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MEDICAL WASTE MANAGEMENT CHOICES AND POLICY ADHERENCE OF HEALTH FACILITIES IN THE BAMENDA HEALTH DISTRICT, NORTH WEST REGION CAMEROON

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Abstract

Medical waste poses significant dangers to public health and the environment, making its management crucial. Based on 2023 data, only 25% of health facilities had basic healthcare waste management services. This study sought to identify the medical waste management choices and assess the medical waste management policy adherence rate of health facilities in the Bamenda Health District. The study was a cross-sectional survey. Results revealed a 100% provision and use of safety boxes and watertight waste bins for medical waste storage. In addition, 57.1% of health facilities treated their medical waste by incineration whereas 42.9% burned and buried their waste. Disposal methods included public council waste bins, incineration, onsite open waste pits, placenta pits and open burning. Health facility adherence rate for medical waste management policy was 55.6%. The medical waste management choices of health facilities were inadequate.

Keywords: Medical Waste, Medical Waste Management, Policy, Policy adherence, health facilities, Bamenda Health District

INTRODUCTION

Healthcare has become one of the fastest growing global industries in recent years (Kenny & Priyadarshini (2021). Medical waste is any waste generated during diagnoses, treatment and immunization or medical research (Dihan *et al.,* 2023). It is a by-product of healthcare delivery and the most identifiable externality of the healthcare sector (Nishla *et al.,* 2020). The healthcare industry is the 5th largest emitter of greenhouse gases worldwide equivalent to 4.4% of global net emissions (Karliner & Slotterback, 2019). Around 1.47 billion tonnes of solid waste are produced each year globally, of which 5.9 million tonnes are estimated to be healthcare waste (Kenny & Priyadarshini, 2021). Water Aid (2023) and the World Health Organization (WHO) fact sheet (2024) attest that, about 85% of waste generated form healthcare activities is general non-hazardous waste while the remaining 15% is considered hazardous and maybe infectious, toxic, carcinogen, flammable, corrosive, reactive, explosive or radioactive. Since December 2020, there has been an exponential increase in the quantum of infectious medical waste production across health facilities worldwide, estimated at 30% and 40% as a result of the Covid-19 pandemic (Achile, 2020). The medical waste challenge is more a question of its hazardous nature than the quantity generated (Manasi, 2017) hence, efficient medical waste management (MWM) is essential for the preservation of human health and the environment.

Unsafe medical waste management is common in many regions of the world, especially in low and middle-income countries (Hassan *et al.,* 2018). According to WHO/UNICEF and based on 2023 data, only 25% of health facilities had basic healthcare waste management (HCWM) services (WHO fact sheet, 2024). Modern treatment methods like autoclaving, microwave and steam sterilization have been adopted by developed countries to treat healthcare waste, which have proven to be more sustainable and efficient than incineration. However, the high cost and complexity of these technologies have limited the adoption of these modern methods to a few developing countries (Raji & Adeogun, 2024). Medical waste management in developing countries is still a big challenge, as insufficient and inadequate equipment to manage the growing volume of medical waste has led to the dumping of significant amounts of waste in illegal sites and occasional burning within health facility premises (Idemudia *et al.,* 2024). For efficient MWM, reducing waste quantities generated by regulating the use of disposables, segregating waste according to regulations, limiting incineration, following stricter technological measures for incineration and investing in new eco-friendly technologies for disinfection and treatment of medical waste are needed (Attrah *et al.,* 2022)**.** Augmented Reality and the Artificial Intelligence recognition technologies have been combined to identify various types of waste and reduce environmental pollution (JuChen & Liou, 2024). Although digitalization in waste management has become a prevalent practice, it is mostly implemented in municipal waste management rather than MWM. Thus, the heterogeneous and hazardous nature of medical waste necessitates that its handling should follow specific guidelines.

