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Circular Economy and Waste Management Actions during the COVID-19 Pandemic in Nigeria

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ABSTRACT

Background: Circular economy is gaining global acceptability, and its practice is rather poor in Nigeria similar to other developing countries. COVID-19 pandemic has caused enormous amounts of hazardous wastes, which require special attention. The present study aimed to assess circular economy and waste management actions during the COVID-19 pandemic in Nigeria.
Methods: Data were collected using quantitative and qualitative methods and analyzed to determine the challenges of hazardous waste management in Nigeria by two notable healthcare centers in Ilorin as the cases. In total, 204 questionnaires were distributed among the staff, and 202 (99%) were returned.
Results: The respondents were 102 men (50.5%) and 100 women (49.5%) with various disciplines, including health workers (n=104; 51.5%), maintenance staff (n=42; 20.8%), and cleaners/waste handlers (n=56; 27.7%). The majority of the subjects (97%) believed that COVID-19 wastes should be segregated, while 111 subjects (55%) rated the management of personal protective equipment to be appropriate during the pandemic.
Conclusion: According to the results, the implementation and enforcement of national policies regarding solid waste management are essential through the training and retraining of staff on hazardous waste management in the studied healthcare centers.

1. Introduction

The traditional linear economy of manufacturing, use, and disposal is prominent in Nigeria most likely due to the lack of the enforcement and implementation of legislative frameworks for solid waste management (SWM). Medical wastes are a specific waste category, which requires special attention and effective techniques of management. Hazardous waste management minimizes possible harmful effects on the human health and environment through proper techniques of handling, storage, transportation, treatment, and disposal [1].

Currently, Nigeria has an estimated population of 200 million in 36 federating states and is operationally divided into six geopolitical zones. Nigeria has been classified as a lower-middle-income country by the World Bank and has the largest economy in Africa [2]. Based on population and per capita generation rate (0.5 kg/capita/day), the output of solid wastes in this country is over 35 million tons per annum. The models used to predict waste generation have suggested that Nigeria will have produced 54.8 million tons

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of solid waste by the year 2030.

In the cities across Nigeria, solid waste is disposed by transportation and discharge in open dumps, which are generally located on the outskirts where the nuisance level of these disposal sites to humans is minimal. In the urban areas of the country, home, industrial, and other wastes (low/medium) have become a perennial problem as they continue to cause environmental pollution and degradation. Solid Waste Management (SWM) is a public health service, the value of which often becomes more evident after widespread service deficits [3]. Poor waste management systems coupled with a hot climate increase the associated environmental problems and lead to significant local and global consequences [4].

The most common issues associated with the improper management of solid waste include disease transmission, risk of fire, odor pollution, atmosphere and water pollution, aesthetic pollution, and economic losses [5]. Presently, open dump systems are among the major threats to health and environmental aesthetics, while they also contaminate natural resources and increase the risk of fire outbreaks, pollution of rivers and underground facilities by leachate, and other grave health issues [6, 7]. Moreover, open dump systems have greatly contributed to climate change through anaerobic decomposition, thereby leading to methane emission and impacting the quality of life of citizens.

The accompaniment of SWM by a public health emergency such as the Coronavirus disease 2019 (COVID 19) pandemic further highlights the importance of these services to the authorities [8]. COVID-19 is a disease caused by a new strain of coronavirus that had not been previously identified in humans, which was declared a global pandemic in February 2020 and immediately caused monumental challenges. The disease has also taken its toll on Nigeria, and the efforts to contain the outbreak and prevent the spread of the coronavirus in this country have entirely been directed toward testing, isolation, and treatment centers/facilities with insufficient attention to the produced hazardous wastes and their management [9].

In response to the COVID-19 pandemic, hospitals, healthcare facilities, and individuals have been producing more waste than usual, including masks, gloves, and other protective equipment that may be infected with the virus [10]. When these wastes are not managed safely, infected medical wastes could be subject to uncontrolled dumping, which in turn increases public health risks, while their open burning or uncontrolled incineration could lead to the release of various toxins. While SWM is an important sanitary barrier to disease prevention [11], uncollected solid waste in cities is a major cause of disease transmission.

Critical observations have indicated that the SWM status in Nigerian cities in terms of the collection, recycling, and disposal has invariably become riskier to waste handlers following the outbreak and spread of COVID-19 over the past few months [12]. Although numerous guidelines and advisories (e.g., travel advice and advice for health workers) have been issued, there have been none regarding the management of municipal solid waste arising from the COVID-19 lockdown and restrictions, as well as COVID-19 wastes, which might escape the necessary protocols in private hospitals in the handling of such wastes.

The irregular clearance of COVID-19 medical wastes in various hospitals poses a significant threat to the spread of the COVID-19 viral infection, which is associated with the renewed spread of the virus in and around hospitals during the current pandemic due to inefficient management. Where appropriate, countries should monitor COVID-19 wastes by optimizing the available waste management technologies avoiding potentially long-term environmental impacts at the same time [10].

