

Poor COVID 19 Pandemic Waste Management Outcome in Nigeria: A Possible Potential Public Health Threat and Promoter of Community Transmission

Azunwu Obioma^{1*}, Ahiakwo Christian² and Egba Promise Chijioke¹

¹Department of Medical Laboratory Science, Medical Bacteriology / Virology / Parasitology Unit, Rivers State University, Nkpulu – Oroworukwo, Port Harcourt, Nigeria.

²Department of Animal and Environmental Biology, Rivers State University, Nkpulu – Oroworukwo, Port Harcourt, Nigeria.

***Corresponding Author:** Azunwu Obioma, Department of Medical Laboratory Science, Medical Bacteriology / Virology / Parasitology Unit, Rivers State University, Nkpulu – Oroworukwo, Port Harcourt, Nigeria.

Received date: July 08, 2020; **Accepted date:** September 01, 2020; **Published date:** September 04, 2020

Citation: Azunwu O, Ahiakwo C, Egba Promise C. (2020) Poor COVID 19 Pandemic Waste Management Outcome in Nigeria: A Possible Potential Public Health Threat and Promoter of Community Transmission; Biomedical Research and Clinical Reviews. 1(2); DOI: [10.31579/2692-9406/013](https://doi.org/10.31579/2692-9406/013)

Copyright: © 2020 Azunwu Obioma, This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Introduction: The COVID-19 pandemic outcome which is an emerging infectious disease that potentially originated from Wuhan in China has seen an upsurge of cases and deaths globally over time. One of the consequences found in the course of the management of these viral pandemic involves the massive production and usage of different myriad of medical supplies to meet up the increasing demands by health workers, patients and the public. This trend has resulted in the proliferation of medical wastes against a backdrop of poor waste management outcome especially in Nigeria.

Aim: The aim of this article borders on bringing to light the effects of improperly managed medical wastes, and the risks it poses to human health and the environment at large. Furthermore also, to outline various types of medical wastes and the guidelines associated with their disposal, especially those associated with management of COVID-19 pandemic saga.

Method/Methodology: The study approach follows the systematic review of peer-reviewed published articles as well as online publications and articles derived from various databases with search keywords relevant to the topic of discourse.

Findings and Results: Findings from this study show that the coronavirus disease of 2019 has spread widely globally with massive socio-economic and socio-cultural consequences. Over time there has been a progressive increase in cases and deaths due to Covid-19 in Nigeria and most other countries. The management of COVID-19 pandemic has resulted in the proliferation of medical wastes. Medical wastes are those generated from the use of medical supplies in the course of healthcare delivery and disease prevention such as hand gloves, facemasks, and hazmat suits etc. Medical wastes legislations that support the proper disposal of medical wastes in Nigeria and most other developing nations have been very weak and have failed to achieve the desired results, with high incidences of infectious diseases such as HIV and Hepatitis still being transmitted through improperly disposed of wastes. Therefore improper waste disposal may probably serve as a very potent means of community transmission of COVID-19 transmission, if not handled in good time especially the freshly disposed materials

Conclusion and Recommendation: While the generation of massive wastes is being seen in this COVID-19 pandemic period, it may be unavoidable that there could be re-infection of subjects from improper medical waste disposal strategies. Thus, it is pertinent that relevant regulations are put in place, enforced and monitored to ensure that improperly managed wastes do not form another avenue for widespread of the virus in our communities. It is also very necessary to organize massive campaigns aimed at creating enough public awareness of the risks associated with medical wastes and on the need for proper disposal especially COVID 19 associated waste materials.

Keywords: coronavirus (covid-19) Nigeria; poor policies; healthcare waste; infection; poor hygiene; community transmission

Introduction

Environmental and Public Health risk associated with the COVID-19 pandemic has assumed a dangerous trend, following the continuous rise in Coronavirus cases since the pandemic outbreak which originated from the city of Wuhan, China in December 2019 and subsequently spreading across the globe unhindered. New cases are announced daily with America and Europe recording the highest numbers [1]. The case of COVID-19 pandemic is similar to other pandemics that hit the world with a high number of deaths recorded in retrospect. In 2002, the Severe Acute

Respiratory Syndrome (SARS) recorded 800 deaths out of 8,000 confirmed cases. In 2009 H1N1, recorded 18,500 deaths, while the Middle East Respiratory Syndrome recorded 800 deaths out of 2,500 confirmed cases [2, 3]. Furthermore, in 2014, was the outbreak of Ebola disease which recorded 11,310 deaths out of 28,616 confirmed cases [2, 3]. These outbreaks of diseases have caused an increase in the demand and consumption of some of the items used for containment and prevention strategies. These items end up in healthcare environment and can potentially be littered in streets and open dumpsites which are not the

appropriate sites for the dumping of these contaminated clinical waste materials, especially in an era of COVID 19 pandemic upsurge.

