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Hospital Solid Waste Status: A Case Study of Dosso Mother and Child Health Center (CSME) in Niger

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ABSTRACT

Thus, this study evaluated the solid waste management of the mother and child health center (CSME) of Dosso to contribute to its improvement. The approach involved conducting surveys and interviews, quantifying waste production, and analyzing how it is managed. According to the CSME Dosso hospital solid waste management analysis, all surface technicians were trained in hospital waste management, but 69% were illiterate. However, as part of this management, 51 bins of different capacities are set up for the entire establishment, including (18 bins with a capacity of 240 liters, 14 bins with 20 liters, and 19 small baskets with 10 liters). This characterization, based on both qualitative and quantitative measurements, indicates that Dosso CSME produces 167.63 kilograms of waste per day, 58.67 tons of waste per year, of which 72% is waste that is risk-free, primarily waste. Approximately 28% of waste, including household waste and containing infectious, toxic, and anatomical risks, is at risk. The disposal of this produced waste is done either by burning, by landfilling, or by burial in pits dug without any standards. This management through these different stages constitutes a source of environmental impact. This analysis also shows that the Dosso CSME needs a waste management plan and an operational incinerator, given the absence of administrative regulations, unqualified technicians, and insufficient financial resources.

INTRODUCTION

Hospital waste consists of solid, liquid, or gaseous substances resulting from healthcare activities. They are a source of environmental pollution and a vector for spreading a wide range of diseases. (OMS, 2005). Even though they remain a serious public health issue, their management remains a concern of politicians and the institutions that generate them. (OMS, 2005; Ndiaye et al., 2012). Despite efforts, most African countries have low levels of hospital waste management (Abdelhak et al., 2019). A low-quality waste management system in hospitals is generally caused by a lack of policy and reference documents, an absence of resources, and poor institutional organization. (CICR, 2011; Metghari et al., 2012). Health sector wastes have a significant impact on community and healthcare hygiene (Anonyme, 2007a). On the one hand, their management plays a crucial role in the quality of care, in the safety of patients and caregivers, and on the other hand, in the protection of the environment and the community from pollution and contamination (Maiboukar, 1999). Healthcare waste carries a higher risk of infection and injury than household waste-like waste (Tesfahun et al., 2014). In this regard, they can be explained by the fact that they contain waste similar to household waste, sharp or pathological objects, infectious materials, pharmaceutical materials, medical devices, and radioactive materials. Many factors contribute to the generation of hospital waste, including the social and economic condition of patients, the type of healthcare facilities, the hospital's specialty, the waste sorting options available, seasonal variations, the number of beds, and the number of patients treated daily (Mahananda, 2015). A review by the WHO (2009) states that open waste can contain harmful microorganisms that can infect hospitalized patients, medical personnel, and the general public, hence the need to eliminate such waste safely. Based on their origin and the danger they pose to humans or the environment, waste can be classified (Topanou, 2012). Hospital waste can be divided into two categories: waste assimilated from household items and waste generated from healthcare activities. Healthcare waste consists of potentially infectious and non-infectious wastes from a healthcare establishment (OMS, 2005). It is essential to understand that any waste similar to household waste becomes contaminated when it comes into contact with hazardous waste, either directly or when it is not packaged bacteriologically. Thus, hazardous waste can either be direct (depending on production) or indirect (contamination during collection). (Maystre et Duflon, 1994; Maystre et Viret, 1995). WHO (2005) reports that 60% to 64% of health facilities in developing countries do not dispose of waste according to recommended methods. The production of biomedical waste in Mali is estimated at 1603 kilograms per day. In addition, 13.15 % of the units practiced waste sorting, while 78.39% did not treat their waste (Rayanatou, 1999; Sanogo et al., 2007). According to Ndié et Yongsi (2016), 92% of referral health facilities in Cameroon had poor hospital waste management. Since the last decades, Niger has improved its health coverage through the construction of several

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health facilities and the expansion of existing structures. As a result, this sector produces a large quantity of waste (PNGDISS, 2015). Microorganisms are concentrated in these wastes, resulting in environmental and atmospheric pollution (Yaya, 2011). As a result, poor management contributes to the spread of infections both within and outside hospitals. Several scientific studies have shown that disposal of solid hospital waste is not always satisfactory, especially in developing countries and Africa south of the Sahara (Mohamed, 2008; David, 2004; Ndiaye et al., 2003). This led the Mother and Child Health Center (MCHC) in the Dosso Region of the Republic of Niger to become interested in managing solid hospital waste with the primary aim of improving hospital waste disposal.

