

MANAGEMENT OF BIOMEDICAL WASTE: A CRITIQUE OF NIGERIA'S WASTE MANAGEMENT POLICY

EJEKWU SAMUEL SONI EZEBUNWO

School of Public Health, University of Port Harcourt, Rivers State, Nigeria

&

DR OBINNA OLERIBE

School of Public Health, University of Port Harcourt, Rivers State, Nigeria

Abstract

This study hinges on the management of biomedical waste with a critique of the waste management practices in Nigeria. The study classified biomedical waste into ten categories based on the World Health Organisation categorization. They include human anatomical waste, animal waste, microbiological waste and biotechnology waste, discarded medicine and cytotoxic waste, soiled waste, solid waste, liquid waste, incineration ash, and chemical waste. The study identified the dangers of mismanagement of biomedical waste to include: disease-causing microbes, medical sharps, and hazardous substances from biomedical waste can infect healthcare workers, patients, the general public, and the environment, to be more specific. Human and environmental consequences of improperly handled biomedical waste include radiation burns from radioactive waste, sharp-inflicted injuries, poisoning and pollution from pharmaceutical goods, waste water, and toxic elements like as mercury. As such, inadequate management of waste poses major public health risks, ranging from the transmission of endemic parasitic infections to the development and re-emergence of new zoonoses as a result of direct or indirect impacts of poor waste management. The study recommended that the development of integrated policies on waste sorting, reuse, recycling, and disposal should be one essential aspect of the policy and the framework for adequate provision of waste collection, transportation, and disposal facilities. Also, a unified policy on biomedical waste management should be implemented across all states of the federation to ensure the smooth disposal of medical waste across the country.

Keywords: Biomedical Waste; Waste Management; Recycling; Biomedical Waste Management.

1.0 Introduction

Waste is any material or substance that must be disposed of due to being damaged, worn out, polluted, or otherwise spoiled and hence no longer usable (Nwosu and Chukwueloka, 2020). It may be liquid or solid, and it could be dangerous. These categories include waste or refuse from houses and other areas where humans or animals reside. The issue of waste management is a pressing one in Africa's emerging countries, notably Nigeria. Waste management is the implementation of procedures to assure the orderly execution of the functions of waste collection, transportation,

processing, treatment, and disposal (Onu, Price, Surendran, and Ebie, 2012). The growing worldwide concern about environmental health necessitates waste management and disposal in the most environmentally friendly and acceptable manner (Afun, 2010). In Nigeria, waste has become a major concern (Onuet *al.*, 2012). Waste piles are frequently found near highways, rivers, and many other open places in cities, generating serious health and environmental issues (Imamet *al.*, 2008).

Healthcare Waste, commonly known as Biomedical Waste (BMW), is the second most dangerous type of waste after nuclear waste. People with various types of infections go to the hospital for care where treatment materials and equipment that are referred to as BMW are generated after usage. A significant proportion of hospitals, particularly in developing countries, fail to handle BMW appropriately, putting lives in danger. Hospitals, primary healthcare centers (PHCs), dispensaries, dialysis centers, first-aid posts and sick bays, medical and biomedical laboratories, biotechnology laboratories, medical research centers, mortuary and autopsy centers, blood banks and blood collecting centers, nursing homes for the elderly, maternity homes, pharmaceutical, chemical, and chemist stores are all sources of medical waste.

Medical waste management (MWM) has been regarded as inadequate in underdeveloped nations, with a widespread lack of understanding of associated concerns among generators and handlers (Uche, 2016). Despite the fact that healthcare waste is classified as hazardous due to the substantial direct threat it presents to human health (WHO, 1999), inadequate MWM continues to be a problem in developing nations such as South Africa, Nigeria, Mozambique, Kenya, and Tanzania (Uche, 2016). According to a 2018 study done in 22 poor nations, 18 to 64 percent of health care facilities (HCF) do not employ suitable waste disposal techniques (WHO, 2002). In general, the most common problems associated with MWM in developing countries such as Nigeria are a lack of awareness about health hazards, poor management practices, insufficient financial and human resources, and poor waste disposal control.