According to Aremu *et al.* (2020), the waste management standards in this regard have been poor and outdated, and the methods of waste storage and collection during the current pandemic have mostly been inefficient, with no proper documentation of waste generation rates or waste composition. Municipal wastes are disposed with toxic and hazardous wastes as these wastes are dumped indiscriminately and lead to an inefficient economy. For a circular economy, it is essential to recycle materials from waste to closing the loop. In addition, energy recovery from waste plays a key role in ensuring a proper and safe waste management system. Waste disposal should be phased out and if inevitable, effectively managed to ensure that it is safe for the human health and environment [13]. Figure 1 shows the unsegregated solid wastes in a hospital environment during the COVID-19 pandemic.

Figure 1; Unsegregated solid waste disposal during covid-19 pandemic in hospital premises

Nigeria has a growing concern regarding the circular economy resulting from factors such as the lack of a legislative framework to control unsafe waste management practices and inadequacy of the existing infrastructure to properly manage the amount and types of produced wastes [2]. The core issue of SWM in the country is attributable to the non-implementation of the existing laws and legislations, need for the upgrade of obsolete legal instruments, inadequate budgetary provisions and funding mechanisms, and poor monitoring and evaluation mechanisms to guide environmentally safe SWM practices [14].

The Nigerian policy on SWM encompasses the executive, legislature, and judiciary at the federal, state, and local government levels. The policy outlines the key sources of solid waste in Nigeria so that the segregation, collection, transportation, storage, treatment, and disposal of waste are carried out to provide protection for the environment and human health in compliance with legal requirements. In Nigeria, the Senate Committee on the Environment and Ecology and the House Committee on the Environment at the Federal level are the institutional frameworks within the legislature responsible for the policy and regulatory matters on solid waste and the environment. Both these committees play important roles in enacting appropriate legislation to foster the successful implementation of policy guidelines and action plans [14].

A Waste Management Legislation was enacted in 2018 and released in 2019 to kick-start the operation of a structured circular economy in Nigeria. The compliance and enforcement of the policy paper were to follow the Federal Government of Nigeria 5R's hierarchy for SWM (reduce, repair, reuse, recycle, and recover). The policy encompasses the protection of environmental standards, enforcement of regulations and legislation, compliance with international treaties, and standards. Therefore, Nigeria must move into a more circular economy by mainstreaming its principles and practices into local, state, and national road maps for a sustainable transition from a linear to a circular economy, the implementation of which seems crucial at this point [14].

Nigeria practices circularity in certain aspects of life, including micro-level involvement in household waste reduction and reuse strategies and the involvement of informal markets as waste scavengers, merchants, and recyclers. Material recovery facilities have also been established in some areas to recover valuable resources from wastes by local authorities or recyclers; such example is the waste-to-wealth initiative setup by the government of some states, such as Lagos, Ogun, Oyo, Ekiti, and Osun. Notably, circularity is still not widespread in the country for a significant impact [2].

COVID-19 is globally new and has been declared a pandemic by the World Health Organization (WHO), management of such hazardous waste needs special attention and actions hence, this study was conducted to solve human problems, measured with numbers with use of questionnaires and analyzed using statistical techniques with the aim of evaluating circularity and management actions during the pandemic in Nigeria.

2. Materials and Methods

This study was conducted in 2020 at the University of Ilorin Teaching Hospital (UITH) and Kwara State Specialist Hospital as the COVID-19 isolation facilities in Ilorin, Kwara State, Nigeria with a focus on the recognition of the challenges in the management of such category of waste. Data collection was performed using quantitative and qualitative methods and a checklist [15]. Questionnaires were distributed among the healthcare providers, maintenance staff, and cleaners/waste handlers of the health facilities in accordance with Creswell 2009. The checklist included sections on COVID-19 healthcare wastes (identification, characterization, and segregation at the healthcare facilities), emergency preparedness and response, safety, health, and environment. The qualitative approach was attained through field observations and key informant interviews

A set of semi-structured questionnaires was used to collect data on the management and disposal of COVID-19 wastes, perception of medical wastes during the COVID-19 pandemic, and other technical questions in this regard. Simple random sampling was performed for the distribution of the research tool among the hospital staff (medical and healthcare workers) and maintenance staff (ward attendants, cleaners, waste handlers, incinerator operators, and cleaning supervisors). In total, 204 questionnaires were distributed; 150 of them were at the UITH and 54 questionnaires were at the isolation center in Sobi. A total of 202 questionnaires were returned.

2.1. Statistical Analysis

Data collected from the surveyed COVID-19 isolation facilities were cleaned, edited, and frequency tables were generated for the presentation of the results in SPSS version 20.0 (IBM Statistical Package for the Social Sciences 20.0) for the presentation of the results [15].

3. Results and Discussion

3.1. Kwara State COVID-19 Center and Infectious Waste Management

Table 1 shows the biodata of the respondents: 114 of 202 (56.4%) were aged between 20-40 years of age while 88 of 202 (43.6%) were aged between 41-60 years. 102 of 202 (50.5% were male while 100 of 202 (49.5%) were female.