MATERIALS AND METHODS

Dosso Mother and Child Health Center presentation

In addition to providing gynecological-obstetric and postnatal care, the Dosso Mother and Child Health Center also offers family planning services. The center is located between latitude 3°.21" and longitude 13°.037" in the urban municipality of Dosso. Approximately 4 hectares of land are occupied by the hospital, which has 108 beds, including 96 functional beds in its various departments. The hospital has five (05) hospitalization departments (gynecology, obstetrics, pediatrics, CRENI), as well as seven (7) support services (Laboratory, Pharmacy, Medical Imaging, Maintenance, Hygiene/Sanitation) and ancillary services (Kitchen, Laundry, Morgue).

Study scope limitation

This study examined all possible hospital solid waste generation services offered by the center. The operating room, radiology, referral, laboratory, administrative block, social services, pharmacy, Gynecology, and Pediatrics A/B are among these facilities.

Sampling

Surveys were carried out during this study using a representative sample. The sample included doctors and majors in various departments, the head of hygiene and sanitation, and laborers responsible for waste management. This individual-type survey questioned 50 agents, including 24 medical and paramedical staff, 25 surface technicians, and the head of sanitation and hygiene.

The methodological approach

In this study, primary and secondary data were collected and analyzed using a qualitative and quantitative approach. The primary data was obtained by measuring the waste produced in various hospital departments. Wastes generated by infectious activities, chemical or toxic activities, household wastes, and anatomical wastes generated at various levels of the CSME in Dosso were quantified. Afon et al. followed this methodology in their study (2017). Waste generated by each department was measured and recorded. For storage and weighing purposes, each cleaner received two (2) polythene bags per day. The polyethylene bags were measured on a calibrated spring scale of 10 kg±0.1 kg. A repeat of this experience took place every 24 hours for 10 days (August 28 through September 8, 2021). Secondary data was collected from agents using a questionnaire and field observations. Through direct observation, we could observe the waste produced in this establishment and gain a better understanding of their waste management system (production, sorting, packaging, collection, storage, transportation, and disposal). Additionally, the data obtained included the number of beds in the services, the number of cleaners, and the number of waste managers. Cross-tabulations and graphs were used to analyze the collected data.

RESULTS AND DISCUSSION

Results

Human Resources

In addition to one sanitation and hygiene technician, there are twenty-five (25) surface technicians that collect solid waste within the Dosso CSME. In figure 1, surface technicians are grouped based on their level of education. Most of these technicians are housekeepers who maintain the cleanliness of the course as well as the rooms for each service.

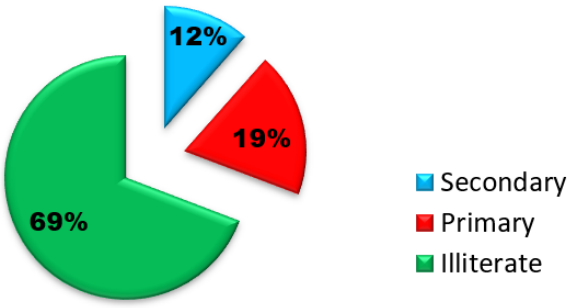

Figure 1: Education level distribution of surface technicians

Based on Figure 1, it is evident that 69% of surface technicians are illiterate, 12% are secondary educated, and 19% are primary educated. Additionally, these technicians are categorized based on their level of training in hospital waste management (Figure 2). The figure shows that all the

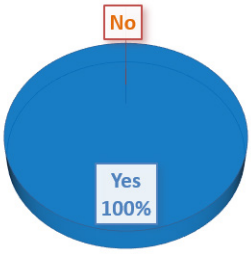

Figure 2: A distribution of surface technicians based on the level of training they have received in hospital waste management

surface technicians who were surveyed attended at least one training course in hospital solid waste management. This training course helped them to have the notions and skills necessary to manage solid hospital waste properly.