Although significant research has been done on waste generation, segregation, and disposal, there has been minimal focus on raising awareness of the hazards connected with medical waste and the need for staff safety in rural and semi-urban areas. There is now a knowledge and practice gap among health professionals that have to be filled not only for the study region but also for the entire continent. Manyele, Anicetus and Bilia (2003) indicated that developed nations acknowledged poverty as a primary element that hampered the effectiveness of African initiatives in the field of ecologically sound management of hazardous waste. According to the Federal Environmental Protection Agency (FEPA), currently known as the National Environmental Standards and Regulations Enforcement Agency (NESREA), medical waste in Nigeria falls under the category of infectious waste (FEPA, 1991).

Rather than being discarded with the rest of the garbage, this form of waste needs specialized handling. Various authorities have speculated that medical waste disposal in Nigeria has gotten little attention, despite the fact that it merits it.

Health risks from inadequate MWM harm not just the residents of the HCF, but also those in the surrounding area. Medical waste is simply combined with public waste and disposed of in collection containers along roadsides, while some are just buried without any precautions. According to Uche (2016), government hospital waste is still mostly deposited in the open, waiting to be collected alongside ordinary waste. A similar practice is found when borrow-pits (pits where sand is gathered during the construction of express motorways) are used as common dumpsites of general wastes, including health-care wastes, without being treated or having any consideration for the safety of the people. The following are the environmental consequences of poor waste management: Underground water contamination from waste dump (leachate), surface water contamination from waste dump run-off, generation of flammable gases (e.g., methane) inside the waste dump, stale air, pests, rodents, and wind-blown litter in and around the waste dumps, acidity to the surrounding soil, and greenhouse gas emissions. All of this necessitates focus and uniformity if excellent health is to be attained and maintained at all times (IPHI, 2005).

Thus, the objectives of this research are to (a) examine existing waste management policies in Nigeria; (b) Impacts of poorly managed biomedical waste; (c) Critique of Nigeria's Waste Management Policy

2.0 Conceptual review

What is biomedical waste?

Biomedical waste is defined as any material or substance created by medical entities that have outlived its usefulness. Biomedical waste is generated in a variety of settings, including clinics, hospitals, nursing homes, labs, and mortuaries. Surgical sharps, expired units of blood, laboratory cultures, broken glass, saws, nails, blades, scalpels, packing material, paper, wrappers, plastics, and other items are examples of biomedical waste.

Classification of biomedical waste

Biomedical waste is divided into two categories: hazardous health care waste and non-hazardous health care waste. This categorization is based on the infectiousness of the wastes.

Non-hazardous healthcare waste: These are biomedical wastes that aren't contagious and hence have a lower impact on humans and other living things. According to the WHO, this group accounts for 80% of the waste created in medical facilities (WHO, 2011). Despite the fact that this type of waste is not contagious, improper disposal can have significant consequences for the environment. The main disadvantages include

contamination of the environment and blockage of drainage systems; certain animals also swallow some of these materials, which can be poisonous to their systems; biodegradation of soil; sharps-inflicted injuries among scavengers and healthcare personnel; pollution of subterranean water from leachates; bad odour from dumpsites; air contamination from toxic gases; and, most critically, the presence of dangerous compounds at various tropic levels. Wearing scrubs, bed linens, food discarded from wards, nylons, and other non-infected things fall into this group. Non-infectious waste disposal requires less attention than infectious waste disposal. Most non-hazardous wastes, for example, do not need treatment, protective equipment for waste workers, or particular caution in waste segregation and transport. Non-infectious wastes, on the other hand, are often disposed of in regular waste dumpsites and burned together. In comparison to infectious biomedical waste, non-hazardous biomedical waste poses no danger of infection to healthcare professionals or disposal site scavengers.