Medical waste management is a major issue that has become a key aspect of the national health policies of many countries (Raji & Adeogun, 2024). According to the WHO, improvements in MWM practices in any country can only take place on the basis of National legislation This is because, it establishes legal controls and permits the national agency responsible for the disposal of medical waste (usually the Ministry of Health), to apply pressure for their implementation. The law should be complemented by a policy document and by the development of technical guidelines (IMANI Centre for Policy and Education, 2016). In many industrialized countries, institutions that generate medical waste have a legal obligation to manage the waste. Thus, appropriate structures for handling each type of waste exist with the quantity of hazardous waste generated being constantly monitored (Janik-Karpinska *et al.,* 2023). Medical waste ttreatment and disposal methods in the developed world are varied and governed by national and international legislation (Kenny & Priyadarshini, 2021). Also, a broad range of rules and regulations regarding HCWM have been formulated in developing countries in recent years (WHO, Western Pacific Region, 2024). The current scalable, usable and realistic methods of healthcare waste disposal come with a wide array of problems primarily due to lack

of adequate resources and non-adherence to guidelines and legislations (Kenny & Priyadarshini, 2021). Thus, this study sought to identify the medical waste management choices and assess the medical waste management policy adherence rate of health facilities in the Bamenda Health District.

The theoretical framework for this study stipulates that a national policy on medical waste management is designed to guide health facilities in their waste management practices because, in the process of supplying healthcare, health facilities generate waste that poses health and environmental concerns. Based on the heterogeneous and hazardous nature of medical waste, its journey from the cradle (generation) to the grave (disposal) must be regulated. From the point of generation, the medical waste journey begins with segregation, temporal storage into waste receptacles at point of generation, on-site transportation to a common storage area, transportation out of health facility premises for treatment and subsequent disposal. Hence, it is necessitous to identify the medical waste management choices of health facilities and assess their adherence to the medical waste management policy put in place by the state for protection of human health and the environment The study's theoretical framework was adapted from Olaniyi *et al.*, 2018.

METHODOLOGY

Study Area

The North West Region is one of the ten Regions of Cameroon, with Bamenda as the main agglomeration and headquarter of the Region. It has a population of 2,307,319 inhabitants (National Institute of statistics of Cameroon, 2023). According to the statistics provided by the United Nations World Urbanization prospects, 2021, the total population of Bamenda health district is 553,000 inhabitants. Occupying an area of about 17,300km2. The population is composed of natives and migrants from different regions of the country seeking for job opportunities in the city. The population is distributed in to three health districts such as Bamenda 1 health district, Bamenda 11 health district and Bamenda III health district (Désiré et al., 2025). At the time of this study, the health district comprised of 18 health areas distributed into Bamenda I, II and III Sub Divisions. There were 35 health facilities in the BHD categorised into 18 public, 12 private and 5 confessionals (Bamenda Health District, 2020).

Study Design

This study was a cross-sectional survey with a descriptive study design. Non-probabilistic sampling was used to identify study participants for oral interviews based on their knowledge and experience on issues related to medical waste management. Based on the non-

probability nature of the sampling technique, representativeness of the study population was ensured by the stratification of health facilities by ownership (public, private, confessional), type (hospital, health centre, medicalized health centre, clinic) and location (Bamenda I, II and III). In addition, a 40% minimum representation was established for health areas and health facilities based on resource limitation. Thus, out of 18 health areas, 9 were included (50%) and out of 35 health facilities, 14 were included (40%).

Sampling

Health facilities (hospitals, health centres and clinics) located in the BHD that gave consent to participate, were included in the study. Heads of health facilities, heads of waste management departments, heads of infection prevention units and some key personnel in the waste management department who consented to participate were interviewed. Conversely, Private pharmacies and medicine stores in the BHD, alongside health facilities that did not consent to participate in the study were excluded. A mixed method approach was used for data collection. This included an observation checklist and a structured interview guide. Interviews on MWM practices were conducted with administrators/managers of health facilities, heads of waste management departments, heads of infection prevention and control (IPC) units and waste handlers. To evaluate the medical waste management policy adherence rate of health facilities, an excerpt from Cameroon legislative and regulatory text Order N^0 003/MINEPDED of 15 October 2012, laying down specific conditions for medical and pharmaceutical waste management was used. Furthermore, 32 legal specifications were extracted from the policy document. Data for this study was collected from June-September 2021.