Waste storage

A central storage facility is located at the Dosso CSME for disposing of waste before evacuation. Upon the arrival of the town hall's evacuation vehicle, hazardous waste and household waste are stored in bulk next to the burner. Infectious waste is burned before disposal. The site is compartmentalized according to the two types of waste collected: infectious waste is burned before disposal.

The Estimated amount of waste

Tables 1, 2, and 3 present the results of quantifying solid waste in the hospital for all departments involved in this study. Table 1 shows the quantitative analysis of infectious risk wastes from the 11 departments studied. Infectious risk activities average 3.13 kg per day (Laboratory) and 8.25 kg per day (Operating Room). There is an average of 42.28 kilograms of infectious risk activities evacuated from the departments studied every day. There is an average of 23.75 kg (Pediatrics A) to 4 kg (Radiology) per day in similar household waste, resulting in a total production of 124.69 kg (Tab2). Besides anatomical wastes (Table 3), chemical or toxic wastes were analyzed quantitatively. The radiology department recorded 17

Table 1: Wastes with infectious risks (kg)

Services	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Daily Average
Gynecology	4,5	2	3	6	7	2	2,5	9	6	7,5	4,95
Obstetrics	6	4,5	6	11	3	1,5	3,5	7	4	4,5	5,1
Laboratory	3	2,5	1,5	3,5	4	2,8	3	4	2	5	3,13
Operating room	7	8	4	9,5	9	6,5	4,5	12	14,5	7,5	8,25
Referral	7	5	13	5	4,5	3			7	3,5	6
Pediatrics A	6	9	5,5	7	6,5	10	8	6	7,5	8	7,35
Pediatrics B	7,5	6	7	3,5	8	8,5	5	13	11	7,5	7,7
Total	**41**	**37**	**40**	**45,5**	**42**	**34,3**	**26,5**	**51**	**52**	**43,5**	**42,28**

Table 2: Similar to household waste, quantification (kg)

Services	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Daily Average
Gynecology	15	15	18	13	17	16	12,5	17	18	12,5	15,4
Obstetrics	28	22	37	4,5	17,5	19,5	18	24	20	23,5	21,4
Laboratory	8	6	5	7	4	3,5	2	7	9	7	5,85
Operating room	5	7	8	5	9	2	13	7	15	14,5	8,55
Referral	6,5	10	6	22,5	4,5	4,8	7	7	5,5	7	8,44
Radiology	4										4
Pharmacy	3,5	2	2	6	6,5	2,5	4,5	1,5	7	6	4,15
Administrative block	4,5	6	5,5	2	3,5	5	1,5	7	5	1,5	4,15
Social Service	6	11	7	3,5	7	3	7	12	7,5	4	6,8
Pediatrics A	21,5	17	25	27	22	32	23	19,5	20	30,5	23,75
Pediatrics B	25	28	21	22,5	14	18,5	15,5	24,5	26	27	22,2
Total	**127**	**124**	**134,5**	**113**	**105**	**102**	**104**	**126,5**	**133**	**133,5**	**124,69**

Table 3: Waste with toxic or chemical risks and anatomical waste quantification (kg)

Services	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Mon	Tue	Wed	Daily Average
Waste with toxic or chemical risks											
Radiology	2,5	1,5	1	2,5	2	-	-	4,5	1	2	2,5
Anatomical waste											
Obstetrics	3,5	2	1,5	3,5	2,5	4,5	6	4	4,5	3	3,5

kg of hazardous chemicals or toxic waste over ten (10) days, an average of 2.5 kg per day. An average of 3.5 kg of anatomical waste (placentas) is produced by the obstetrics department every day. According to the days of the week, Figure 3 summarizes the total daily production of Waste with infectious risks and Similar to household waste. All waste categories are lower on Friday, Saturday, and Sunday than the rest of the week. With a maximum recorded on Wednesday (134.5 kg), similar to household waste releases are greater than wastes with infectious risks during the week (daily production: 45.5kg). The minimum production is recorded on Sunday for both Wastes with infectious risks (26.5kg) and Similar to household waste (104kg). In addition, waste similar to household waste is produced in all departments, while infectious risk waste is absent from Radiology, the Administrative Block, Social Services, and Transfer Pharmacy. In Figure 4a, risk-free waste (waste similar to household waste) and

risk-based waste (waste with infectious or chemical risks or anatomical waste) represent respectively 72% and 28% of the center's waste production. Figure shows 4b how hazardous waste is distributed in the center. A total of 87% of the waste produced has an infectious risk. Infectious and anatomical waste accounted for 7% and 6% of the total waste, respectively.

