Sub-Sahara African Academic Research Publications
December, 2022, Editions

JBER
Journal of Biodiversity and Environmental Research
Vol.26, No.4, ISSN 2211-8735

EFFECTIVENESS OF MEDICAL WASTE MANAEMENT IN SELECTED HEALTH-CARE FACILITIES IN MINNA AND BIDA, NIGER STATE NIGERIA

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Abstract
This study aimed at assessing the effectiveness of medical waste management (MWM) in the selected Healthcare facilities (HCFs). The study involved the survey of a descriptive cross-sectional study that assessed seven (7) HCFs in Minna and Bida in Niger State, Nigeria. Five (5) public (A, B, C, E and G) and two (2) private (D and F) HCFs. Data were collected using three instruments: questionnaire, in-depth interviews and field survey. The study revealed that highest percentage (26.5%) of professional cadres were nurses/midwife. Hence, the majority (76.4%) of the study participants involving medical personnel and handlersreported dealing with hazardous medical wastes. This evidenced that medical staff and handlers are mostly considered prone to the potential harmful occupational hazard with high level of risk and burden of transmission of infectious waste that was yield to represent the highest proportion (16.1%) of hazardous medical waste. The present study also established that all the HCFs have the same process of managing their medical waste and deficiencies were found in the adaptation of holistic approaches and current MWM techniques. Most (65.8%) of the existing practices of all operating system prevailed Poor compliance to a set standard. Moreover, the study revealed that the existing practice of general MWM strategies in accordance with the T&C (2005) guidelines at studied sites are mostly classified as operational performance level 0 and 2 which implies that the present management practice for medical waste is ineffective and should not be relied upon to protect human health and environmental integrity.

Keywords: Medical Waste, Medical Waste Management, and Healthcare Facilities

Introduction

Medical waste (also called "healthcare wastes, biomedical and infectious wastes") refers to waste, which is produced in the course of medical treatment, medical testing, post-mortem examinations, quarantine inspections, medical research, dental practices, blood banks, and the manufacture of chemical agents or biological materials by health care facilities (HCFs) such as Hospitals, clinics, physician's offices, medical treatment organizations, medical testing institutions, medical laboratories, veterinary hospitals/clinics, and industrial and research organization laboratories engaged in genetic or bio-technological research (Tsai, 2021).
Medical waste is classified as hazardous and nonhazardous (General)wastes with consistency of solid, liquid and gaseous forms. The hazardous, toxic or even lethal part of waste from healthcare facilities comprising infectious, sharps, pathological, pharmaceutical, genotoxic and radioactive

materials as well as high pressure wastes constitute a grave risk to mankind and the environment because of their high potential for diseases transmission, if these are not properly treated / disposed or are allowed to be mixed with other municipal waste (Health Care Waste Management Plan HCWMP-2018).

Most of the medical waste generated from healthcare settings is not always hazardous or more dangerous than general household waste. However, it depends on the type of medical waste that represents different health risk levels (World Health Organization-WHO, 2018). For example, infectious wastes, which accounts for 15%-25% of the total medical waste, including sharp objects, body parts, chemical or expired medicines, and radioactive and cytotoxic waste (WHO, 2019; WHO, 2020a).The management of medical wastes practices differs from country to country. In particular, it depends on the income of countries (WHO, 2018). Due to a number of factors associated with inadequate planning and monitoring, logistics issues, storage and access issues, developing countries including Nigeria record high amounts of expired medical commodities, and wastes which are considered hazardous and infectious (Tull, 2018).

The effective management of medical wastes depends on various factors like proper planning, funding, administration and commitment at policy level and should include basically; storage in generating premises, effective collection, effective transportation and proper disposal to create a reduce–reuse–recycle system that can change the outlook of medical waste handling while at the same time adding a revenue stream (Survey Report, Executive Summary 2012; Liu and Yao, 2018). Inadequacies of appropriate management practices and infrastructure make medical waste management in Nigeria unsustainable (Ezechi*et al*., 2017).Despite the challenges for the implementation of environmentally sound management of MW, there are solutions that can be implemented by adopting treatment technologies, and concepts that will help drive the medical system forward to a circular economy concept (Singh*etal*., 2021). The importance of this study is to focus on the need for effective medical waste management in protecting patients and staff working in entities generating types/categories of medical waste, health of general public and the environment.

Study Area

Nigeria (As shown in Map A) is a large country with 1,045 kilometers long and wide of 1,126 kilometers. The cross-sectional study will be conducted in Minna (As Shown in Map D) and Bida (Shown in Map C) Metropolis. Minna is a capital city of Niger State (As shown in Map B) in the North-Central, Nigeria and the administrative headquarter of Chanchaga Local Government Area. Minna lies at latitudes 9°37'N- 9°79'N and longitude 6°16'E - 6°65'E (Ibrahim *et al.,* 2014). Minna has a total land area of 74,344 km^2 wide and it is approximately 8% of the land area of the country. According to the United Nation World Urbanization Prospects (WUPs), The population of Minna has grown from 384,725 to 461,743 (WUP; 2015 - 2021 estimates) at 3.30% growth rate. Minna is predominantly inhabited by three (3) major ethnic groups namely; Gbagi, Nupe and Hausa speaking people with inclusion of other tribes like Hausa, Yoruba, Ibo and Kakanda, etc. (Owoeye, 2018).

