. PMID: 36540295; PMCID: PMC9754754.
32. Chartier Y, Emmanuel J, Pieper U, Pruss A, Rushbrook P, Stringer R. WHO; Geneva: Safe management of wastes from health-care activities. [Google Scholar]; 2014.
33. Ilyas S., Srivastava RR, Kim H. Disinfection technology and strategies for COVID-19 hospital and bio-medical waste management. Sci Total Environ. 2020;749 [PMC free article] [PubMed] [Google Scholar] [Ref list]

ANNEX



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