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Original article

Evaluation of the biomedical waste management method at the district hospital of commune iv in 2023 in Bamako

Évaluation de la méthode de gestion des déchets biomédicaux à l'hôpital de district de la commune IV en 2023 à Bamako

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Résumé

La gestion des déchets biomédicaux (DBI) englobe toutes les étapes, du tri et du conditionnement à la collecte, au transport, au stockage, au traitement et à l'élimination finale, avec un suivi spécifique des sites d'élimination.

Cette étude a évalué les pratiques de gestion des DBI au sein de l'hôpital de distribution de la commune IV de Bamako, sur la période du 1er mars 2023 au 29 février 2024.

Il s'agissait d'une étude transversale descriptive menée à l'hôpital de district IV de la municipalité. Les données ont été collectées auprès de techniciens médicaux, paramédicaux et de surface (n = 209), par observations directes, entretiens semi-directifs et questionnaire sur la typologie et l'élimination des déchets, les incidents de manipulation et la formation du personnel. Le taux de participation était de 79,2%. Les hommes étaient surreprésentés (56,5 %). La méthode de traitement des déchets la plus pratiquée est l'incinération (90 %). Le tri des DBI était inadéquat dans 25,8 % des unités et l'utilisation du système de codage couleur efficace dans 87 % des cas.

La gestion des déchets biomédicaux demeure un défi majeur à l'hôpital de district de la commune IV. Le renforcement des activités de formation continue et de sensibilisation du personnel apparaît essentiel pour une gestion plus radicale et durable.

Mots-clés : méthode d'évaluation et de gestion, déchets biomédicaux, hôpital de district, commune IV, Mali.

Abstract

Biomedical waste management encompasses all stages from sorting and packaging to collection, transport, storage, treatment and final disposal, with specific monitoring of disposal sites.

This study evaluated biomedical waste management practices within the distribution hospital of Commune IV of Bamako, over the period from March 1, 2023 to February 29, 2024.

This was a descriptive cross-sectional study conducted at the municipality's district hospital

IV. Data were collected from medical, paramedical and surface technicians (n = 209), using direct observations, semi-structured interviews and a questionnaire on the typology and disposal of waste, man- nipulation incidents and staff training. The turnout was 79.2%. Men were over-represented (56.5%). The most practised methods of waste treatment are incineration (90%). The sorting of the DBMs was inadequate in 25.8% of the units and the use of the effective colour coding system in 87% of cases.

Biomedical waste management remains a major challenge at the District Hospital of Commune IV. Strengthening continuous training and awareness-raising activities for staff appears essential for more radical and sustainable management.

Keywords: evaluation-management method-biomedical waste-district hospital-commune IV-Mali.

Introduction

Biomedical waste is generated by prevention, diagnosis, monitoring or treatment activities (preventive, curative or palliative) in human, veterinary or research medicine, and presents a physical, biological or chemical risk to humans and the environment [1]

- Nature and classification of waste:

The waste generated in healthcare facilities is distributed as follows:

- Waste from high-risk healthcare activities
- (DASR): 30%
- Waste assimilable to household waste (DAOM): 70%
- Waste from healthcare activities with infec-
- (DASI): 25%
- Other rubbish dangerous (chemical, toxic and radioactive): < 5%

The main risk factors associated with this waste include: ecotoxicity, infectivity, physical, chemical and radioactive hazards. Infectious agents in waste, which pose a danger to personnel, include bacteria, viruses, fungi and parasites [2].

Global waste production continues to increase, and hospitals and health centers are no exception. Medical waste can be infectious, contain toxic chemicals and pose a risk of contamination to the population and the environment. Safe disposal of this waste is therefore essential to ensure a safe environment and to allow patients to receive appropriate care [2].

In Mali, the Directorate General of Health and Public Hygiene (DGSHP) quantified the production of waste from the activities of care, whether general or dangerous, as follows:

- Community health centres and health care facilities: 0.1 kg of waste per patient per day.
- Reference Health Centres (CS Ref): 1 kg of waste per bed per day.
- Regional hospitals: 2 kg of waste per bed per day.
- National hospitals: 4 kg of waste per bed per day [3].

As in most African countries, Mali faces deficient waste management, resulting in the accumulation of litter along roads, clogged runoffs, hazardous landfill sites in residential areas, inadequate disposal of toxic waste, lack of adequate infrastructure and lack of toxic waste.authorities and communities to deal with them effectively [4].

In 2002, an assessment conducted by the World Health Organization (WHO) in 22 developing countries found that 18 to 64 per cent of health care facilities did not follow proper waste disposal methods, highlighting a significant risk to public health and the environment [5].