Bida is the second largest town in Niger State. It is located 83kms southwest of Minna and on the A124 highway (a regional road) linked southwest states to Minna and Abuja. It lies between latitude 9.083°N and longitude 6.017°E, Coordinates. Bida is the headquarters of the Nupe Kingdom led by the Etsu Nupe and consisting of many districts, such as Katcha, Lapai, Mokwa,

Enagi, Baddeggi, Agaie, Pategi, Lemu, Kutigi, and others with an estimated land area 1,698km$^{2.}$ The population estimation of Bida is 185,553 (NPC, 2006) and project to 260,700 (NPC, 2016). This study covered categories of health-care facilities (HCFs) as public and private sectors in Minna and Bida Metropolises. These HCFs were classified into Tertiary; Secondary and Primary which provide services for low, middle and high income earners.All HCFs (Departments/Units/Wards) offered various medical services. The major departments in the surveyed HCFs are laboratories, consulting rooms, pharmacy, GOPD/receiving areas, labor rooms, administrative offices, surgery/operation rooms and admission wards.

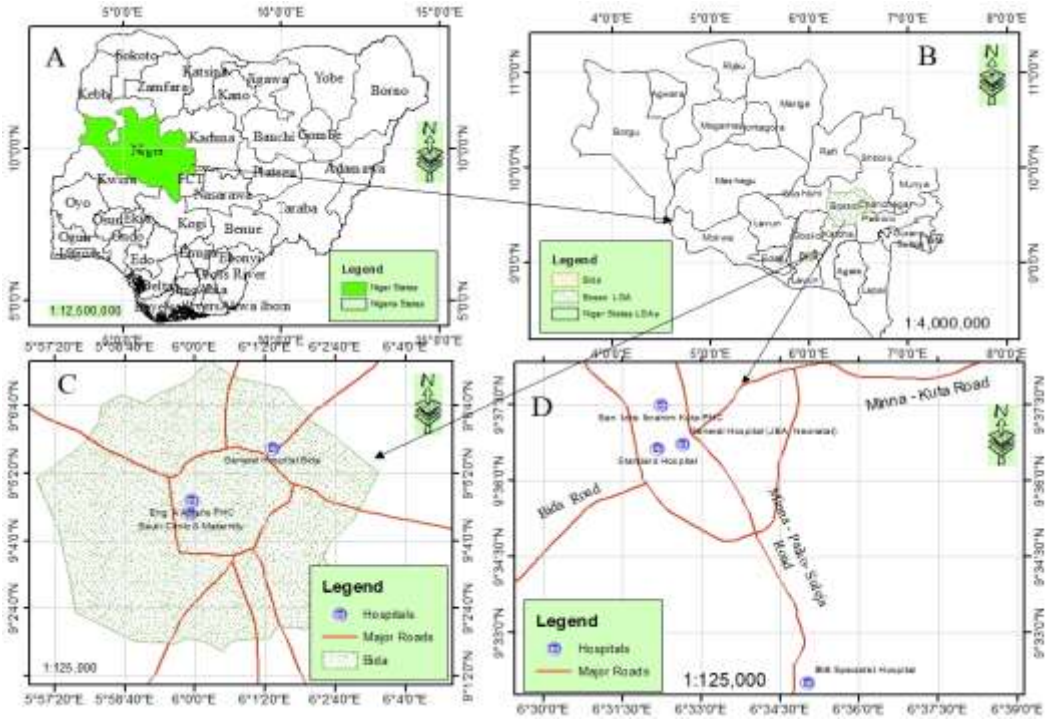

Figure 1: Map of Niger state showing Selected Health Care Centres in Minna and Bida. Source: Remote Sensing and GIS Laboratory, Department of Geography, FUT Minna.

Table 1: Distribution of the sampled HCFs in the study area

STUDY AREA	TERTIARY (Public)	SECONDARY (public)	PRIMARY (public)	SECONDARY (Private)	PRIMARY (private)
MINNA	IBB Specialist	General Hospital- New Extention	Dr. I. I. kuta Memorial PHC	Standard Hospital & diagnostic services	____
BIDA	_____	Umar SandaNdayako General Hospital	Eng. A. A. Kure	____	Sauki Clinic and Maternity

Materials and Methods

Basically, two types of data were used for this study to address the respective research questions. These are Primary and Secondary data.The primary data were sourced using thestructured

questionnaires, interview schedule, field survey and photographs and secondary data were sourced from the archives of the healthcare facilities, conferences, internets, text books, journals, published reports etc.

Seven (7) HCFs were selected for this study using purposive sampling methods and then stratified into private (Secondary and Primary) and Public (Tertiary, Secondary and Primary) HCFs based on the ownership of the HCFs.

Data analysis

To facilitate the entry process, the qualitative approach of methodology by means of theinterview schedule, structured questionnaires and field survey were analyzed using statistical package for social science (SPSS) version 22.0. Data were gathered from the survey instruments and inspected for reliability and completeness, and then compiled using descriptive statistical and thematic content analysis. The data analyzed were summed up and presented in tables and charts to provide the frequency counts and percentages using MS excel and SPSS software.

Results and Discussion

A total of 285 study participants were recruited in this study. However, eighteen (18) workers dropped out of the study due to failure to return their filled questionnaires to the researchers during the study period. Hence, the response rate for the survey which were deemed acceptable for analysis was 267(93.7 %). Out of the 267 successful participants, not all the study participants responded to all the questions they were asked about their demographic information therefore, it was indicated in figure 4.1 that the majority 26.5% (69/260)of study participant's profession were nurses/midwife, followed by handlers (21.9%), laboratory (11.9%), CHEWs (10.8%), doctors (11.2%) and the least participant's profession (7.7%) were pharmacists.