Nonetheless, while assessing the state of facilities for the disposal of healthcare wastes, the World Health Organization found that just over half (58%) of sampled facilities from 24 countries had adequate systems in place for the safe disposal of healthcare waste [4]. The developed guideline from the assessment addressed areas such as regulating framework, planning issues, handling, storage and transportation, treatment and disposal option and training. Furthermore, the World Health Organization in collaboration with other partners developed a series of training modules on good practices in healthcare waste management covering all aspects of waste management activities from identification and classification of wastes to considerations guiding their safe disposal, using both non-incineration or incineration strategies [4].

Medical waste management has become a critical issue as it poses a potential health risk and danger to the environment [5]. It is also of greater importance due to its potential environmental hazards and Public Health risks with a high propensity to result in pandemic outcome [6]. This has continued to be a major challenge, particularly in most healthcare facilities of the developing countries where it is hampered by technological, economic and social difficulties and inadequate training of staff, responsible for the handling of the wastes [7]. In Nigeria, many citizens are not aware of the great environmental pollution and hazards caused by medical wastes especially in the era of COVID 19 pandemic [8]. However, it is important to note that medical waste, when not properly managed could pose even greater threat and danger to Public Health than the original diseases outcome [9]. This is because many microorganisms associated with medical wastes have been discovered to be highly antibiotic-resistant strains [10]. However, the need of this study cannot be overemphasized in our region, given the huge gap and lack of co-ordinated health education strategy in our communities, secondly, it is seemingly strongly believed that the infection control methods put in place by World Health Organization which was adopted by the Nigeria Centre for Disease Control (NCDC) did not take into cognizance with much needed emphases, the waste management strategies and treatment of materials such as the different myriad of face mask of different fabrics and materials used for the prevention, containment and treatment of COVID-19 patients in our various isolation, holding and treatment centres in Nigeria.

Thus, the primary aim of this study is to outline the various challenges poor COVID 19 wastes disposal strategy could pose to the community, especially wastes generated during the prevention, handling and treatment of the COVID-19 pandemic patients, as well as outline the various methods that could be put in place for the effective management and handling of these wastes to prevent further spread of the virus through community transmission route, due to inadequate waste management strategy practices. It is therefore strongly believed that conversations generated from the study would increase the curiosity and interest of government and her relevant agencies towards building a robust infrastructure of waste treatment plants in our health facilities across the country.

Methodology

Study Approach

The study method employed in the development of this article is a systematic review of peer-reviewed published articles, as well as a review of articles published online in English language. According to Aveyard, a systematic review is the concrete summary of research details which are evidenced based and can be applied to other studies following the appraisal of a given body of knowledge [11].

Search Strategy

The search strategy involves in the development of this article involves the combination of relevant keywords employed in the search of databases such as Researchgate, Lancet, PubMed, Science direct. Google searches were made at first to aid in the identification of relevant keywords which were as well employed in the searches made on the topic of discourse. Some of the keywords used in the cause of searching for information on the topic are 'COVID -19 outbreak in Africa', 'COVID -19 waste management in Nigeria', 'methods of medical waste disposal' 'poor face mask disposal' 'Community transmission of COVID - 19 due to poor face mask disposal'

Inclusion and Exclusion Criteria

Peer-reviewed published articles and online articles which provided useful knowledge in the development of the themes of the topic of discourse. Articles which were not relevant to the thematic development were set aside and articles which are not published in English language were not accepted.