In view of the diversity of the methods of waste production, their large volume and the seriousness of the risks they present to the population as a whole, it seems inadvisable to that their management be the subject of concerted action. These actions must mobilize health workers, health authorities at different levels, local authorities and the community, in order to ensure the safe management of biomedical waste. It is in this context that ourfinal thesis, entitled: "Evaluation of the biomedical waste management method at the district hospitalof Commune IV of Bamako", aims to contribute to the improvement of biomedical waste management practices.

Methodology

This descriptive cross-sectional study was carried out at the district hospital of Commune IV in Bamako, over a twelve-month period from March 1, 2023 to February 29, 2024. The target population was made up of medical, paramedical and cleaning technicians involved in biomedical waste management. External service providers were excluded, as those who refused to participate and those who were unable to respond. Sampling was based on a non-probability method of suitability for the quantitative component and a reasoned choice for the qualitative component. Data collection was based on direct observations of the contents of the bins in order to characterize the typology of the waste and to document sorting, collection and transport practices. An individual questionnaire was administered to staff to assess their knowledge, attitudes and practices, while Semi-structured interviews were used to deepen the analysis with key informants. The evaluation criteria focused on the nature and quantity of the waste, sorting and treatment methods, compliance with colour coding, handling incident management, and staff training and awareness.

Thus, the quantitative data was captured using Excel 2016 and then analyzed with IBM SPSS software. In addition, the documents were processed using Word 2016 for formatting. With regard to qualitative data, their analysis was based on the content analysis approach described by Laurence Bardin (2013) [6], and on the use of the NVivo 12 software, allowing for in-depth structuring and interpretation of the interviews.

- Ethical consideration

The research protocol was validated by the dissertation director, then an authorization to collect data was requested from the chief physician of the district hospital of the IV community of Bamako. Access to the staffhas been granted by the heads of department. Informed consent, verbal or written, was obtained from each participant, and anonymity and confidentiality were guaranteed throughout the study.

Results

- Descriptive study

Out of a total of 209 health workers targeted, the participation rate was 79.2%. The majority of respondents were male (56.5%) compared to 43.5% female, i.e. a sex ratio of 1.3. The 20–40 age group was the most represented (64.6%). The mean age of the participants was 41.5 ± 7.48 years, with extremes of 20 and 63 years. On the professional level, senior health technicians (33.97%) and cleaning technicians (19.13%) were the most representative categories.

The majority of participants (87%) recognized biomedical waste through the color-coding system of the garbage cans.

54% of participants had already benefited from atraining relating to the GDBM system.

The majority of respondents (74.2%) said that biomedical waste is sorted by health personnel.

- Analytical study
  - Bivariate analysis

Bivariate analysis shows a highly significant association between good biomedical waste management (GDBM) and the perception of the link with nosocomial infections ($p < 0.001$).

The analysis reveals a highly significant association between the existence of a biomedical waste management committee and the quality of management ($p < 0.001$).

  - Multivariate analysis

Multivariate logistic regression analysis identified several factors significantly associated with good

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biomedical waste management ($p < 0.05$).

- Qualitative study

The qualitative analysis of the word cloud reveals a predominance of the terms “incineration”, “treatment”, “burial” and “removal”, reflecting the representations most frequently associated by participants in bio-medical waste management practices.

This cloud shows that the most frequent words concerning the difference between the way the centre is treated and the national policy of which the interviewees were “political”, “national”, “difference”, “disinfected” and “anatomical”.

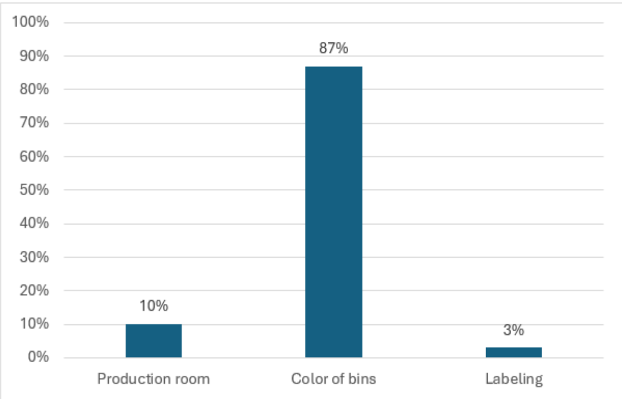

Figure 1 : Participants’ knowledge of the identification of the DBMs.

Legend

Source: Results of the survey conducted by the author at the hospital of the health district of commune four of Bamako, 2024.

DBM: Biomedical waste.

