

Issue of Biomedical Solid Waste Management in CSCOMs, CSREF and Clinics in the Urban Commune of Sikasso

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Abstract

The city of Sikasso is facing an alarming situation regarding the management of biomedical waste, caused by the multiplication of private health facilities. As a result, biomedical waste is often found in neighborhood dumps and sometimes mixed into household waste containers of certain public structures, whose contents are then sent to the public landfill. This situation poses a major risk to both human health and the environment of the city. The objective of this work is to carry out a comparative study on the modes of biomedical waste management between the private and public sectors (Clinics and CSCOMs), and to propose concrete recommendations for more effective, sustainable, and safe management of biomedical solid waste in Sikasso. The adopted methodology consisted of a literature review, followed by field surveys through questionnaires on biomedical solid waste management. The sample was exhaustive, covering all health facilities in the city of Sikasso, including 12 CSCOMs, 8 Clinics, and the CSREF. The study results revealed that 90.5% of facilities practice waste sorting at the source, 14.3% of private clinics have not appointed a person responsible for waste management, 85.7% of facilities have manuals on waste management procedures, and 37.5% of clinics do not practice waste transportation to specialized facilities ensured by GIEs as a disposal method and do not have an anatomical waste pit. To address the environmental and health problems generated by this waste, health centers, especially private clinics, must comply with biomedical waste management standards, and the municipal authorities must become more involved in the management of private facilities.

Keywords: Management; Biomedical Waste; Cscoms; Clinics; Cscref

1. Introduction

Biomedical waste management is a major international priority today. The role of healthcare is to alleviate suffering and promote disease prevention, not to cause harm. Yet, poor waste management in healthcare facilities exposes staff, patients, and the community to various risks. Biomedical waste consists of materials whose improper disposal can affect both human health and the environment. In other countries of the sub-region, such as Senegal, shortcomings in biomedical waste management have been identified [1], and most healthcare facilities disposed of their waste through the household waste stream at Dakar's public landfills [2].

In Mali, the problem is exacerbated by the increase in healthcare facilities, particularly private ones, which generate growing quantities of biomedical waste. As early as 2010, a study conducted by the National Hospital Evaluation Agency (2010) [3] had already highlighted the limitations of the biomedical waste management system. Nationally, the presence of hazardous waste in landfills is at 26%, and in the regions surveyed, hazardous waste was observed in several depots, with the exception of the Koulikoro region where no trace of hazardous waste was reported [4]. This waste, often poorly

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managed, ends up in public landfills or is disposed of inappropriately, increasing health and environmental risks. This study focuses on the urban commune of Sikasso, a region facing major challenges in biomedical waste management. The main objective is to identify and propose improvement strategies for the effective, sustainable, and compliant management of biomedical waste in the health facilities of the urban commune of Sikasso.

2. Material and Methods

Study Area: Located in the third administrative region, the urban commune of Sikasso, with an altitude of 11.5° and a longitude of 5.30° west, covers an area of 277.50 km² and has a total population of 709,691 inhabitants (2013), with an estimated population of 711,394 inhabitants (2021), representing a density of approximately 485.67 inhabitants/km².