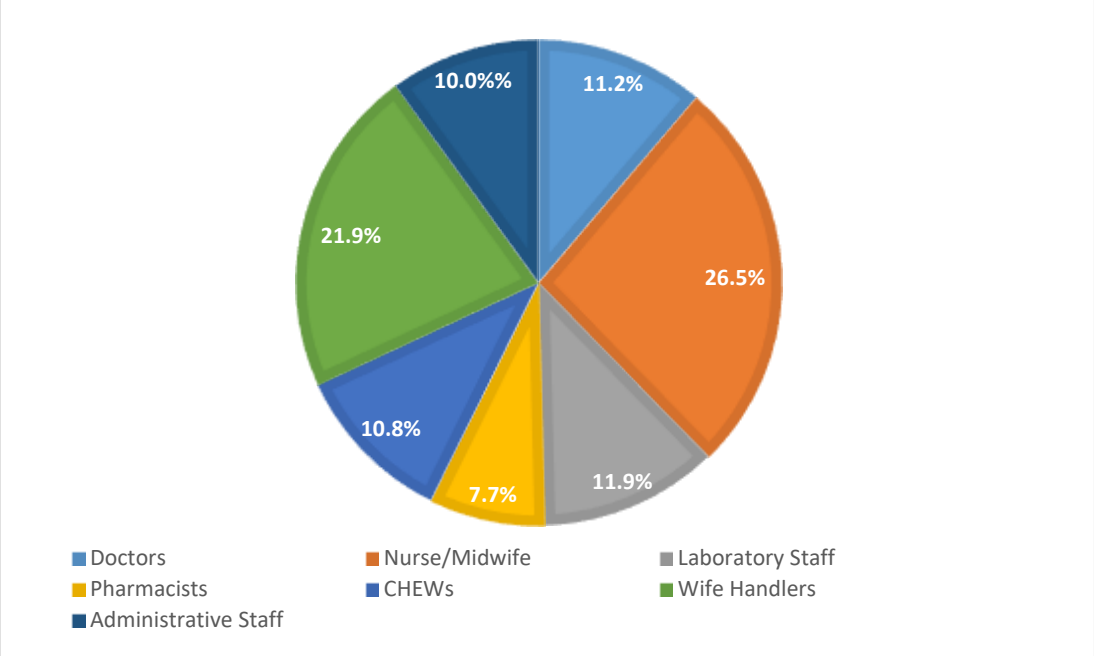

Figure 2: Percentage distribution of professional cadres surveyed

Assessment of medical waste types and categories (components) generated by the study participants at the surveyed HCFs

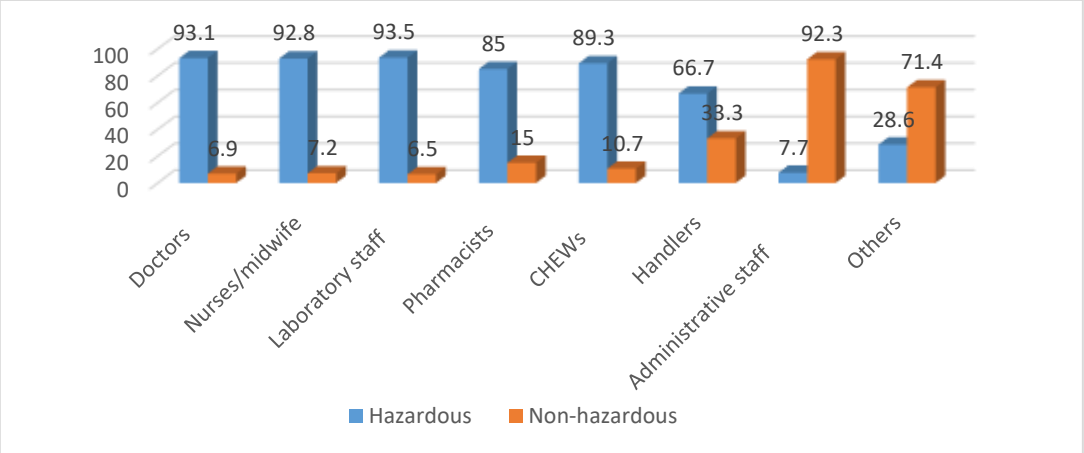

Figure 3: Percentage distribution of types of medical waste generated in surveyed HCFs

Regarding the types of medical waste generated and /or handled by the various category of professions during their practices, it was revealed in figure 3, that the higher percentage proportion 204(76.4%) of the study participants reported generating hazardous MW while 63(23.6%) indicated that they generate general (non-hazardous) MW. For hazardous MW generated/handled, it was indicated that laboratory staff constituted the highest proportion (93.5%) hazardous MW more than other professions. The justification for this observation was witness during the in-depth interview section where laboratory staff (scientist/technician) displayed their activities of dealing with hazardous MW than others. Conversely, the majority (92.3 %) of administrative staff reported generating/handling general (non-hazardous MW against lesser proportion (6.5 %) of laboratory staff. This result come to agreeing with that study done by Abebe (2017) which reported that either proportion of hazardous MW is varied in Ethiopia from 21 to 70%. A further analysis indicates that highest percentage proportion (93.5%) of laboratory staff reported dealing with items that constitute.