Data Analysis

Data from observation checklists and structured interviews was summarized and presented in a logical sequence. An assessment sheet was developed with 14 columns that were coded 1-14, representing health facilities while its 32 rows had 32 legal specifications on medical and pharmaceutical waste management. To facilitate coefficient interpretation due to the nominal nature of the data, ‘1’ and ‘0’ dummy codes were used, representing ‘Yes’ and ‘No’ respectively. Furthermore, Total Policy Adherence Score (TPAS) for each health facility was gotten by summing all ‘Yes’ scores represented by ‘1’. To obtain each health facility’s Policy Adherence Rate (PAR), its TPAS was divided by 32 (the 32 legal specifications) and multiplied by 100. To obtain the overall medical waste management policy adherence rate of health facilities, the PARs of all health facilities was summed and the value divided by the total number of health facilities.

Academic authorization for the study was obtained from the Catholic University of Cameroon (CATUC) - Bamenda and administrative clearance from the North West Regional Delegation of Public Health (RDPH). To access each health facility, approval letters were obtained from administrators, managers, directors and chief of centres of the respective health facilities. To ensure anonymity and confidentiality, questionnaires carried no personal information with respect to respondent's name, telephone number or email address.

RESULTS

Demographic data showed that a cross section of health facilities were Integrated health centres (57.1%), 21.4% were hospitals, 14.3% clinics and a medicalized health centre (7.1%). In terms of ownership, most were public health facilities (50.0%), 35.7% confessional and 14.3% private. Furthermore, 71.4% were located in Bamenda II Sub-division and 28.6% in Bamenda III Sub-division (Fig 1).

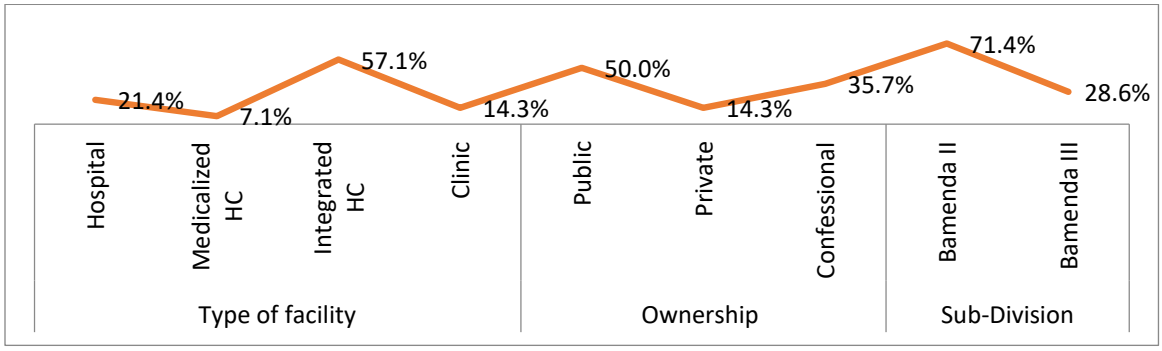

Figure 1: Demographic variables for health facilities in the Bamenda Health District

Key- HC: Health Center

Medical waste management choices of health facilities in the Bamenda Health District