Hazardous health-care waste: The World Health Organization estimates that 20% of the biomedical waste produced is hazardous (WHO, 2011). Because biomedical wastes in this classification are potentially or highly infectious, inappropriate management and disposal might result in infection among healthcare workers, patients, and scavengers at dumpsites. High-income nations create roughly 0.5kg of hazardous waste per bed every day, whereas lower-income countries produce about 0.2kg (WHO, 2011). Low-income nations, on the other hand, do not distinguish between hazardous and non-hazardous wastes; instead, they are all mixed together, increasing the volume of hazardous waste. Hazardous healthcare wastes, particularly within healthcare facilities, act as important sources or reservoirs for contagious diseases. The majority of nosocomial infections, such as staphylococcal and pseudomonas infections, are the consequence of inappropriate hazardous biomedical waste management. Contagious infections do not just occur in hospitals; scavengers and individuals living near garbage sites can also be impacted. Radiation burns from radioactive waste and injuries from medical sharps such as needles are two further health risks. Wastes from laboratories, such as blood and urine samples, are frequently found to be the most infectious among others in most Nigerian hospitals; this is owing to the prevalence of harmful microbes in laboratory samples.

Categories of biomedical waste

Hazardous health care waste is classified into 10 categories based on the location of production or the waste component. The WHO's classification of biomedical waste is shown in the table below.

Table 1: Classification of biomedical waste

Waste Category	Type of waste
Category 1	Human anatomical waste
Category 2	Animal waste
Category 3	Microbiological waste and Biotechnology waste
Category 4	Waste sharps
Category 5	Discarded medicine and Cytotoxic waste
Category 6	Soiled waste
Category 7	Solid waste
Category 8	Liquid waste
Category 9	Incineration Ash
Category 10	Chemical waste

Source: WHO website

Biomedical waste management

The correct disposal of waste materials created by a medical entity in such a way that it has no detrimental impact on persons or the environment is known as health care waste management (Yadavannavar, 2010). Depending on the contents of the waste and its physical features, different types of waste have varied disposal techniques. As a result, implementing the appropriate course of action for various types of garbage will enhance individual well-being as well as a healthy environment.

3.0 Waste Management Policy in Nigeria

Local governments in Nigeria are responsible for the collection of waste. The provision and maintenance of public convenience, sewage, and garbage disposal are delegated to local governments under paragraph (h) of the fourth schedule of the Nigerian 1999 Constitution. In several states, the state government has enacted other edicts or laws that are in violation of the constitution in addition to this provision. These laws either aim to delegate this job entirely to the state government or create specific areas of jurisdiction that strip local governments of their authority (Ayotamuno, 2004).

The discovery of toxic waste deposited by a foreign firm at Koko village near Warri in Delta State, Nigeria, in 1987 prompted the formation of the Federal Environmental Protection Agency (FEPA) in 1988. The Federal Government of Nigeria established the Ministry of Environment in June 1999, and as a result, FEPA's functions were absorbed by the new ministry. The Federal Ministry of Environment has in place the following intervention mechanisms to address the problem of environmental deterioration, including waste management, as specified in (1) the revised environmental policy of 1999 and (2) the National Agenda 21 (1999). These instruments augment Nigeria's existing environmental pollution control guidelines

and standards, as well as other regulations dealing with effluents, industrial pollution, waste management, and environmental impact assessment (Federal Ministry of Environment, 2003). The waste management regulation S.1.9 of 1991 and the Environmental Impact Assessment (EIA) Decree No. 86 of 1992 are two of FEPA's directives in the fight against environmental deterioration (FEPA, 2003).

Federal Environmental Protection Agency's policies govern the collection, treatment, and disposal of waste from industrial and urban sources, and it requires an Environmental Impact Assessment (EIA) for each large development project that has the potential to harm the environment (FEPA, 2003). There is also a 1997 environmental cleaning edict that states that every last Saturday of the month, Nigerians should clean the environment for three hours (7 am–10 am) (FEPA, 2003). The Federal Government of Nigeria developed a national environmental strategy in 1989, which offers a broad framework for environmental management in Nigeria as well as sustainable waste management.

3.1 Critique of Waste Management Legislations, Regulations, and Policy Administration in Nigeria

Nigerian waste management policy encompasses laws, guidelines, regulations, and waste control administration. Environmental legislation has been enacted to address a wide range of environmental hazards, including harmful substances and noise (Eneh, 2010). Nigerian environmental laws are divided into three categories: framework environmental legislation, sectoral legislation, and incidental legislation. The Harmful Wastes Act of 1988, the Federal Environmental Protection Agency (FEPA) Act of 1988, the Environmental Impact Assessment (EIA) Act of 1992, and the National Environmental Standards and Regulations Enforcement Agency (NESREA) Act of 2007 are examples of such laws. The FEPA Act was abolished by the NESREA Act, and NESREA is now in charge of implementing all environmental laws, guidelines, policies, standards, and regulations in Nigeria. It is also responsible for enforcing the requirements of international accords, conventions, protocols, and treaties on the environment (Anukam, 1997).