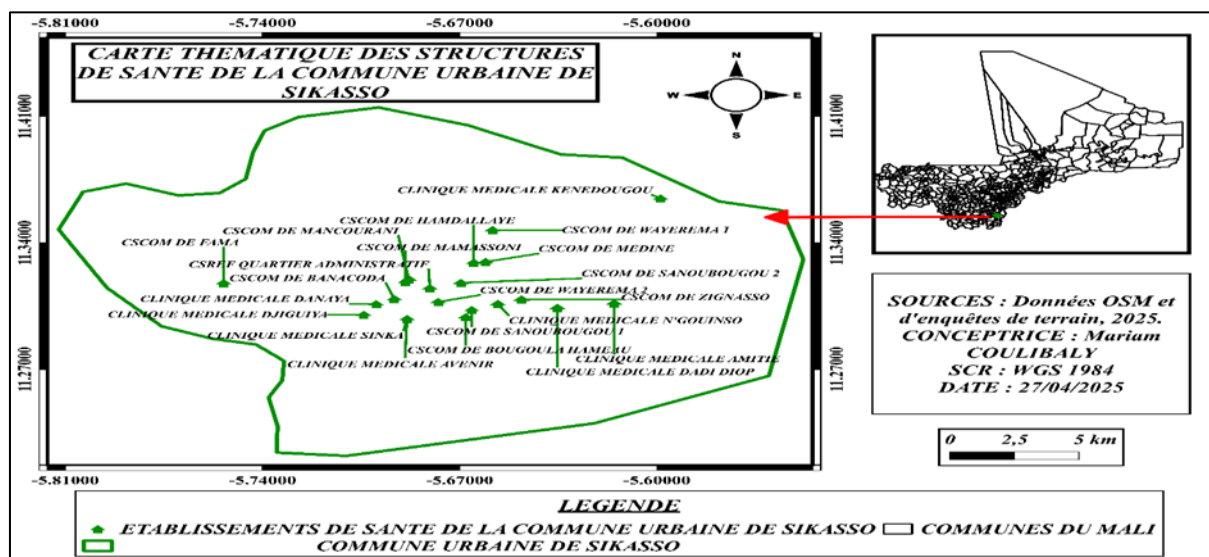


Figure 1 Carte de la Zone d'étude

For data collection, questionnaires were developed using Kobocollect software. The tool facilitated data entry and manipulation using an Android device and a laptop. The questionnaires were designed to highlight various aspects, such as gender and social issues, in order to analyze problems at multiple levels and propose appropriate solutions for the sustainable management of biomedical solid waste. The methodology used is based on the standards described in the Manual of Standards and Procedures for Biomedical Waste Management in Mali.

The documentary research focused on a literature review, which involved consulting and utilizing books, theses, university dissertations, reports, and scientific articles related to the topic. Internet sources were also used.

The field study focused on interviews with stakeholders involved in the collection and management of biomedical waste and the observation of certain practices. To this end, community health centers (CSCOMs) and clinics in the urban commune of Sikasso were visited to observe staff practices, identify their waste management methods, and thus document numerous anomalies.

For sampling, the random sampling method was preferred in selecting survey sites. This method appears to be the most appropriate for the present topic. The surveys were conducted at 12 community health centers (CSCOMs), 8 clinics, and the regional health center (CSREF) in the urban commune of Sikasso.

Data processing: SPSS and Excel software were used for data processing and analysis. We first created a database in Kobocollect and then developed our figures and maps using SPSS and QGIS software.

Ethical considerations: Authorization for investigation, confidentiality.

3. Results

3.1. Distribution by type of establishment

Table 1 Distribution by type of establishment

Type of establishment	Number of establishments	Percentage
Private clinics	8	38%
Community Health Center (CSCOMs)	12	57%
Reference Health Center (CSREF)	1	5%
Total	21	100%

The results (Table 1) show that the majority (57%) of respondents are from Community Health Centers (CSCOMs), which is consistent with the fact that they are often the first point of contact for populations in urban and peri-urban areas. Private clinics represent slightly more than a third (38%), highlighting the involvement of the private sector in healthcare. The Regional Health and Social Services Center (CSREF), as a referral center, is poorly represented (5%), which can be explained by their more limited number across the country.

3.2. Average number of patients per month in healthcare facilities

Table 2 Average number of patients per month in health facilities

Type of establishment	Average number of patients/months
Private clinics	205.56
Community Health Center (CSCOMs)	217.8
Reference Health Center (CSREF)	12 000

Table 2 shows the number of patients seen per month at the health centers. It reveals that the CSREF (Regional Community Health Center) receives an average of 12,000 patients per month. This figure is significantly higher than that of other types of facilities. This reflects the regional and referral role of the CSREF, which receives cases referred by the CSCOM (Community Health Centers) and clinics. Such a high volume of patients suggests a large operational capacity but also a significant production of biomedical waste. Despite their small proportion in the sample (only 5%), the CSREF carry out a tremendous amount of medical activity. The CSCOM receives an average of 217.08 patients per month. CSCOMs are the most frequent type of facility in the sample (57%). The average of 217 patients per month reflects their role as the first point of contact for the population, especially in semi-urban and rural areas.