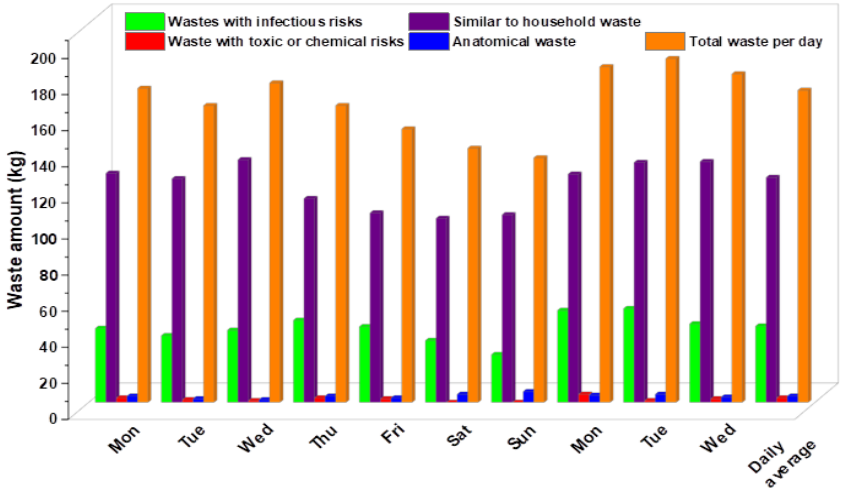

Figure 3: Daily waste production (in kg)

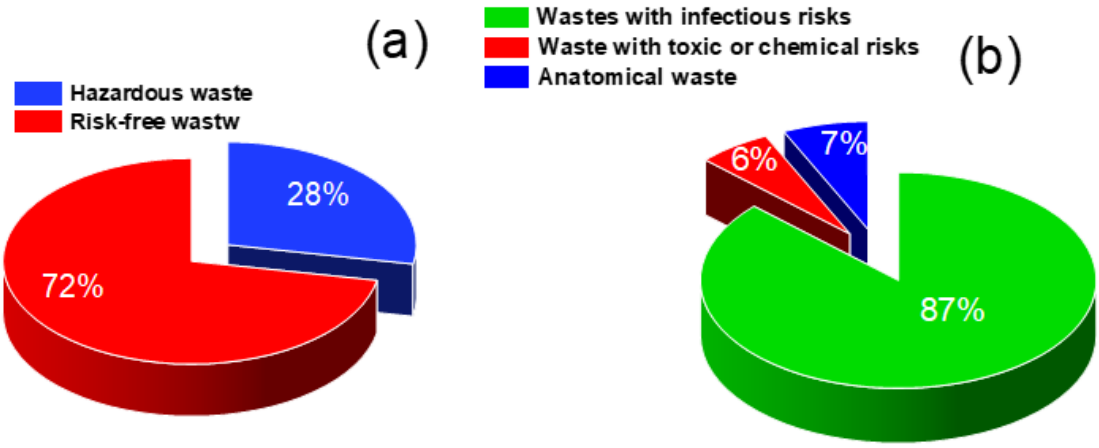

Figure 4: (a)-Typology of hospital waste from the Dosso CSME, (b)-Distribution of hazardous waste from the Dosso CSME