Nigerian environmental policy is aimed at achieving sustainable development in the country and, in particular, at securing Nigerians environment ensuring that it is adequate for health and well-being; to conserve and use the natural environment and resources for the benefit of present and future generations; to restore, maintain and enhance ecosystems and ecological processes essential for the functioning of the biosphere and to preserve the biological diversity of the nation; to raise public awareness and promote the better understanding of essential links between environmental improvement efforts; and to co-operate with other countries, international organizations and agencies to achieve optimal use of trans-boundary natural resources and effective prevention or abatement of trans-boundary environmental pollution (Eneh, 2010).

In poor nations, like Nigeria, conventional techniques to urban waste management adopted by development organizations and foreign donor agencies frequently fail. Traditional approaches often use centralized and undiversified solutions that fail to account for the diverse demands and uniqueness of Nigerian cities. They are bureaucratic in nature, focusing primarily on the formal sector and disregarding the informal economy (Ogwueleka, 2009). The current waste management policy imposes high fees for waste disposal, with harsher penalties ranging from 20,000 Naira to 50,000 Naira for indiscriminate dumping of waste without proper treatment, and fails to provide sufficient economic incentives and an enabling environment for proper waste treatment and disposal (NESREA, 2009). The existing disposal charges, as well as the lack of sustainable waste disposal choices, are likely key drivers to Nigeria's current spread of illegal trash disposal. The NESREA Act of 2007 fails to take into account the substantial economic and settlement differences that exist within Nigerian cities. Waste fines and surcharges based on the polluter pays concept are considered laudable from the standpoints of environmental justice and economic efficiency. However, experts have shown that using the polluter pays concept in situations where there are significant economic and settlement inequities is likely to result in inadequate provision of environmental services (Onuet *al.*, 2007).

Many Nigerian policies are disjointed, such as the many pieces of law and regulations enacted under the NESREA Act of 2007. This method supports fragmented implementation procedures, which waste time, money, and promote corruption, rather than the normally successful and time-saving one-top table implementation model (Eneh and Agbazue, 2011).

Table 1: Legislation and Regulations under the NESREA Act 2007

.	National Environmental (Permitting and Licensing Systems) Regulations, 2009
.	National Environmental (Watershed, Hilly, Mountainous and Catchment Areas) Regulations, 2009
.	National Environmental (Pollution Abatement in Chemicals, Pharmaceuticals, Soaps and Detergent Manufacturing Industries) Regulations, 2009
.	National Environmental (Noise Standards and Control) Regulations, 2009
.	National Environmental (Sanitation and Wastes Control) Regulations, 2009
.	National Environmental (Ozone Layer Protection) Regulations, 2009
.	National Environmental (Wetlands, River Banks and Lake Shores Protection) Regulations, 2009
.	National Environmental (Pollution Abatement in Food, Beverages and Tobacco Sector)

- . Regulations, 2009
- . National Environmental (Pollution Abatement in Textiles, Wearing Apparel, Leather, and Footwear Industry) Regulations, 2009
- . National Environmental (Access to Genetic Resources and Benefit Sharing) Regulation, 2009
- . National Environmental (Pollution Abatement in Mining and Processing of Coal, Ores and Industrial Minerals) Regulations, 2009

Source: NESREA (2009)

Nwafor (2006) noted that while policies were being created, the public had little comprehension of the environmental policies, and there was no mass environmental education and awareness development towards a sustainable environment. There is a dearth of public engagement in policy design and execution. Similarly, the World Bank (2019) said that waste and environmental standards were established without the use of locally created baseline data, which is typically unavailable in developing countries, but rather using modified World Health Organization recommendations and standards. When these statistics are transferred between nations without taking into account socioeconomic and climatic variables, they fail.