3.3. Availability of procedure manuals

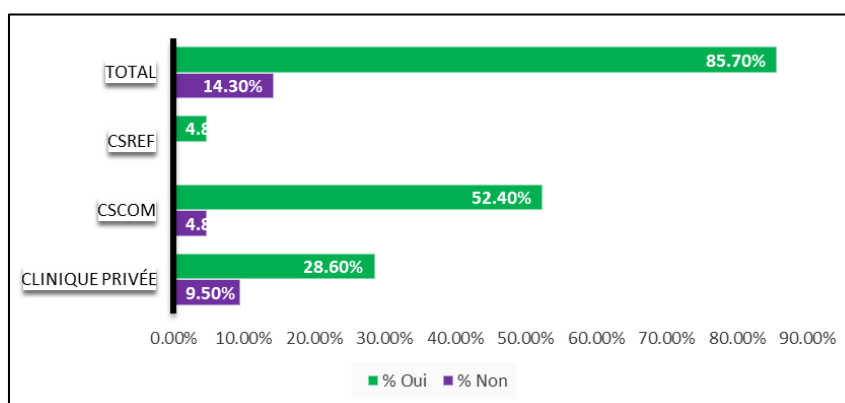


Figure 2 Availability of procedure manuals for waste management

Figure 2 reveals that the majority (85.7%) of healthcare facilities have procedure manuals. However, a significant proportion of facilities operate without these reference tools, which could potentially impact the uniformity and quality of biomedical waste management in the municipality.

3.4. Estimated quantity of waste produced per day/week/month

Table 3 Estimated quantity of waste produced per day/week/month

Type establishment	Estimation (kg/jour)	Estimation (kg/simazine)	Estimation (kg/moist)	Percentage de production waste
Community Health Center (CSCOM)	3.42 kg	23.94 kg	41.04 kg	7.32 %
Private clinic	2.28 kg	15.96 kg	27.36 kg	4.88 %
Reference health center (CSREF)	20.5 kg	123 kg	492 kg	87.79 %

Table 3 shows the estimated quantity of waste produced per day/week/month in health centers. It shows that 7.32% of biomedical waste is produced by the CSCOM (Community Health Center), i.e. 41.04 kg/month, 4.88% by the private clinic with an average production of 27.36 kg/month, and 87.79% by the CSREF (Regional Health and Education Center) with an average production of 492 kg/month.

3.5. Waste Sorting and Collection

Table 4 Existence of a sorting system (yes/no)

Type of establishment	% Sort No	% Sort yes
Private clinics,	25.00	75.00
Community Health Center (CSCOM)	0.00	100.00
Reference Health Center (CSREF)	0.00	100.00
Total	9.52	90.48

Table (4) indicates that a total of 90.48% of the facilities have implemented a sorting system. This demonstrates good compliance with minimum waste management standards, which is crucial in a community environment where the risks of contamination are high.

3.6. Container Type

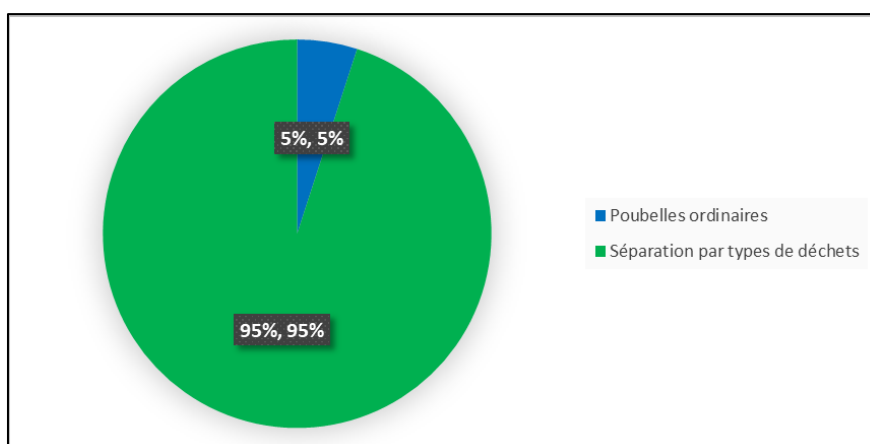


Figure 3 Types of containers used for storage

Figure 3 shows that the majority of facilities practice waste separation by type. Only a minority of clinics still use a regular trash can (5%). These private clinics need awareness training, supervision, and equipment. This reflects the good support provided by the community public sector and some private facilities regarding waste management standards.