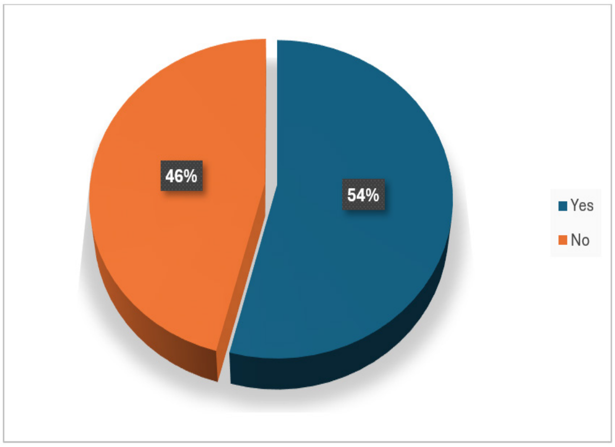

Figure 2: Respondents’ participation in training on GDBM.

Caption: Results of the investigation conducted by the author at the hospital of the health district of commune four of Bamako, 2024.

GDBM: Biomedical Waste Management.

Figure 3: Word cloud relating to the methods of treatment of biomedical waste.

Caption: Source: author’s survey, 2024.

Data Collection Tool: Interview Guide.

Analysis tool used: NVivo 12 software

Figure 4: Word cloud of difference between the modes of the centre and that of national politics

Legend:

Source: author’s survey, 2024.

Data Collection Tool: Interview Guide.

Analysis tool used: NVivo 12 softwar

Table I : Sociodemographic and occupational profile of participants.

Variables	Results
Participation rate	79,17%
Male	56,5%
Female	43,5%
Sex ratio (M/F)	1,30
Most represented age group (20-40 years old)	64,6%
Average age	41.5 years ± 7.48 (20-63 years)
Senior Health Technicians	33,97%
Cleaning technicians	19,13%

Legend:

Source: Data from the field survey carried out by the author, Bamako Commune IV Health District Hospital, 2024.

Collection tool used: individual questionnaire

Table II : Distribution of respondents by person in charge of sorting waste

Who sorts out the DBMs	Workforce (n)	Percentage %
Specialists	32	15,3
Health personnel	155	74,2
Maneuvers	20	9,6
I have no idea	2	0,9
Total	209	100

Legend

Source: Data from the field survey carried out by the author, Bamako Commune IV Health District Hospital, 2024.

DBM: Biomedical waste.

Collection tool used: individual questionnaire

Table III: Relationship between good GDBM and nosocomial infections

		DBM well managed today		Total	P. Value
		No	Yes		
Relationship between DBMs and NIs	No	17	10	27	<0.001
	Yes	39	143	182	
Total		56	153	209	

Pearson's chi-square=20.68; ddl=1

Legend:

Test used: Pearson's chi-square test, $\chi^2 = 20.68$; ddl = 1; $p < 0.001$

Source: Data from the field survey carried out by the author, Bamako Commune IV Health District Hospital, 2024.

IN: nosocomial infections

DBM: Biomedical waste.

Tool used for bivariate analysis: IBM SPSS software.

Table IV: Good GDBM and Existence of the Biomedical Waste Management Committee

		DBM well managed today		Total	P. Value
		No	Yes		
DBM Management Committee exists	No	11	8	19	<0.001
	NSP	15	9	24	
	Yes	30	136	166	
Total		56	153	**209**	

Pearson's chi-square=31.41; ddl=2

Legend:

Test used: Pearson's chi-square test, $\chi^2 = 31.41$; ddl = 2; p-value< 0.001

Source: Data from the field survey carried out by the author, Bamako Commune IV Health District Hospital, 2024.

DBM: Biomedical waste.

NSP: don't know

Tool used for bivariate analysis: IBM SPSS software.

Table V: Unconditional logistic regression of significant determinants of good GDBM

Variables	GOLD	DBM currently well managed (CI= 95%)		P
		Lower	Upper	
Removal schedule respected	29,53	0,82	34,94	<0.001
DBM Management Committee exists	10,31	6,71	354,04	<0.001
Well equipped to manage DBMs	17,63	0,56	5,92	<0.001
DBM repository infrastructure	15,30	1,78	165,47	<0.001
Know what happens to this waste	45,60	2,78	167,51	<0.001
Know the risks associated with these DBMs	4,55	7,18	35,42	<0.001
Relationship between BMD and Nosocomial Infections	20,68	2,64	14,7	<0.001

Legend: Odds Ratio (OR) = 2.45; Confidence Interval (95% CI) = [1.60 – 3.75].

Source: Data from the field survey carried out by the author, Bamako Commune IV Health District Hospital, 2024.

DBM: Biomedical waste.

GDBM: Biomedical Waste Management

Tool used for multivariate analysis: IBM SPSS software.

Discussion

- Quantitative data

Socio-demographic characteristics Socio-demographic characteristics related to the sex, age and qualifications of the officers surveyed.

- *Sex*

Male sex predominated in our sample (56.5%), with a sex ratio of 1.30. This result is consistent with the study by M. Diakité [7], who also observed an over-representation of men (75.8%).