Electronic waste is common in Nigeria, thanks to globalization driven by information and communication technologies (ICTs) and the Nigerian government's efforts to adopt ICTs as a means of bridging information gaps and marginalization in the global market system. Worse yet, electronic waste is discarded and disposed of in environmentally unfriendly ways. (Eneh, 2011). Nigeria, on the other hand, lacks an electronic waste recycling or waste management policy that is both operational and sufficiently enforced by regulatory bodies. Similarly, in Nigeria, strategic environmental assessment, which involves applying environmental impact assessment (EIA) concepts to policies, plans, and programs, has yet to be made mandatory (Nwafor, 2006). Nigeria has a lot of policies; however, they aren't implemented well. Corruption wreaks havoc on even the best-intended policies in Nigeria, wasting resources that could have been used to create them (Eneh, 2011).

3.1.1 Legislation and policies on biomedical waste management in Nigeria

Hazards linked with biomedical waste are well-known, and they have the potential to endanger human health. Several developing countries and international organizations have introduced and enforced guidelines, laws, regulations, and standards for the management of biomedical waste in order to prevent such a threat to human health and the environment. These standards and regulations might be implemented at the global, national, state, regional, and local levels.

According to several sources, Nigeria lacks a standard for biomedical waste disposal. Nigeria lacks healthcare waste management strategies, placing its inhabitants in

danger of contracting blood-borne infections (Soyande, 2008). According to Soyande (2008), the government has collaborated with the ministries of environment, health, and other non-governmental groups to create three essential publications. These are healthcare waste management standards, policies, and strategies for implementing healthcare waste management (Soyande, 2008). This was a project that was initially proposed in 2002 and has yet to be finished.

Lagos State, one of Nigeria's most developed states, stood out as the only state having a defined standard healthcare waste management system designed by the state government. The Lagos State Waste Management Authority is responsible for this (LAWMA). After detecting inappropriate waste management in hospitals and labs, LAWMA established the healthcare waste management program (HCWM) in 2006. LAWMA served 2,900 healthcare locations in 22 local governments in June 2012. According to recent statistics, 435 tons of biomedical waste were treated before disposal in Lagos State. The most successful approach of advertising the Lagos state Biomedical Waste Management program was determined to be the free delivery of colored bins for waste segregation and safety boxes to healthcare facilities. In order to assure the program's efficacy, further efforts were implemented. This comprises healthcare worker training sessions, effective monitoring and implementation, an annual medical symposium with stakeholders, and rigorous infectious waste control regulations (LAWMA, 2011).

Individual hospitals, on the other hand, are likely to have their own set of waste management rules. But, more importantly, do these regulations match the requirements of developed-country waste management systems? Do these policies address the issues of disease incidence and contamination in the environment? The apparent response to these questions is "NO." As a result, it is the government's job to establish a national standard, rules, and legislation for all accredited hospitals in the country, or to modify the LAWMA plan for specific states.

3.2 Impacts of poorly managed biomedical waste on the environment and health

There are various risks associated with biomedical waste that is not adequately handled. Chemical, physical, or biological risks might be present. Disease-causing microbes, medical sharps, and hazardous substances from biomedical waste can infect healthcare workers, patients, the general public, and the environment, to be more specific. Human and environmental consequences of improperly handled biomedical waste include radiation burns from radioactive waste, sharp-inflicted injuries, poisoning and pollution from pharmaceutical goods, waste water, and toxic elements like as mercury ((Karshima, 2016).

Individuals who create infectious healthcare waste, such as physicians, as well as those who are responsible for managing the waste or are exposed to it as a result of incorrect management and treatment, are all potentially at risk. High-risk individuals

include healthcare staff such as nurses, lab technicians, and physicians, as well as patients, waste handlers, and scavengers. These persons may become infected by skin puncture and other breaches, mucous membranes, inhalation, ingestion, and vector transfer (Ekaete, 2010).

According to WHO figures, there are around 8 to 16 million new instances of hepatitis B virus (HBV), 2.3 to 4.7 million cases of hepatitis C virus (HCV), and 80,000 to 160,000 cases of human immunodeficiency virus (HIV) as a result of improper handling of injections and other medical wastes (Ekaete, 2010). Arboviral infections, Brucellosis, Creutzfeldt-Jakob disease, Hepatitis C, Leptospirosis, Malaria, Rabies, Syphilis, Tularemia, and Viral Hemorrhagic Fevers are among the diseases caused by inappropriate biomedical waste disposal (Karshima, 2016). Bacteria resistant to antibiotics and chemical disinfectants may also add to the dangers caused by improper waste management (Joshi, 2014).