3.7. Frequency of waste collection

Table 5 Frequency of waste removal

Category	Workforce	Percentage (%)
Once a week	7	33
Every day	12	57
Once/month	1	5
Twice/month	1	5
Total	21	100

The majority of facilities (57%) dispose of their solid biomedical waste daily. A third (33%) do so weekly. A small proportion (5% each) have a monthly or bi-monthly disposal frequency. While waste disposal is generally frequent, disparities exist, with a minority of facilities having longer disposal intervals.

3.8. Availability and use of personal protective equipment (PPE)

Table 6 Availability and use of personal protective equipment (PPE).

Type of establishment	% No	% Yes
Private clinics	12.50	87.50
Community Health Center (CSCOMs)	8.33	91.67
Reference Health Center (CSREF)	0.00	100.00
Total	9.52	90.48

CSCOMs, 91.67% PPE Availability/utilization of PPE. The vast majority of CSCOMs have and use PPE (gloves, masks, gowns, goggles, etc.). This demonstrates a high level of compliance with staff protection measures, which is essential in frontline care where biological risks are frequent. However, a small fraction (8.33%) remains exposed, suggesting targeted needs for equipment or awareness training.

CSREF 100% Availability/utilization of PPE. The CSREF is fully compliant. This reference facility therefore has a well-established protection system, likely linked to strict hospital protocols and the high volume of specialized interventions. This reflects adequate management of occupational risks within this facility.

Private clinics: 87.50% availability/ utilization of PPE. While the majority are compliant, 12.5% of private clinics do not use or do not have sufficient PPE. This poses a health risk to staff and patients and suggests potential gaps in supply, training, or supervision within the private sector.

Table 7 Involvement of a private service (GIE) in waste management.

Type of establishment	% No	% Yes
Private clinics	37.50	62.50
Community Health Center (CSCOMs)	58.33	41.67
Reference Health Center (CSREF)	100.00	0.00
Total	52.38	47.62

CSREF: The involvement of a private service (GIE) is nonexistent, indicating that these centers likely manage waste internally. They may rely on public or community resources, but this approach can be problematic if human, technical, or logistical resources are insufficient.

CSCOM: Approximately 41.67% of these centers use private management. This means that about 6 out of 10 CSCOMs manage their own waste, often with limited resources, which can compromise efficiency and safety.

Private Clinics: These facilities show a strong tendency to use private services, with a rate of 62.50%. As commercial entities, they often prefer to outsource waste management to specialized providers for compliance and efficiency reasons.

3.8.1. Waste treatment and disposal

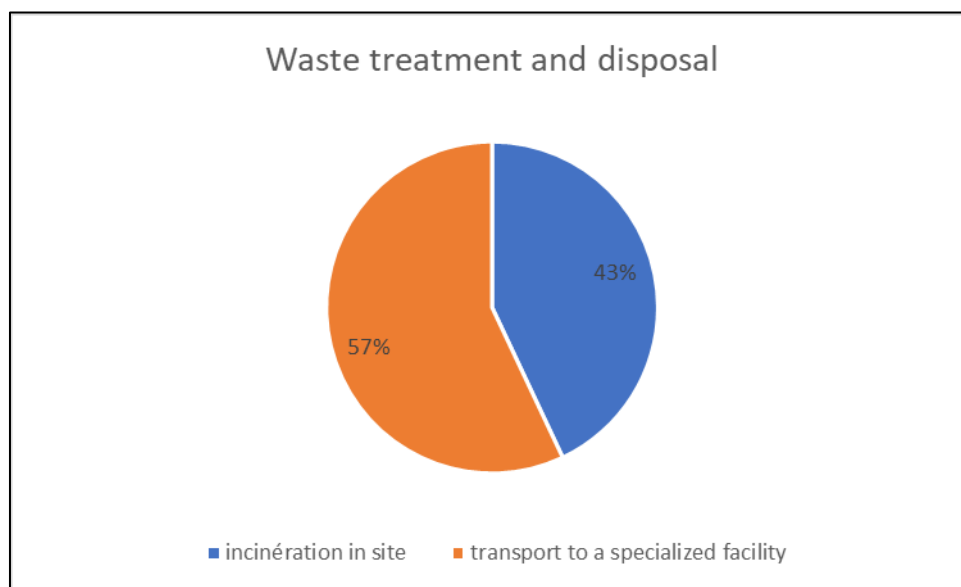


Figure 4 Disposal methods used

Most facilities use on-site incineration (CSCOM and CSREF).