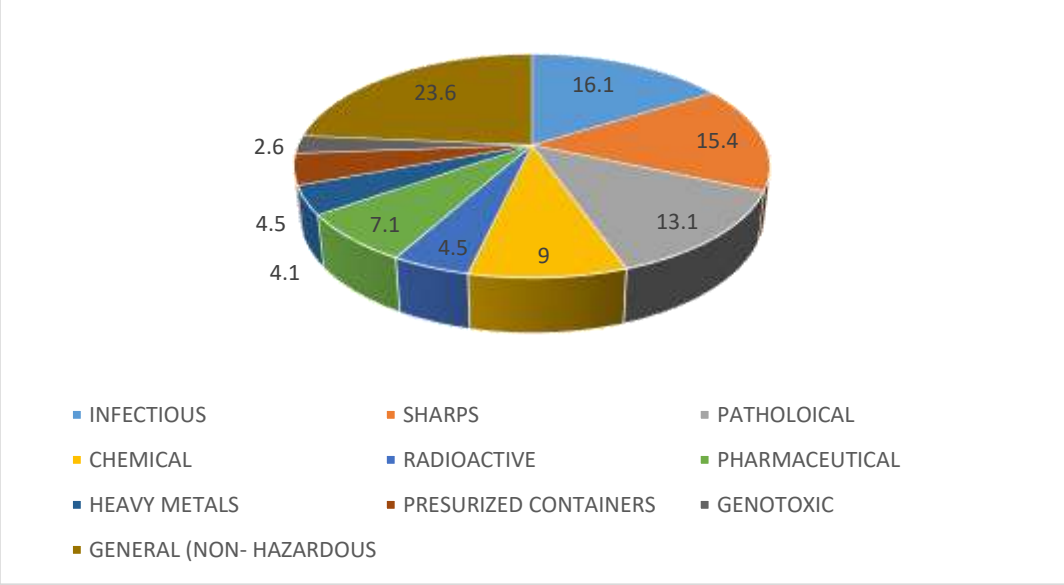

Figure 4: Percentage distribution of medical waste categories generated in the surveyed HCFs

As presented in figure 4, the highest proportion 23.6% (63/267) of the study participantsreported generating general (non-hazardous) MW category. Furthermore, it was noted that the leading proportion (16.1%) of the study participants reported generating infectious MW among hazardous types.This is consistent with the finding on assessment of MW generated at medical center in Keffi-metropolis by Jonah *et al.,* (2018).

Examine the techniques concerning current MWM practices in the study areas

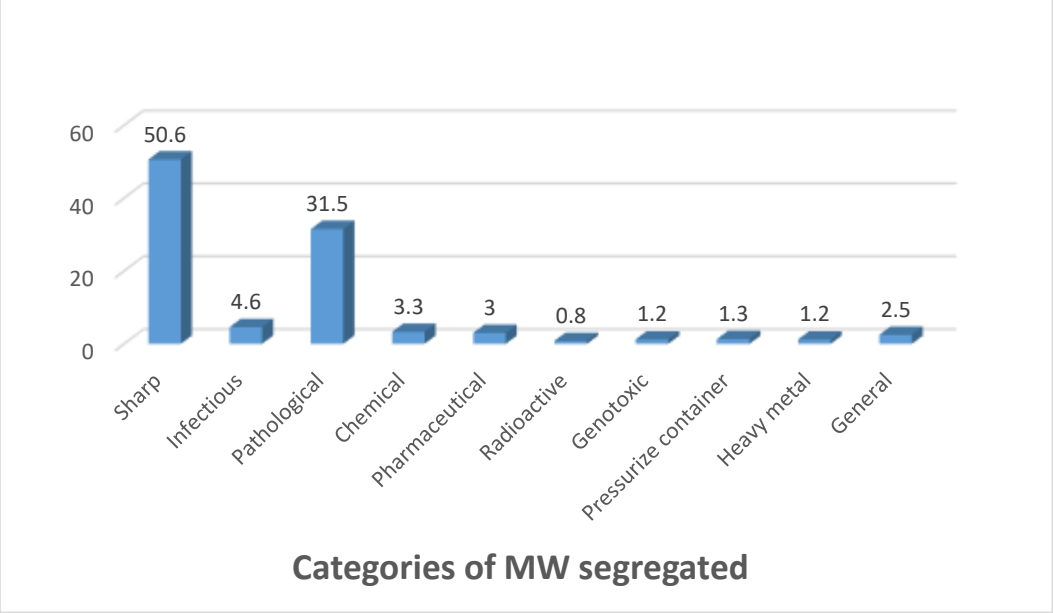

Figure 5: Percentage distribution of segregated MW categories

The finding on the need for segregation of MW categories shows in figure 5 revealed that (50.6%) and nearly one-third (31.5%) of study participants rightly reported segregating only sharps and pathological wastes compared to a small proportion (4.6%), (3.3%), (3.0%), (1.2%), (1.2%), (1.3%), (0.8%) and (2.5%) of the study participants indicated segregating infectious, chemical, pharmaceutical, genotoxic, heavy metals, pressurized container, radioactive and general wastes respectively.