Background Knowledge

Index Cases of COVID-19 in Africa

The African continent has also recorded several cases of COVID -19 due to returnees from Asia, Europe and America. However, there have been a low number of confirmed cases and deaths from COVID-19 across the continent of Africa compared to the numbers in Asia, Europe and America. The first index case in Africa was in Egypt on the 14th of February, 2020. Algeria recorded the second case on the 25th of February, 2020, while Nigeria and Senegal were third and fourth cases recorded on the 27th of February and 1st of March 2020 respectively. Morocco and Tunisia recorded their index cases on the 2nd of March, 2020. In Southern Africa, South Africa recorded the first index cases on the 5th of March, 2020 while Cameroun and Togo had their index cases on the 6th of March, 2020. Burkina Faso recorded its index case on the 9th of March, 2020, while DR Congo index case was recorded on the 10th of March, 2020. Ivory Coast and Ghana recorded their index cases on 11th and 12th of March, 2020 respectively. Some African countries like Ethiopia, Gabon, Guinea, Kenya, Mauritania, Namibia and Rwanda all have confirmed index cases along with Sudan as of the 13th of March, 2020. Furthermore, others with reported confirmed cases also include Angola, Benin, Cape Verde, Central Africa Republic, Chad, Djibouti, Eritrea, Eswatini, Gambia, Equatorial Guinea, Kosovo, Liberia, Seychelles and Somalia [12, 2, 3].

Infection Control Methods: The WHO Strategy

The World Health Organization highlighted the followings as a possible means of transmission of the virus:-

- 1. Person-to-person:** This is one of the commonest ways for infectious diseases to spread from one person to the other through the direct transfer of bacteria, viruses and other germs. In the case of the COVID-19 pandemic, handshaking, hugging, kissing and other bodily contacts could be a possible link of spreading the virus from person-to-person. In most cases, this could happen before an infected person is aware of the illness [13].
- 2. From droplets of an infected person to others:** Droplets are tiny molecules or aerosols emitted from an infected person through sneezing and coughing into the air. These droplets can travel to a distance of 3ft (1 metre). Healthy individuals may become infected with the virus if they inhale infectious respiratory droplets of the virus, or if the infectious respiratory droplet gets in contact with openings such as eyes, nose and mouth [13].
- 3. Contaminated Surfaces-to-person:** Droplets from infected persons when released can travel between 3 – 6ft which eventually land on

surfaces or objects. These objects or surfaces (tables, laptops, doorknobs, telephones, clothes, floors, food materials and cooking and feeding utensils) harbour these viruses for up to 72 hours [13]. When a healthy person touches these contaminated surfaces or objects with their hands and then touches the eyes, nose or mouth, he may probably get infected with the virus [13]. Nonetheless, in a bid to break the chain of transmission, the World Health Organization rolled out various control strategies for governments of various nations to adopt in limiting the spread of the virus which include:

- Borders closure (air, land and sea) to prevent inter and intrastate or community spread of the virus.
- Social distancing, including school closures, avoidance of public gatherings to break the chain of person-to-person transmission.
- Establishment of crisis response management outlets and lines to call.
- Preparation of isolation centres and hospitals for treatment of confirmed cases.
- The training of health workers for infection management and prevention.
- Washing of hand under running water with soap which destroys the fatty layers of the virus.
- Use of 60% alcohol-based hand sanitizers.
- Use of gloves and face masks as a barrier against the virus droplets or aerosols.

According to the World Health Organization, countries are to use these above strategies in detecting, testing, treating, isolating and tracking every contact and to mobilize citizens in the response [14].

Solid Waste Management in Nigeria

Waste material according to the Oxford Advanced Learner's Dictionary is defined as, "any material (s) that are no longer needed and are thrown away". Covid-19 waste materials are called biological or healthcare waste and can be grouped into two categories

Solid Wastes

1. Those materials generated from the COVID-19 treatment and isolation centre across Nigeria:
 - a. Syringes and needles
 - b. Sample bottles
 - c. Hand gloves
 - d. Face masks
 - e. Hand sanitizer containers
 - f. Wipes
 - g. Coveralls
2. Those materials generated from our homes and offices daily:
 - a. Hand gloves
 - b. Masks
 - c. Sanitizers containers
 - d. Wipes

The challenge of solid waste management in Nigeria and other developing as well as underdeveloped countries have risen considerably with an increase in population size especially in major cities [15, 16, 17]. Adequate and acceptable waste management is necessary to minimize the debilitating effects of waste on humans and the environment [18]. In several surveys carried out online since 2010, some Nigerian cities such

as Lagos, Ibadan and Abuja have been ranked among the dirtiest cities in the world as there is massive littering of solid wastes in places such as roads, along drainage lines and on vacant lands [19]. This is chiefly due to the habit of indiscriminately dumping of wastes along highways and other unauthorized places for waste disposal [20, 19]. This results in leaching into water bodies during rainfall thereby causing environmental pollution and other environmental health risks [21].