This practice can reduce transportation costs, but the quality of the incinerators and compliance with environmental standards are sometimes inadequate. Monitoring and upgrading of equipment are necessary.

Private clinics transport waste to specialized facilities. This option is more expensive but often safer and more compliant with regulations, particularly in large cities.

Table 8 Existence of a pit for anatomical waste.

Type of establishment	% No	% Yes
Private clinics	100.00	0.00
Community Health Center (CSCOMs)	25.00	75.00
Reference Health Center (CSREF)	0.00 %	100.00
Total	52.38	47.62

Private clinics: 100% of private clinics do not have a pit for anatomical waste. This reveals a complete lack of suitable infrastructure in this type of facility, which poses significant risks in terms of hygiene, safety, and the environment. Community Health Centers (CSCOMs): 75% of CSCOMs have a pit, while 25% do not. This shows good availability, but a quarter of CSCOMs still do not comply with anatomical waste disposal standards.

Reference Health Centers (CSREF): 100% of CSREFs have a pit for anatomical waste. This reflects a high level of compliance in reference centers, likely due to their superior technical and financial capacity. Overall, 47.62% of healthcare facilities have a pit for anatomical waste. This rate masks significant disparities between types of facilities. Private clinics have a glaring deficiency, unlike CSREFs, which are fully compliant. Strengthening infrastructure, particularly in the private sector, is strongly recommended to ensure the safe management of hazardous waste.

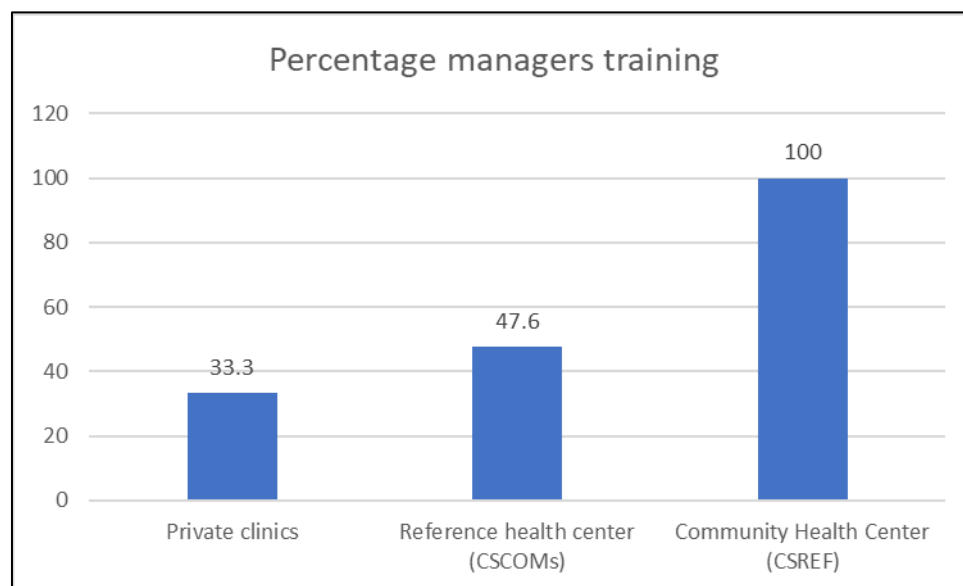


Figure 5 Training of those responsible for waste management (RGD)

Private clinics: 33.3% of managers are trained. This shows an effort in training within the private sector, but one that remains limited. Community health centers (CSCOMs): 47.6% of managers are trained, compared to 14.3% who are not. This type of structure shows the best performance in terms of training, which is encouraging for primary care. Regional community health centers (CSREFs): All managers are trained (100%).

3.8.2. Regulatory framework

- Knowledge of the regulations in force on the management of biomedical waste in Mali.

Table 9 Knowledge of current regulations on biomedical waste management in Mali

Type of establishment	No (%)	Yes (%)	Total
Private clinics	50	50	8
Community Health Center (CSCOMs)	41.67	58.33	12
Reference Health Center (CSREF)	0	100	1
Total	42.86	57.14	21

57.14% of healthcare professionals are familiar with the regulations, while 42.86% are not. Overall, nearly half of healthcare workers are not familiar with the regulations on biomedical waste management, which poses a risk to public health and the environment.

- Availability of written or posted protocols for waste management.