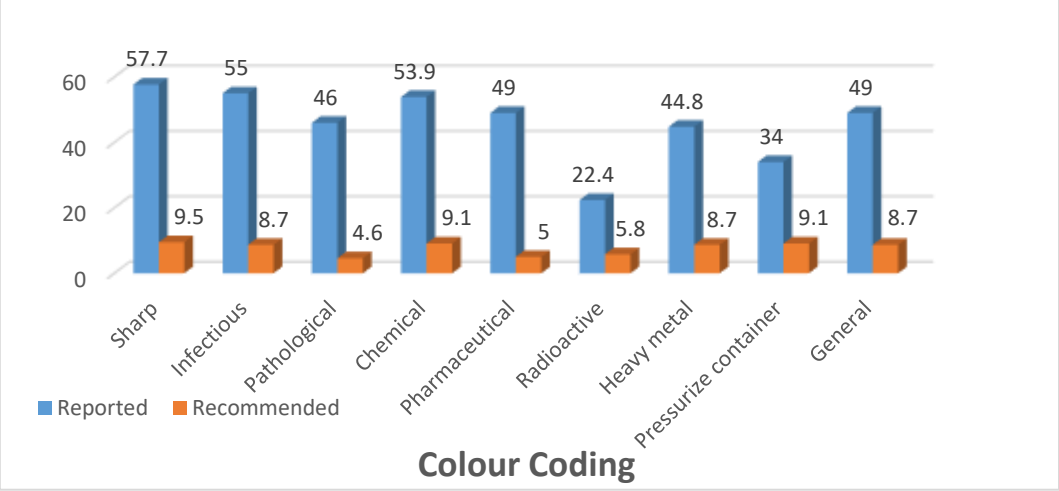

Figure 6: Percentage distribution of color coded receptacles of MW categories

Regarding the practices of color coding of receptacles of MW categories as shown in figure 6, all study participant in various HCFs accounted for only small proportion (below 10%) could rightly identified the recommended national /international requirement for color codes of receptaclesas follows: (8.7%) infectious and (9.5%) sharps as a color code yellow; (5.0%) pharmacy, (4.6%) pathological and chemical (9.1%) as a color codes brown; radioactive (5.8%)as radioactive symbol; heavy metal (8.7%)as red, pressurized container (9.1%) and general (non- hazardous) 8.7%0as a color code black respectively.

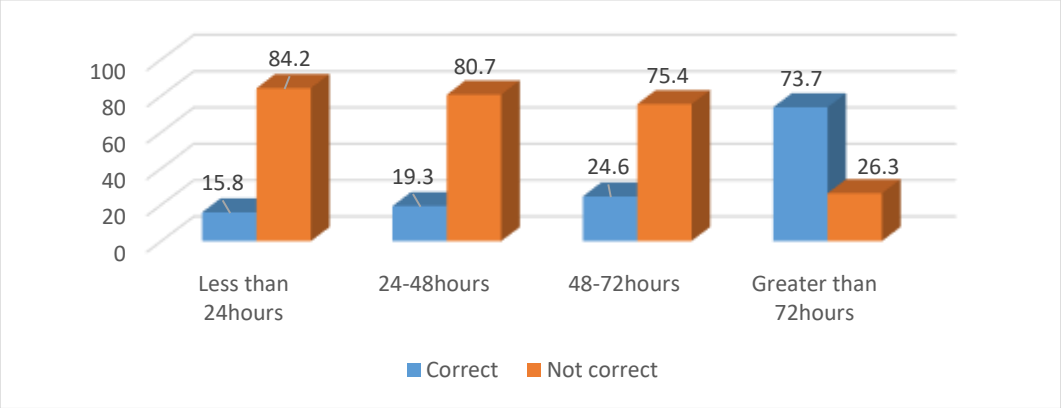

Figure 7: Percentage distribution of adopted storage period of MW at temporary storage area

The finding from figure 7 shows that the majority (73.7%) of the study participants reported adopting storage period of MW at temporary storage area exceed the recommended standard period. Only about 19.9% correctly reported adopting appropriate period of MW temporary storage.

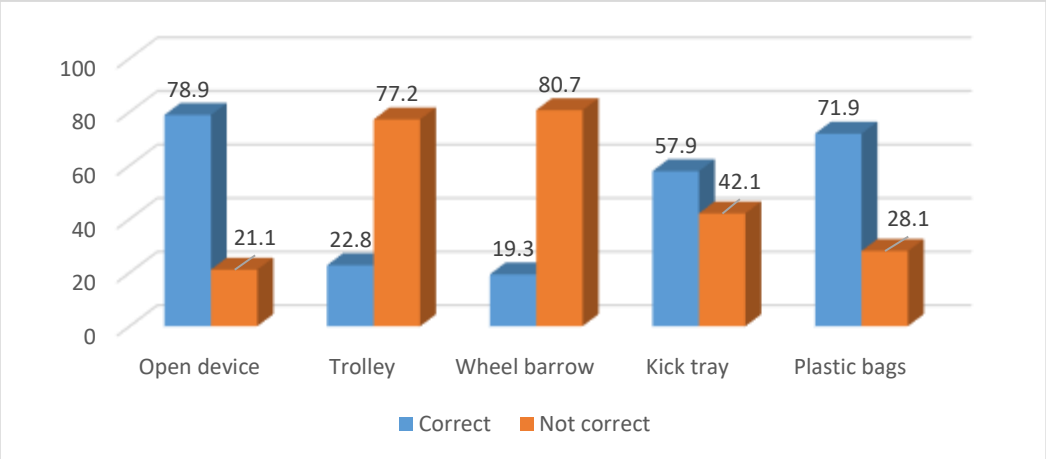

Figure 8: Percentage distribution of transferring means for on-site transportation

Result on transferring means for on-site transportation showed highest portions (78.9%) of the study Participants correctly indicated open device (bins) as the transferring means, followed by

(71.9%) plastic bags,(22.8%) for trolley while the lesser proportion 19.3% (11/57) of the study participants indicated wheel barrow.