In relation to disposal practices, 50.0% of health facilities disposed biodegradable general waste in council waste bins and 50.0% in onsite open waste pits. Non-biodegradable general waste was disposed in council bins by 35.7% of health facilities, 35.7% dispose in open waste pits, meanwhile 28.6% chose to incinerate. Results also showed that, 92.9% of health facilities incinerated sharps waste as against 7.1% that disposed by onsite open burning. Moreover, 92.9% disposed pathological waste in onsite placenta pits while 7.1% disposed in a pit toilet. Results further revealed that the North West Regional Fund for Health Promotion (NWRFHP) - Public Initiative Group (PIG) disposed pharmaceutical waste for 85.7% of health facilities, while the Presbyterian Central Pharmacy disposed for health facility and the Cameroon Baptist Convention (CBC) central pharmacy also disposed for a health facility (Fig 2).

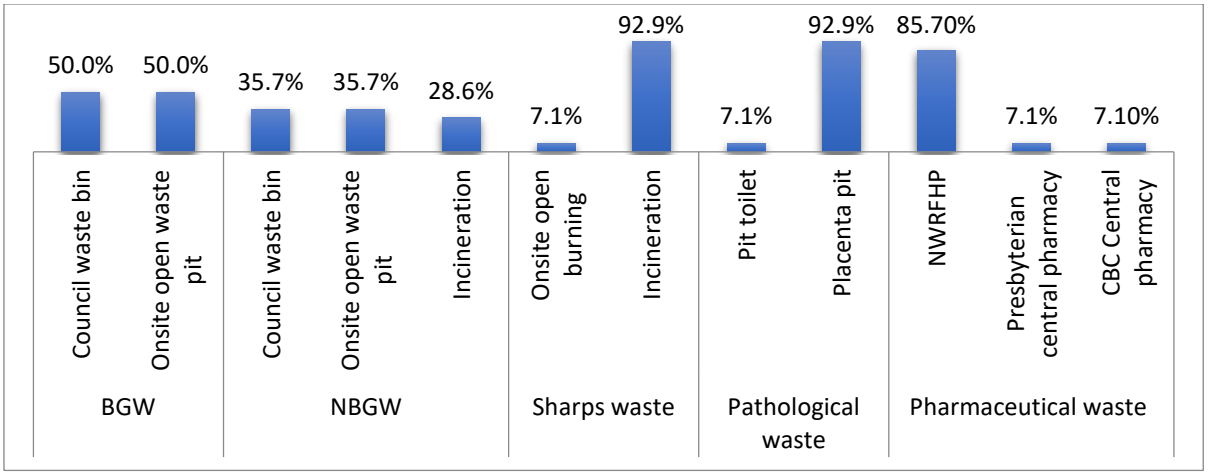

Figure 2: Medical waste disposal methods of health facilities in Bamenda Health District

Key- BGW: Biodegradable general waste; NBGW: Non-Biodegradable general waste

Medical waste management Policy Adherence Rate of health facilities

Based on the 32 legal specifications on medical and pharmaceutical waste management extracted from the policy document, most health facilities (64.3 %) had a PAR > 50.0 %, while 14.3% had a PAR = 50.0% and 21.4% had a PAR < 50.0 %. Overall, the medical waste management policy adherence rate of health facilities was 55.6% (Table 1).

Table 1: Medical waste management policy adherence rate of health facilities based on 32 the legal specifications on medical and pharmaceutical waste

Health Facilities														
#	1	2	3	4	5	6	7	8	9	10	11	12	13	14
TPAS (32)	20	19	19	21	15	15	19	16	19	19	16	19	15	17
PAR (%)	62.5	59.4	59.4	65.6	46.9	46.9	59.4	50.0	59.4	59.4	50.0	59.4	46.9	53.1
OPAR	55.6%													

Key- HF: Health Facility; TPAS: Total Policy Adherence score;
PAR: Policy Adherence Rate; OPAR: Overall Policy Adherence Rate