Table 10 Availability of written or posted protocols for waste management

Type of establishment	No (%)	Yes (%)	Total
Private clinics	50	50	8
Community Health Center (CSCOMs)	50	50	12
Reference Health Center (CSREF)	0	100	1
Total	42.86	57.14	21

57.14% of facilities have protocols in place, while 42.86% do not. Overall, nearly half of healthcare facilities still lack formalized protocols, which compromises the efficiency and safety of waste management.

4. Discussion

The results of the staff training survey on the GDBM showed that 85.4% were trained, which is slightly higher than that of WaterAid and IRC Sahel (2025) [6], estimated at 73%. Staff training is essential, as Sanogo et al. (2020) remind us [15].

Procedure manuals are present in 85.7% of health facilities, a figure significantly higher than that of WaterAid and IRC Sahel (2025) [6], which is estimated at 19% based on the GDBM Procedure Manual. These results demonstrate that health facilities are provided with reference documents on GDBM.

The CSREF produces the majority of biomedical waste (87.79%), followed by the CSCOM (7.32%) each month, due to the high number of monthly consultations at the CSREF, and the CSCOM being the first point of contact within the healthcare system. These data confirm the observations of Coulibaly et al. (2021) [16], who noted high production in community health centers due to the large number of monthly consultations.

Waste sorting is carried out in 90.48% of health facilities in the urban commune of Sikasso. This finding contradicts that of the National Health Directorate (DNS), in collaboration with the WHO and UNICEF, from January 2013 to January 2014, which indicated that 75% of health facilities have facilities with no or only partial sorting of waste at the source. Similar shortcomings in waste sorting were also reported by KONE (2018) [17]. This poor result is often due to a lack of or insufficient medical waste container facilities.

Our studies show that GIEs are involved in 62.5% of the waste transport from clinics, which aligns with the findings of the INSAT report (2021) [4], indicating that more than half of the transfer stations were used by GIEs, including 69.0% in the Sikasso region. These results confirm that the majority of clinic waste can end up in transfer stations.

Incineration is the primary method used at CSREF and CSCOM facilities, but landfills are also used. Clinics mostly transfer waste to specialized facilities. This situation aligns with the findings of Traoré et al. (2019) [18], who noted that incinerators, although recommended, are not always functional or compliant with environmental standards in primary care facilities. These results demonstrate that CSREF, CSCOM, and clinics, as primary contact facilities, must be monitored and equipped with high-quality materials for the proper management of medical waste and thus avoid its transport to uncertain destinations.

Our study shows that 57.14% of facilities are aware of the regulations in force regarding Biomedical Waste Management (GDBM). This remains a concern, although consistent with the findings of Diakité (2017) [19], who, on the one hand, observed a frequent lack of awareness of the regulations, particularly in private clinics, and, on the other hand, highlighted weak implementation of standards in private facilities in Bamako. These results demonstrate that the authorities must become more involved in making these regulations available and in regularly monitoring their application.

The absence of anatomical waste pits in private clinics, and their strong presence in CSCOM/CSREF agrees with the research of Bassey BE et al (2016) [20] who state that public or larger structures put in place management devices (pits) while small private clinics, often more informal, may avoid or outsource disposal. The availability of PPE (90.48%) is much higher than that reported by Hakim et al. (2024) [21], who demonstrated that in many low- and middle-income countries, the complete availability of PPE is low (13%). The results of our survey reflect adequate management of occupational risks.

In our study, the majority of facilities have a protocol, which is higher than the results of the study conducted by Bop et al. (2017) [24] in the Goudiry health district of Senegal. These results demonstrate better structuring in the facilities within our study area.

5. Conclusion

The management of biomedical waste in healthcare facilities in the urban commune of Sikasso is still far from meeting Malian standards, and this poor management poses significant health and environmental risks. While some efforts are visible, particularly at the Regional Health Centers (CSREF) and Community Health Centers (CSCOMS), shortcomings persist in private clinics. Most of these facilities do not adhere to source separation of waste, treatment is carried out under substandard conditions, and insufficient management infrastructure further complicates the process. The health and environmental risks remain high in the absence of a public-private partnership and the implementation of a comprehensive, coherent, and sustained strategy. This situation calls for the responsibility of all stakeholders, especially the highest authorities, who must ensure the application of the relevant laws and regulations.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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