Table 2 comprised of technical questions on respondents' discipline, rating of solid waste before COVID-19, questions

Table 1: Biodata

Characteristics		N	%
Age of Respondents (year)	20-40	114	56.4
	41-60	88	43.6
Gender	Male	102	50.5
	Female	100	49.5

Table 2: Technical questions

Characteristics	N	%
Discipline		
Healthcare Worker	104	51.5
Maintenance Staff	42	20.8
Cleaner/Waste Handler	56	27.7
Rating of Solid Waste before COVID-19		
Poor	60	29.7
Good	128	63.4
Very Good	13	6.4
Excellent	1	0.5
Is the needed attention paid to the disposal and management of PPE in this period?		
Yes	198	98.0
No	4	2.0
How would you rate the disposal and management of PPE before COVID-19?		
Poor	53	26.2
Good	122	60.4
Very Good	26	12.9
Excellent	1	0.5
Do you think COVID-19 wastes should be separated from other solid wastes?		
Yes	196	97.0
No	6	3.0
Do you use more PPE during COVID-19 than before the pandemic?		
Yes	191	94.6
No	11	5.4
Do you buy PPE with your own money?		
Yes	41	20.3
No	161	79.7
How would you rate the disposal and management of the used PPE during COVID-19?		
Poor	24	11.9
Good	111	55.0
Very Good	54	26.7
Excellent	13	6.4
Are the current waste management practices effective to prevent the spread of COVID-19?		
Yes	161	79.7
No	41	20.3
Do you pay more attention to the disposal of your used PPE now than before COVID-19?		
Yes	198	98.0
No	4	2.0
Is there provision for separate waste bins for the disposal of COVID-19 wastes?		
Yes	112	55.4
No	90	44.6
Can COVID-19 spread through solid waste?		
Yes	193	95.5
No	9	4.5
How often is the solid waste generated in your workplace taken away for disposal?		
Twice Daily	50	24.8
Daily	146	72.3
Every Two Days	5	2.5
More than Two Days	1	0.5

on attention paid to the disposal and management of Personal Protective Equipment (PPE) during and before COVID-19, separation of COVID-19 hazardous waste from other solid wastes, extent of use of PPE during the pandemic, and whether PPE was purchased from personal purse.

Nigeria confirmed its first case of COVID-19 in the Lagos state on the 25th of February 2020 through an Italian citizen who worked in Nigeria, and the number of the confirmed cases increased to 84,414, with 71,034 discharged patients and 1,254 deaths as of 28th December 2020 [16].

The Kwara state reported its first recorded case on the 6th April 2020, and the figure rose to 1,379 confirmed cases and 1,094 discharged patients by 28th December, along with 31 deaths [16].

In Nigeria, the infected patients are quarantined at the Kwara State Specialist Hospital isolation center in Sobi, which is located in the state capital. However, the UITH is the largest tertiary hospital in the state and encounters suspected cases that are eventually confirmed at the diagnostic center. The state has various measures in place to contain the pandemic and manage its highly infectious medical wastes.

The findings of the current research in two study areas revealed that both areas have double chambered incinerators for handling hazardous wastes, while the UITH incinerator has broken down and cannot function for a while. Therefore, the waste handlers must resort to the open burning of all the wastes emanating from the hospital. In addition, neither of the study areas segregates wastes, and all the wastes produced by the isolation centers w ere treated as infectious waste and end up for incineration at the incinerator site.

4. Conclusion

This study aimed to assess the circular economy and challenges in the management of COVID-19 wastes at two prominent centers during the current pandemic in the Kwara State, Nigeria. According to the results, there are considerable inadequacies in the management of such hazardous wastes. The two areas practice linear economy and use double chambered incinerators for final waste disposal, while the incinerator of the UITH does not function currently. Majority of the respondents (60.4%) rated the management of used COVID-19 PPE as good, 94.6% agreed to more quantity of used PPE during the pandemic than before, some (20.3%) use their personal money to provide PPE for their own safety, 79.7% believe current waste management practices are effective in preventing COVID-19 spread, majority (98%) pay more attention to used PPE than before, 44.6% reported no separate waste bins were provided for COVID-19 wastes.

From this study, the respondents seem to be aware of dangers that may emanate from mismanagement of this category of waste, however, health care providers have to do more in provision of adequate PPE and management of same when used in accordance with the policy enacted in 2018.

Research Implications

• Implementation and enforcement of 2018 National Policy on Solid Waste Management.
• Handing waste as raw materials for other innovations (zero-waste)
• Capacity building on medical waste management occasionally among healthcare workers

Authors' Contributions

O.A.M., designed the study and performed the statistical analysis; R.S.T., designed the questionnaire and collected the data. The authors read and approved the final manuscript.

Conflicts of Interest

The Authors declare that there is no conflict of interest.

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