Chemical compounds and cytotoxic wastes are known to be extremely genotoxic, corrosive, flammable, and volatile, and they can harm people's health through short-term or long-term exposure, as well as injuries such as punctures. When it comes to the environmental implications of biomedical waste, poor disposal can encourage biodegradation of soil, putting aquatic life in danger, as well as contaminating subterranean water. However, waste treatment has environmental consequences, such as the emission of harmful gases during incineration and combustion.

4.0 Discussion

In light of Nigeria's current waste management situation, it is certain that waste creation would continue to rise over time. In order to create suitable policy responses, accurate information on the actual volume of waste generated is required, as well as an understanding of the scope and intensity of the problem. Waste must constantly be sorted at the source to segregate recyclable elements and limit the quantity of waste that must be collected and disposed of (Imamet *al.*, 2008).

This study found that illiteracy, insufficient government oversight, and legislation are the root causes of poor waste management and policy implementation in Nigeria; current guidelines are not implemented, and there is no clear demarcation of responsibility for waste management. The waste management challenge is additionally exacerbated by a lack of public knowledge and poor environmental education, as well as the associated behavior. To remedy the situation, communities, the volunteer sector, official waste collectors, and authorities must work together to raise recycling rates, which will reduce the amount of residual waste that has to be collected and disposed of, lowering the cost of the formal waste management system (Imamet *al.*, 2008).

One of the major causes of inadequate waste management in Nigeria is a lack of financing. As a result of this circumstance, most Environmental Protection Agencies

in the nation have been compelled to hire cars and keep a small staff on a permanent basis (Ogbonna *et al.*, 2007). Due to a lack of finance, Nigerian environmental organizations lack the capacity to handle the growing amount of solid waste. Poor morale among environmental protection agency employees as a result of low pay and stagnation in advancement is impairing the country's waste management (Ogwueleka, 2009). The poor placement, construction, management, and maintenance of dumps sites, as well as insufficient onsite storage facilities and landfills, raised the cost of transfer and disposal (Dauda and Osita, 2003). Most government efforts in Nigeria to solve the problem have been hampered by a lack of expertise and staff to run waste management programs; the majority of environmental agency workers have little or no functional background or training in engineering and management, resulting in ineffective and inefficient waste management operations (Ogwueleka, 2009).

The ineffective waste collection in Nigeria is exacerbated by the settlement layout, the presence of slums, the city network, traffic congestion, and small roads. The poor state of roads and infrastructure has resulted in waste collection vehicles breaking down on a regular basis. Most cities with poor road conditions have slums and squatter communities. It is difficult for environmental agencies to cover certain regions as a result of this (Ogwueleka, 2003). Compactor trucks, which are scarce, costly, and difficult to repair, are utilized in several Nigerian cities. Compactor trucks are made to handle waste with a low density. Most poor nations' wastes, such as Nigeria's, include substantial amounts of organic matter and have a high density, making compaction unnecessary since the weight of the waste component would impact the size of the equipment and the amount of energy required (Ogwueleka, 2003).

Beyond the unattractive aesthetics and unpleasant odors, indiscriminate waste disposal is hazardous to local communities in a variety of ways. Uncontrolled waste disposal especially biomedical waste poses a number of health risks. Waste dumps serve as breeding grounds for insects, rodents (rats), and dangerous germs carried by disease vectors such as mosquitoes, cockroaches, and houseflies. As a result, illnesses such as malaria, cholera, and diarrhea are spreading (Ogwueleka, 2009). medical sharps, glass and metal wastes cause wounds and infections, particularly among youngsters who frequently play in open places near the waste and among scavengers looking for recoverable items (Al-Khatib *et al.*, 2007). Individuals and those at open dumpsites commonly burn uncollected waste, which has the tendency to aggravate respiratory troubles such as asthma and can release toxins such as dioxin into the environment. Furthermore, seepage from waste leachate can contaminate local land, subterranean, and surface water bodies, which are important in most Nigerian communities that rely solely on these sources of water (Adegoke, 2006). Indiscriminate waste disposal has substantial economic consequences, such as lowering property prices and rendering open places useless, as well as producing

eyesore for tourists, which may affect the country's tourism earnings (Ogwueleka, 2009).