DISCUSSION

From August 10 to November 10, 2020, this study occurred at the Dosso mother and child health center. In the study, 11 services at the center generated waste that was similar to household waste, infectious risk waste, chemical or toxic risk waste, and anatomical waste. As a result of the coexistence of administrative and care services in the center, this type of waste is generated. According to WHO (2009) recommendations, healthcare facilities should have an appropriate management plan. Furthermore, the availability of waste collection equipment enhances the safety of healthcare waste management (OMS, 2005). At the Center, not only are the materials intended for waste management insufficient, but they also need to meet the standards set by WHO regarding adequate waste management. Since biomedical wastes are not sorted, all waste is classified as "a" waste at risk, increasing the risk of contamination (Metghari et al., 2012). It is for this reason that sorting is so critical. The majority of agents (74%), who were surveyed during this study, confirm the existence of waste sorting at the source, in contrast to 28% who believe nurses do not respect it. Accordingly, field observations confirmed the existence of this sorting in most departments, although not according to WHO standards, since the hazardous waste was often mixed with similar to household waste. It is apparent that hospital staff are not trained in waste management, which explains the failures observed in waste management. The same observation was made in several African health structures (Adon, 2011, Koffi, 2021). Quantification of waste can be used to rationally estimate the required material and human resources and then develop a waste management plan tailored to each service's requirements. As a result of observations made in the field, waste can be divided into various categories, such as infectious waste (sharp or not), chemical waste, toxic waste, radioactive waste, and household waste. This is mainly due to the different healthcare services

the institution offers. An identical study conducted in Algeria (Abdelhak et al., 2019) found that infectious wastes, pharmaceutical wastes, household garbage wastes, anatomical wastes, and radioactive wastes were most prevalent at the level of the health sector in Sidi Bel Abbes. Most of the waste generated by Dosso CSME is similar to household waste, while 28% is specific to its activities. According to the World Health Organization, hazardous waste should not account for more than 10 to 15% of the total waste produced in healthcare facilities. A study conducted by Koffi et al., (2021) found lower rates at the Daloa Regional Hospital Center in Côte d'Ivoire. However, it is not uncommon for fractions of waste similar to household waste to be found in the bins designated for waste specific to a care activity. It appears that hospital waste management at the CSME in Dosso still needs to be improved. In total, 1729.7 kg of solid hospital waste is generated per day at the Dosso CSME, which is 5.2 t/month. From this, we can conclude that the Dosso CSME produces 62.3 t/year of solid hospital waste. Based on the results of a study conducted at the EL KHROUB Hospital in the wilaya of Constantine, Sedrati and Sebti (2017) found a quantity of 146.27 kg/d, or 51.19 tons per year. Nevertheless, this amount is negligible compared to the volume of waste produced at the Lamordé National Hospital (HNL) in Niamey, which is 329.87 t/year. Because public hospitals receive high attendance every day and have a relatively high staffing level, this makes sense. There are a number of stages involved in hospital waste management, from production to final disposal. The disposal of hospital waste from the Dosso CSME leads to pollution of water, air, soil, and health, including puncture wounds, infections, and intoxication of collectors. According to Jean-Paul (2017), the Paul VI Surgical Medical Center's waste management also has an environmental and health impact. In the study, 67.66% of personnel had been stung, 14.71 % suffered from musculoskeletal disorders, 5.88% had suffered cuts, and 2.94% had been irritated by eyes; on the other hand, there is pollution in the atmosphere with 7.549 t of greenhouse gases, soil pollution, and water pollution.

CONCLUSION

A study at the CSME of Dosso was conducted to evaluate the ongoing management of hospital solid waste. According to the data obtained, the CSME of Dosso does not have an incinerator or a guide that would allow rational waste management. Surface technicians are trained in managing biomedical waste, but 69% are illiterate. Biomedical waste is usually treated in situ by burning and burying. It is pertinent to recognize that this is an influential factor that can influence the effectiveness of these agents in managing hospital waste. Hospital waste management is associated with several risks, but the lack of monitoring (rewards or sanctions) of activities explains the difficulties in sorting, collection frequency, and external transportation. There are two types of waste that Dosso CSME produces: risk-free waste (waste that is similar to household waste) and risk waste (waste that is potentially infectious, chemically or toxically hazardous, or anatomically hazardous). Dosso's CSME is limited in terms of managing solid hospital waste as a result of regulatory, organizational, technical, and financial constraints. Managing this effectively requires collaboration, coordination, and harmonious participation from management at all levels. To remove these constraints, waste management plans outline the objectives, activities, stakeholders, resources, monitoring, supervision, and control mechanisms. The liquid waste generated by the Dosso CSME was not considered in this study. A diagnosis of the CSME's liquid waste management system would be an exciting aspect of this study.

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Conflict of interest

The authors have declared no conflict of interest.

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