- *Age*

The 20–40 age group was the most represented (64.6%), which could promote the effective implementation of hospital waste management practices at the district hospital of commune IV. These results are comparable to those of Hounsou and Degbey [8] in Benin, where 54% of the agents also belonged to a young population (20–39 years).

- *Qualification*

Among the participants in our survey, senior health technicians (33.97%) and cleaning technicians (19.13%) made up the most represented categories. This result is close to that reported by Souleymane Sinaly Traoré [9], where the majority of participants were nurses (40%). These data indicate that biomedical waste management involves all health personnel, from production to waste treatment, highlighting the importance of training and cross-cutting awareness to ensure safe and compliant practices.

- Means and procedures for the collection, transport and processing of DBMs

The means of waste collection were evaluated according to the types of waste produced inthe different units of the distribution hospital . Our study reveals that 97.1% of participants were aware of biomedical waste, a higher rate than that reported by Bertille [10], who observed that only 63% of health care staff considered their knowledge to be satisfactory when evaluating biomedical waste management at the Sakété Zone Hospital.

In addition, the majority of participants (87%) identified biomedical waste through the colour-coding system of the bins, a result comparable to that of Souleymane Sinaly Traoré (9) in Mali, who found 65%, and consistent with the observations of M. Diakité (7), where 76.7% of hospital actors also used this system. These results suggestthat the knowledge and use of colour coding is now widely integrated among hospital staff, which is a key element for the safety and efficiency of the biomedical waste collection process.

- Waste sorting

In our study, 74.2% of waste sorting was carried out by hospital staff, a rate higher than that reported by Ndiaye M. et al. [11] in 2012, when sorting was systematically carried out in only 46.5% of the departments of the five hospitals in Dakar.

This improvement underlines the increasing importance of direct staff involvement in the biomedical waste management process, as efficient separation at the point of production is fundamental to reduce adverse risks, facilitate proper waste treatment and ensure the safety of staff and the hospital environment.

- Staff knowledge of the health and environmental risks of DBMs

In our study, 95% of the staff surveyed said they were aware of the risks associated with the poor management of biomedical waste, while 91.9% were aware of no-socomial infections. In addition, 87% of participants recognized the existence of a direct link between biomedical waste and the occurrence of nosocomial infections. These results are comparable to those of Mr. Diakité, who reported that 85.8% of the staff also identified this association.

These data indicate that the vast majority of staff have a good knowledge of the health risks associated with biomedical waste, which is essential for the implementation of safe management practices and for the effective prevention of noso-inflammatory infections within the hospital

- Interpretation of bivariate and multivariate analysis
  * The statistical analysis showed a significant association between good biomedical waste

management and the perception of the link with nosocomial infections (p<0.001), highlighting that improved management practices contribute to a better awareness of the risks of infection among staff.

It also revealed a significant association between the existence of a biomedical waste management committee and the quality of management. Therefore, the presence of a management committee is a key organizational factor promoting the effective implementation of good biomedical waste management practices.

* The multivariate analysis by logistic regression identified several factors including compliance with the removal schedule, the existence of the DBM Management Committee, the availability of equipment, the existence of infrastructure for the disposal of DBMs, knowledge of the fate and risks associated with DBMs in a meaningful way with good management of bio- ($p < 0.05$).

These results underline that the proper management of DBMs depends on both:

1. Structural and organisational factors (existence of a committee, infrastructure, equipment, adherence to the schedule).
2. Cognitive factors related to staff awareness and knowledge.

Thus, an integrated approach combining organizational strengthening and continuous training appears essential to sustainably improve the management of DBMs and reduce infec- tive risks.

- Qualitative data

Summary of semi-structured individual interviews.

The individual interviews made it possible to identify several major results. First, the interviewee showed a general knowledge of biomedical waste, reflecting a certain awareness of the issue. Secondly, it emerged that cremation is the most frequently used treatment method in hospitals. Finally, the participants highlighted a lack of implementation of national biomedical waste management guidelines, highlighting a gap between local practices and the current national policy.

- Issues

These findings reveal the need to strengthen the continuous training of staff, to improve the compliance of practices with national standards, and to invest in appropriate infrastructure to ensure a safer and more sustainable management of biomedical waste. Such alignment is essential to reduce health risks, prevent environmental contamination and ensure a better quality of care.

- Bounds

This study has some limitations. It was conducted only within the district hospitalof Commune IV and involved 209 staff members and 10 department heads. The sample size could have been larger by including other facilities in the health district. In addition, reluctance to participate and the unavailability of certain agents may have limited the representativeness of the results.

Conclusion

The management of biomedical waste is a real problem at the district hospital of Commune IV of Bamako, Continuous training and sensitization of staff are among the strategies to be put in place for a rational and sustainable management of biomedical waste in this structure.

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Conflict of interest : None

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