DISCUSSION

This study sought to identify the medical waste management choices and assess the medical waste management policy adherence rate of health facilities in the Bamenda Health District. With medical waste generated, no health facility used colour-codes to segregate waste and only one (7.1%) used pictures to enhance segregation practices and 14.3% used writings as directives. Alain et al., (2023) and Peter *et al.,* (2023) in their study also reported non-use of

colour codes. However, Adu *et al.,* (2020) reported the use of colour-coding for infectious waste containers although this was inconsistent across health facilities. All health facilities in this study used water tight was bins to store medical waste. It should be noted that WHO (2017) established 7 categories of medical waste, but proposed a 3-bin system of 'general waste', 'infectious waste' and 'sharp waste'. To them, the simplest and safest waste segregation system is to separate all hazardous waste from non-hazardous general waste at the point of generation. This study reported that from temporal to disposal site, 57.1% of facilities transported waste manually and 57.1% used wheelbarrows. Niyongabo et al., (2019) noted the use of wheelbarrows and trucks for medical waste transportation although for Hassan *et al*., *(*2018), manual transportation was common in smaller health facilities compared to bigger ones. In contrast, Alain et al., (2023), reported that 40% of health facilities transported infectious and non-infectious waste separately as recommended by norms and only 13.3% used a wheel barrow for transportation.

Furthermore, in this study, incineration was the main method used for medical waste treatment by 57.1% of health facilities, although none was equipped with a scrubber and no facility treated bottom ash before disposal. Idemudia *et al.,* (2024) in their study reported higher use of incineration by health facilities (70.5%) while Chepchirchir & Ngoye (2024) reported a much higher rate (80%). However, to Bako & Ali (2022), incineration and deep burial were the main disposal method in 50% of hospitals that complied with stipulated guidelines. Few treatment alternatives were available in the study of Neves *et al.,* (2022), with incineration and autoclaving standing out as the commonly used method. Ekani et al., (2024), assessed the incineration practices of solid hospital waste in Douala, Cameroon and showed that in total, 14.1% of health facilities mainly practised decentralised incineration of infectious solid hospital waste (ISHW) as against 0.8% that carried out controlled decentralised incineration of ISHW. while 13.3% practised uncontrolled decentralised incineration of ISHW. To them all health facilities in category 1 and 2 had 100% functional incinerators that met environmental standards for atmospheric emissions from incineration (Nitrogen Oxides (NOx) less than 80 mg/N m3; Dioxins and Furans limited to 0.1 ng/m3), safety standards (presence of fire extinguishers (100%) and generators (100%). A standard incinerator for medical waste (Incinis K20) at the BHD went operational in 2019. It has a maximum temperature of 1200^0C, equipped with a primary and secondary chamber that cleans gases and particulate pollutants like Polychlorinated Debenzo-p- dioxins (PCDD)/dibenzofurans (PCDF) before their release into the atmosphere. It serves all health facilities and institutions that generate medical and pharmaceutical waste (public, private, confessional) including home generators against a small charge. Similar modern incinerators in Cameroon are located in Guider Health District (North

Region), Etoa Meki Medicalised Health Center (Centre Region), Bonassama District Hospital (Litoral Region). Kenny & Priyadarshini (2021) in their systematic review pointed out that incineration is one of the most widely used disposal methods for medical waste and considered the most efficient due to its ability to handle large quantities of waste at once. However, it should be conducted under controlled operational conditions at temperatures between 1100◦C and 1600◦C.

Furthermore, disposal practices identified in this study were; dumping of medical waste in municipal waste bins, onsite open burning, onsite open waste pits and deep burial in waste pits. Peter *et al.,* (2023) indicated that in their study, the disposal of biomedical wastes in communal bin was the only statistically significant category under disposal method. Bako & Ali (2022) reported that in 50% of hospitals, the dominant treatment and disposal methods used were open dumping and burning. Unlike most studies, Adu *et al.,* (2020) reported the presence of third-party companies to manage medical waste whereas for Chepchirchir & Ngoye (2024), outsourcing (62%) was the most common method of dealing with waste. No health facility in this study outsourced its MWM to a third party. The WHO does not specify a recommended treatment type for medical waste, as each country is free to choose a suitable method. However, landfilling is not advised for medical waste disposal due to its potential harm to the environment.