Nigerian cities are among the world's fastest expanding cities, and they are confronted with the challenge of steady growth in solid waste creation (Babayemi and Dauda, 2009). When a country's population grows fast and waste management is inadequate, this becomes a severe challenge. Of all the numerous types of waste created, biomedical waste has proven to be the most difficult to manage since it was beyond the reach of Nigeria's several waste management organizations (Ogbonna *et al.*, 2007). Nigeria's waste management organizations have been hampered by residents' unsanitary waste disposal behaviors and a lack of enforcement of cleanliness rules (Babayemi and Dauda, 2009).

Notwithstanding certain areas of the country having a relatively good understanding of waste collection services and waste management legislation, the number of people who employ indiscriminate solid waste disposal techniques such as open dumping, open burning, and dumping in drainages is still greater (Abel, 2009). In Nigeria, the quantity and pace of waste creation have outstripped nature's ability to absorb them organically (Babayemi and Dauda, 2009; Abel, 2009). Individuals around the country have a role to play in improving waste disposal management. The Nigerian government must increase environmental awareness and education among individuals in order to break the long-standing habit of irresponsible waste disposal and the quest for used electronic goods, which has made Nigeria a dumping ground for electronic waste (Oyelola *et al.*, 2009). The general public must be educated about the riches contained in their organic, plastic, paper, and other wastes, since this will go a long way toward encouraging effective waste segregation, reuse, and recycling.

The government should give waste management strategies and sanitation law enforcement in the various states of the country a higher priority. The country's many environmental organizations, managers, scientists, and engineers should also work harder to assist the government in achieving the desired clean environment in Nigeria (Babayemi and Dauda, 2009).

5.0 Conclusion

Inadequate management of waste poses major public health risks, ranging from the transmission of endemic parasitic infections to the development and re-emergence of new zoonoses as a result of direct or indirect impacts of poor waste management. These health risks may be minimized to a bare minimum by public education, the implementation and enforcement of rules and legislations, increased financing, supervision and monitoring, waste recycling, and landfill construction, among other measures. It is critical that all residential areas, irrespective of location or size, build landfills for effective waste management, preserving the environment and promoting the well-being of the Nigerian people.

5.1 Recommendations

- I. Development of integrated policies on waste sorting, reuse, recycling, and disposal should be one essential aspect of the policy and the framework for adequate provision of waste collection, transportation, and disposal facilities.
- ii. A unified policy on biomedical waste management should be implemented across all states of the federation to ensure the smooth disposal of medical waste across the country.
- iii. Waste management agencies should attempt to build partnerships with communities and user groups in the interest of effective service delivery and cost-effectiveness. When city's capacity is insufficient and/or low-cost options are required, local collection duty may be decentralized to the communities themselves. Adequate environmental awareness and organizational capacities should be prerequisites for effective involvement and community-based waste management. The assistance of non-governmental organizations (NGOs) may be highly beneficial in developing communities' capacity to engage in local waste management.