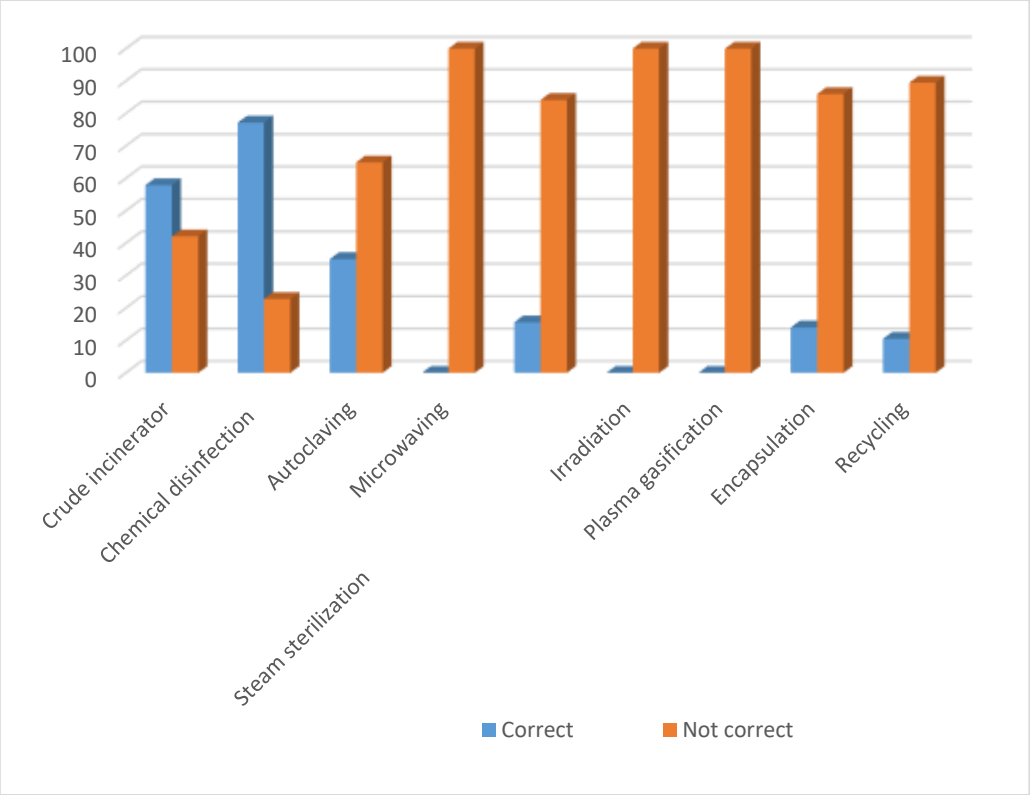

Figure 9: Percentage distribution of MW treatment methods practiced in the surveyed HCFs

As presented in figure 9, most (77.2%) of the study participants correctly reportedusing chemical disinfection as treatment option, followed by (57.9%) crude incineration, and more than one-third (35.1%) reported autoclaving option of MW treatment against small proportion of the study participants that indicated otherwise.

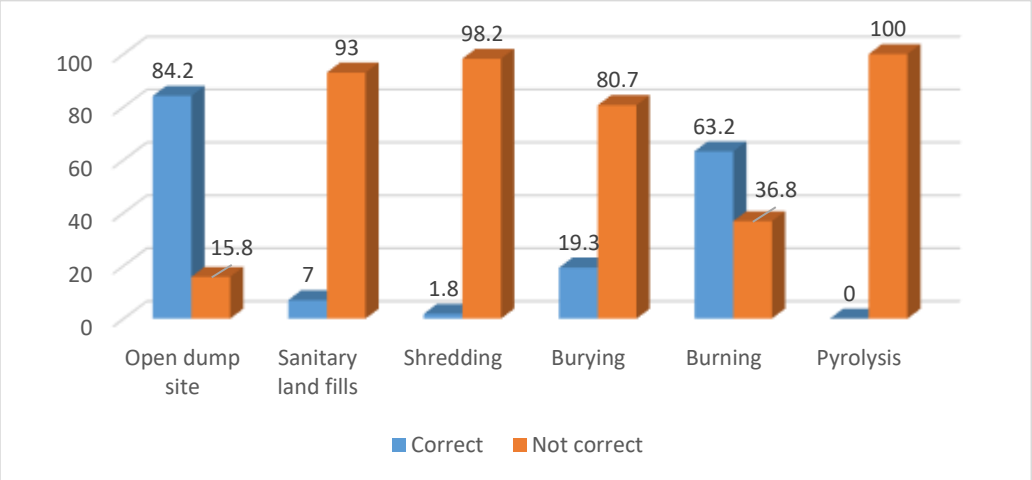

Figure 10:Percentage distribution of final destination of MW disposal

Result on final destination of MW disposal indicated that most (84.2%) and (63.2%) reported using open dump site, and burning as option for final destination of MW. Contrarily, for sanitary landfills, shredding, burying and pyrolysis, less than 20% of the study participants were rightly reported using them. Currently, about 82.5% of all HCF participants claimed off-site final disposal option through burning at open dump site.