In this study, health facility medical waste management policy adherence rate was determined to be 55.6%. Compliance was assessed against a check list of 32 legal specifications laid out in the policy document. Most health facilities depended on infection prevention and control (IPC) guidelines, internal guideline developed by the health facility and personnel knowledge of IPC acquired during trainings and seminars, to manage their medical waste as none had this policy document. Despite the inexhaustive nature of the policy document, it provided a start-off point for policy evaluation. The authors believed a higher adherence rate could be attained, if the National policy document was made available to health facilities. Also, lower rates of compliance (15%) to MWM policy was reported by Mugambi *et al*., (2025). Contrary to our study, Omoleke *et al.,* (2021) revealed that from the study carried out in a low-resource setting, 25% of health facilities had the MWM policy document of which only 7% had implementation challenges. According to Alain *et al.,* (2023) the most reported problems faced with MWM implementation was non respect of MWM guidelines (41.6%). Tsamo *et al.,* (2017) stated that waste management in the health centers in Maroua respected no norms, stemming from poor legislation and regulatory systems. It should be recalled that Raji & Adeogun (2024) in their review of published literature from 2004-2021 concluded that although the healthcare waste management guide by the WHO can be adopted internationally, countries

still need to come up with their local manuals and guides, which will reflect the available budget, manpower, technological know-how and locally available materials better suited to manage their healthcare waste.

This study will increase the stock of published and grey literature on medical waste management in the North West Region, Cameroon, Africa and the world at large. As a consequence, awareness on contemporary issues related to medical waste management practices will increase while significantly enhancing positive behavioural change for communities. In addition, the evidence-based findings and recommendations will enable health facility compliance to medical waste management regulations. This further enables the attainment of Sustainable Development Goal (SDG) 3,3, 11 and 13.

While the findings of this study provide useful insights, several limitations should be acknowledged. First, its cross-sectional design limits its ability to assess changes in waste management practices over time. Second, the ongoing socio-political instability in the North west Region limited access to some health facilities, thereby affecting the representativeness and generalizability of the findings.

In conclusion, the medical waste management choices of health facilities were inadequate and health facilities had an average policy adherence rate. Authors recommend future research on the scale up of the study to other health districts in the region and in Cameroon based on limited data available for policy makers.

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APPENDICES

Appendix 1: Gallery for Medical waste management choices of health facilities in the Bamenda Health District

Fig (A)

Fig (B)

Fig (C)

Storage containers for non-hazardous and hazardous waste

Fig (D) Fig (E) Fig (F)

Storage containers for sharps waste




Fig (G) Fig (H) Fig (I) Fig (J)

Medical waste treatment by incineration




Fig (K) Fig (L) Fig (M) Fig (N)

Placenta Pits for pathological waste




Fig (O) Fig (P) Fig (Q) Fig (R)

Onsite open waste dumps

Fig (S)

Fig (T)

Fig (U)

Onsite open burning of medical waste

Appendix 2: Cameroon's Legislative and Regulatory Specifications for Medical and Pharmaceutical Waste Management, and Health Facility's Adherence