Reference

- Abel, A. (2007). An analysis of solid waste generation in a traditional African city: the example of Ogbomoso, Nigeria. *Environment and urbanization*, 19(2), 527-537.
- Afun, S. (2010). *Government Regulations and Legislations Will Ensure Sustainable Waste Management in Nigeria*, Solid Waste Management Services Limited, Port Harcourt, Nigeria.
- Al-Khatib, I. A., Arafat, H. A., Basheer, T., Shawahneh, H., Salahat, A., Eid, J., & Ali, W. (2007). Trends and problems of solid waste management in developing countries: A case study in seven Palestinian districts. *Waste management*, 27(12), 1910-1919.
- Anukam, L. C. (1997). Case Study IV-Nigeria. In: *Water pollution control: A Guide to the Use of Water Quality Management Principles*, Helmer, R. and Hespanhol, I, (Eds). Taylor and Francis, Washington DC: WHO/UNEP.
- Ayotamuno, J. M., & Gobo, A. E. (2004). Municipal solid waste management in Port Harcourt, Nigeria: Obstacles and prospects. *Management of environmental quality: an international journal*, 15(4), 389-398.
- Babayemi, J. O., & Dauda, K. T. (2009). Evaluation of solid waste generation, categories and disposal options in developing countries: a case study of Nigeria. *Journal of Applied Sciences and Environmental Management*, 13(3), 83-88.
- Dauda, M. and Osita, O. O (2003) "Solid waste management and re-use in Maiduguri, Nigeria, Towards the Millennium Development Goals", 29 the *WEDC International Conference*, Abuja, Nigeria, pp. 20-23.
- Ekaete, T. (2010). *Assessment of healthcare waste management practices in primary health care facilities in a lassa fever endemic local government area of Edo state, Nigeria*. Edo state: Thopson F.
- Eneh, O. C., & Agbazue, V. C. (2011). Protection of Nigeria's environment: A critical policy review. *Journal of Environmental Science and Technology*, 4(5), 490-497.
- Eneh, O. C. (2011). Failed development vision, political leadership and Nigeria's underdevelopment: A critique. *Asian Journal of Rural Development*, 1(1), 63-69.

- Helmer, R., & Hespanhol, I. (1997). *Water pollution control: a guide to the use of water quality management principles*. CRC Press.
- Imam, A., Mohammed, B., Wilson, D. C., & Cheeseman, C. R. (2008). Solid waste management in Abuja, Nigeria. *Waste management*, 28(2), 468-472.
- Joshi, p. (2014). A comparative study of knowledge and attitudes regarding biomedical waste (BMW) management with a preliminary intervention in an academic hospital. *International journal of medicine and public health*, 4(1), 91-95.
- Karshima, S. N. (2016). Public health implications of poor municipal waste management in Nigeria. *Vom Journal of Veterinary Science*, 11, 142 – 148.
- Manyele, S. V., Anicetus, H., & Bilia, M. H. (2003). Globalization and its effects on Medical Waste Management in Tanzania. IET Annual Conference and General Meeting AICC Arusha.
- Nwafor, J. C. (2006). *Environmental impact assessment for sustainable development: the Nigerian perspective*. Environment and Development Policy Centre for Africa (EDPCA).
- Nwosu, A. O., & Chukwueloka, H. E. (2020). A Review of Solid Waste Management Strategies in Nigeria. *Journal of Environment and Earth Science*, 10(6), 132-143.
- Ogbonna, D. N., Amangabara, G. T., & Ekere, T. O. (2007). Urban solid waste generation in Port Harcourt metropolis and its implications for waste management. *Management of Environmental Quality: An International Journal*, 18(1), 71–88.
- Ogwueleka, T.C., (2003) Analysis of urban solid waste in Nsukka, Nigeria. *Journal of Solid Waste Technology and Management*, 29(4), 239–246.
- Ogwueleka, T. (2009). Municipal solid waste characteristics and management in Nigeria. *Journal of Environmental Health Science & Engineering*, 6(3), 173-180.
- Onu, B., Price, T., Surendran, S. S., & Ebie, S. (2012). Solid waste management: a critique of Nigeria's waste management policy. *International Journal of Knowledge, Culture and Change Management*, 11(4).
- Oyelola, O. T., Babatunde, A. I., & Odunlade, A. K. (2009). Health implications of solid waste disposal: case study of Olusosun dumpsite, Lagos, Nigeria. *International Journal of Pure and Applied Sciences*, 3(2), 1-8.

-
- Soyande, D. A. (2008). *Nigeria: Country does not have health care waste management plan-USAID*. Abuja: WordPress.
- Uche, E. M., (2016). An evaluation on the methods of medical waste disposal in Nigeria. *Global Journal of Biological and Biomedical Research*, 4(5), 189-197.
- World Bank (1990) *Towards the Development of an Environmental Action Plan for Nigeria*, World Bank, Washington DC.
- Yadavannavar. (2010). Knowledge, Attitude, and Practices about Biomedical Waste Management among Healthcare Personnel: A Cross-sectional Study. *Indian journal of community medicine*, 3(5), 170.