Assessment of compliance status with recommended best practices regarding current MWM chains based on the national and international regulatory standards

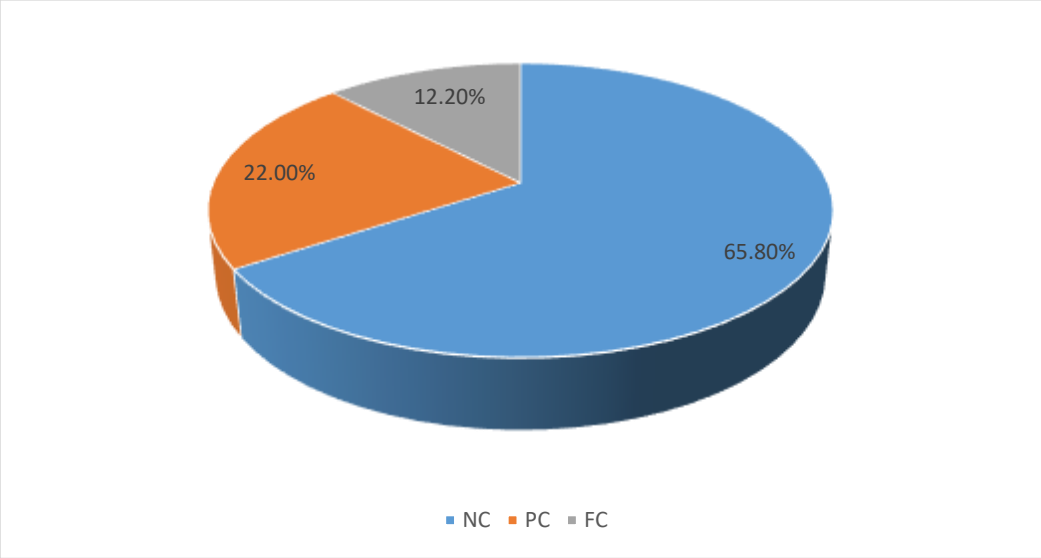

Figure 11: Percentage distribution of compliance status with recommended best practices regarding current MWM chains based on the national and international regulatory standards having FC= Full-Compliance: 70%-Above; PC= Partial-Compliance: 40-69%; NC= Non-Compliance: Below 40%

From figure 11, the leading proportion (65.8%) of existing practices prevailed NC to a set regulatory standards, (22.0%) prevailed PC while a lesser proportion (12.2%) prevailed FC. Table 2: The result of the application of T&Cguidelines on the description of existing practices of MW general management strategiescorresponding to performance level of effectiveness of MWM

Medical Waste General Management Strategies	Description of existing practice	Corresponding effectiveness of MWM on performance level
Current State of Awareness of Top Management of Sustainable Development (SD) **All top management aware of SD** **Some awareness of top management on sustainable development Management unaware of SD** **Some top management trained in SD**	Some top management aware of sustainable development	1
Current State of Commitment of Top Management on SD **No commitment to SD** **Minimal commitment to SD**	Minimal commitment to sustainable development	1

Some commitment to SD **High level commitment to SD through commitment frame work**		
Current State of Mass Balance Undertaken **No mass balance undertaking** **Mass balance undertaking**	No mass balance undertaking	0
Current State of Corruption Cases **Evidence of corruption** **No evidence of corruption issue**	No available issue of corruption cases	2
Current State of Awareness of Top Management on SD Best Value **There is awareness of best value** **Lack of awareness of best value** **There is minimal awareness of best value**	There is minimal awareness of best value	1
Current State of Awareness of Continuous Improvement **No continuous improvements taking place** **Minimal continuous improvement taking place** **Some continuous improvement taking place** **Continuous improvement under taken**	Some continuous improvement on MWM	2
Current State of ISO 14001 certificate **No ISO 14001 certificate** **Available ISO 14001**	No ISO 14001	0
SOCIAL ISSUE **Current State of Staff Consultative Committee** **No staff consultative committee** **Staff consultative committee**	Staff consultative committee	3
Current State of Patient Consultative Committee **No patient consultative committee** **Patient consultative committee**	No patient consultative committee	0
Current State of Health and Safety Committee **No health and safety committee** **There is health and safety committee**	No health and safety committee	1
Current State of Health and Safety Representative **No health and safety representative** **Health and safety representative**	Health and Safety representative	2
Current State of Policy and Frame work for Enforcement **No equal opportunities policy** **Available equal opportunities policy**	Some equal opportunities policy for enforcement	1
Current State of Investor of people Scheme **No investor of people schemes** **investor of people scheme**	No investor of people scheme	0