Legal text specifications	**Health Facility Adherence**						**0=No**	**1=Yes**		**NA=** Not Applicable					**Rate**
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	%
The collection and transportation of medical and pharmaceutical waste by any natural or legal person shall be subject to an environmental permit issued by the administration in charge of environment.	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Damaged or expired pharmaceutical products, biomedical laboratories and/or veterinary clinics/pharmacies, shall be treated under the same conditions as all other medical and pharmaceutical waste,	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
General provisions Article 4: (1) Every medical and pharmaceutical waste generator shall set up an internal management system; which shall include especially:	1 1 1	1 1 1	1 1 1	1 1 1	1 1 1	1 1 0	1 1 0	1 1 1	1 1 0	1 1 1	1 1 1	1 1 1	1 1 0	1 1 0	100 100 64.3
- A unit for managing such waste	0	0	0	0	0	0	0	0	0	0	0	0	0	0	00
-Qualified personnel trained in the management of such waste	1	1	1	1	1	0	0	1	0	1	0	1	0	0	57.1
- A register in which the quantities, category, origin of the waste produced, collected, stored and															

disposed of are updated. **-** Suitable equipment for the safe encapsulation of this waste.															
Article 5: Any medical waste generator shall manage the waste (ie) sort at source, package, store and where appropriate, collect, transport, treat and finally dispose.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
Article 5: Any pharmaceutical waste generator shall manage the waste (i.e) sort at source, package and store,	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
Article 5: Any pharmaceutical waste generator shall where appropriate collect, transport, treat and dispose the waste**.**	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
Legal Text Specification	**Health Facility Adherence**					**0=No**		**1=Yes**		**N/A = Not Applicable**					**Rate**
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	%
Article 6: Medical and pharmaceutical waste shall be sorted according to category from their generation;	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	100 00
- Place these containers of different colours for single use, meeting the manufacturing standards in force, according to the following conditions:	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	100 00
-Resistant and waterproof containers for categories 1a and 1c waste	1	1	1	1	1	0	0	1	0	1	1	1	0	1	71.4
- Resistant and waterproof red-coloured containers for categories 1a and 1c waste	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	00 00
-Solid, hermetically sealed, yellow-coloured containers for category 1b waste	0	1	1	1	1	0	1	1	0	1	0	1	1	1	71.4
-Resistant and leak-proof brown-coloured containers for category 2 waste **-**On-transparent white coloured containers for human or animal organs and tissues of category 3 - Resistant and waterproof black-coloured containers for category 4 waste.															

Article 7: (1) The filling of bags and containers shall not exceed three quarters of their capacity;	0	0	0	0	0	0	0	0	0	0	0	0	0	0	00
-and shall be labelled to indicate the source of the waste	1	0	0	0	1	0	0	0	1	0	0	0	0	0	21.4
-date of first sacking or putting in containers and date of loading.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	00
(2) Bags and containers shall be sealed after filling and	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
- placed in separate containers, reserved for storing according to the category of the waste.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
Legal Text Specification	Health Facility Adherence														
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	Rate
Article 8:(1) Containers used for storing categories 1 and 2 waste shall be rigid, watertight, moisture-proof, solid, cracking- and	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
crushing-resistant under normal conditions of use and	1	0	0	0	1	0	0	0	1	0	0	0	0	0	21.4
be in accordance with the standards in force.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	00
(2) Tightly sealed containers to prevent leakage during	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
transport shall bear a label indicating the category of waste they contain	0	0	0	0	0	0	0	0	0	0	0	0	0	0	00
- and their storage date.	1	1	1	1	1	1	0	1	0	1	0	1	0	1	71.4
(3) The containers shall be placed in an appropriate storage area; away from the waste generating units; accessible only to the waste management unit staff or to the person in charge. **Article 9:** Each unit generating medical waste shall fit out safe storage points. - Each unit generating pharmaceutical waste shall fit out safe storage points.	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100
Chapter IV: Article 18: (3) Non-identifiable organs and tissues of human and animal origin shall be	0	0	0	0	0	0	0	0	0	0	0	0	0	0	00
treated; -and disposed of according to the same procedures for the treatment and disposal as category 1 infectious	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100

waste.															
Total adherence per facility	20	19	19	19	21	15	15	19	16	19	16	19	15	17	
Average adherence rate per facility	62.5	59.4	59.4	59.4	65.6	46.9	46.9	59.4	50.0	59.4	50.0	59.4	46.9	53.1	