HEALTH AND SAFETY (H&S) **Current State of Health and Safety Awareness and Policy** **There is Health and safety awareness and policy** **No Health and safety awareness and policy**	Health and safety awareness and policy	2
Current State of H&S policy implementation **No implementation of policy** **There implementation of policy**	No Implementation of policy	1
Current State of Basic Risk Assessment **There is basic risk assessment,** **Full risk assessment** **Risk assessment and control**	Basic risk assessment	2
Current State of H&S advisor **No H&S advisor** **Person responsible for H&S** **Part-time professional safety advisor** **Full-time professional safety advisor**	No H&S advisor	0
Current State of Instructive poster **No H&S poster** **There is H&S poster** **Wide use of H&S poster**	Health & safety poster in use	2
Current State of H&S Protective Clothing **Basic protective clothing** **Some protective clothing** **Full protective clothing**	Some protective clothing	3
ENERGY AND WATER USE **Current State of Energy Policy** **There is energy policy** **There is No energy policy** **There is Full energy policy**	There is energy policy	3
Current State of Regular Check on Energy use **There is check on energy use** **There is No check on energy use** **There is Full check on energy use**	Check on energy use	3
Current State of Use of Renewable Energy Source **There is a renewable energy source** **There is No renewable energy source** **There is some renewable energy source**	No use of renewable energy source	0
Current State of building Insulation **The buildings are insulated** **No building is insulated** **Some buildings are insulated**	Some building are insulated	2
Current State of Regular Check on Water Consumption **No Check on water consumption** **There is Check on water consumption** **Water consumption regular check**	Check on water consumption	2

Current State of Regular Check to Detect Water Wastage **No inspection to detect water wastage** **Regular inspection to detect water wastage** **Annual inspection to detect water wastage**	Regular inspection to detect water wastage	2
Current State of Staff Car Sharing Scheme **No staff car sharing scheme** **There is staff car sharing scheme**	No staff car sharing scheme	0
Current State of Public Transport Usage **Low percentage of use public transport** **Medium percentage of use public transport** **High percentage of use public transport**	Low percentage of use public transport	0
PURCHASING & SUPPLY OF GOODS **Current State of Purchasing and Supply** **Uncoordinated purchasing &supply** **coordinated purchasing &supply** **Some control on purchasing &supply tendering**	Coordinated purchasing& supply	3
Current State of Specifications of Goods **No detailed specification for goods** **Some detailed specification for goods** **Working with supplier & services provider**	Usually detailed specification for goods	2
Current State of Waste Prevention Practices **No waste prevention practice** **Reduce materials used** **There are waste prevention practices**	Specifically, no budget for waste prevention practice	2
Current State of Clean Production Practices **No regard for clean production practice by supplier** **Some regards for clean production practice by supplier**	Some regards for clean production practice by supplier	2
Current State of Life Cycle Assessment **There are life cycle assessment practices** **There is no life cycle assessment practices**	There is No life cycle assessment	0

0= Unsustainable level of MWM with reluctance to change
1= Unsustainable level of MWM with some evidence of awareness and willingness to change
2=Some aspects are considered sustainable and others unsustainable
3= Operating in accordance with sustainable development but some aspect not ideal
Source: Adapted from Townend and Cheeseman (2005)

As presented in Table 2, based on the scale factor of operational performance levels 1, 2, and 3, the findingrevealed that the description of existing practice of general medical waste management strategies in accordance with the T&C (2005) guidelines criteria at all studied sites are mostly classified as operation performance level 0 and 2 of corresponding effectiveness of MWM. Additionally, there was a significant revelation by interviewees that (some unit heads) said "There were lack of coordination, supervision and monitoring of health care workers and were of the opinion that the supervision and monitoring of health care workers involved in medical waste management is extremely important, so that they will perform their job diligently". Interviewees

in most of HCFs agreed that the MWM techniques for proper adoption of medical waste management are not much applied, therefore the workers are at high risk during practices.

Conclusion

The finding of this study generally reports about the effectiveness of MWM on health-care services that are focused at preventing potential health risks and environmental hazards as well as improving competences of HCFs staff involving selected seven (7) HCFs. Medical waste types and categories (components) according to WHO (2019), HCWMP (2018) and Chartier (2014) were present at studied HCFs. Poor management of these medical waste types and categories exposes the health workers most especially medical staff and Other support staff, patients and general public to health risk. Through this study, the absence of holistic approaches and inadequate adaptation of current medical waste management techniques that would accelerate the integration of MWM into a prospective circular economy was discovered. Lack of legal frame work that govern medical waste management and enforceable policy document as stipulated in the guidelines for sustainable management of medical waste was prevailed at all the studied HCFs with an indication of high level of non-compliance of most existing medical waste management practices with relevant national and international standard procedures. This is a major setback in ensuring a safeguard work environment for workers, clients and the community. Therefore, strengthened continuous monitoring and education by HCFs management was noted to be necessary to ensure on-going compliance. The description of existing practices of MWM criterial in accordance with the T&C (2005) guidance at studied sites created a forum for utmost concern being that all HCFs are mostly classified as operational performance level zero (0) and two (2) of corresponding effectiveness of MW. This implies that most aspects of effectiveness of medical waste are yet to be adopted in all the studied HCFs and referred to as unsustainable practices. There is no doubt that the present management practices for medical waste generated at the studied health-care facilities is ineffective and should not be relied upon to protect human health and environmental integrity. Based on the result and conclusion of this study, its recommended that the health-care facilities management commitment should be aimed at disseminating proper knowledge and rising awareness on medical waste operation procedure to staff in order to avert from risk associated with types and categories of medical waste generated.

There is need for periodic / regular training and capacity building of staff on proper handling and standard methods (techniques) of current medical waste management (i.e. segregation and collection through disposal), adequate provision of personal protective devices, occupational health and safety measures, total overhauling of impediments on effectiveness of medical waste management and quantification and record keeping of a daily medical waste generated.

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