Nevertheless, it is strongly believed that in developed countries, considerable progress has been made as it concerns waste management in practical terms. In the United Kingdom, the Public Health Act 1875 instructed households to collect wastes in containers for disposal which birthed the idea for dustbins [19]. The United States produces about 250 million tons of wastes with about 80 million tones adequately composted and recycled [22]. Some rapidly developing Asian nations such as Malaysia have been able to adequately handle over 80% of their wastes properly with the recycling industry being very effective in the country [23].

Medical Waste Management in Nigeria

Medical waste generation from healthcare facilities and other users of healthcare services can be said to be unavoidable. However, adequate know-how on the hazards associated with medical wastes and acceptable means for disposal remains poor [24]. Medical wastes pose serious health risks to patients, health workers, and the public at large, if they are not adequately and scientifically handled in a way and manner the risk accruable would be potentially reduced to tolerable limits [25, 26]

Medical wastes are generated from facilities such as hospitals, primary health centers, biomedical laboratories, first-aid posts, sick bays, dispensaries and community pharmacy shops [26, 27, 9, 28]. Some of the medical wastes generated constitute a high percentage of infectious wastes, which have the potential to be highly pathogenic and can result in disease conditions in humans who are exposed to them, if they are not handled properly through the decontamination strategic outcome [29]

The steady global growth of the health sector has translated into a higher generation of medical waste [30] this has also increased the incidences of disease, due to medical wastes such as typhoid and hepatitis contracted through contaminated sharp objects [31, 32]. However, Nigeria as well as other developing countries, has struggled with the proper management and disposal of medical wastes, and this largely could be due to limited resources to provide necessary massive infrastructures that will be green to the ecosystem [33, 34]. Most medical wastes are disposed of alongside domestic wastes, which pose a serious health hazard to waste collectors and the general public at large [35, 36]. This calls for proper education on the risks posed by these medical wastes indiscriminate handling, and the need for proper enlightenment on the effective means of disposal. However, it is sad to note that relevant information on this aspect of healthcare is very limited and adequate research is scarce in Nigeria and many other developing nations as confirmed by some studies [30].

Types of Medical Wastes

There are two types of medical wastes, and they are:

- i. Non-risk or Non-hazardous Wastes
- ii. Risk or Hazardous Wastes

Non-risk medical wastes make up about 75-90% of all medical wastes, while risk medical wastes make up about 10-25% medical wastes [37]. However, if they are mixed up, then such medical waste is classified as risk medical waste [37]. Non-risk waste includes materials such as food remnants, carton and plastics [37]. Risk waste includes sharps such as needles, chemicals such as reagents, pathological wastes such as human tissues, infectious wastes such as blood and body fluids, pharmaceutical wastes such as expired drugs [38, 39].

Methods of Disposing Medical Wastes

Various methods of proper and ideal medical waste disposal include incineration, autoclaving, microwaving, hydroclaving, and shredding [40].

- i. **Incineration:** incineration involves the burning of wastes in special incinerators called HMIWs (Hospital/Medical/Infectious Waste Incinerators) and 90% of medical wastes are disposed of with this method [41]. It is a high-temperature combustion that can kill microorganisms under controlled conditions [40]. The advantages are that they considerably reduce the waste volume, and the heat and electricity can be recovered from highly sophisticated incinerators, while disadvantages include the release of toxic substances into the environment, high cost of maintenance and requiring ash disposal [42]. Some toxic substances that may be introduced into the atmosphere, due to poorly handled incineration include carbon monoxides, poly-cyclic aromatic hydrocarbons, and particulate matter [43, 44].
- ii. **Steam Sterilization (Autoclaving):** This involves the use of high temperature and pressure to penetrate medical wastes and kill off microorganisms, after which the decontaminated remnants may be disposed of in landfills or other disposal sites or incinerated [42, 41]. It might be necessary to shred the waste, to homogenize them and ensure easy handling and more efficient sterilization [42]. This is a very efficient method for the decontamination of infectious wastes, especially if the time, temperature and contact between the steam and the waste are sufficient to kill microbial spores [45], it is, however disadvantageous since the waste might still require incineration in conditions whereby communities do not agree to the dumping of sterilized waste into landfills [42]
- iii. **Microwave Treatment:** this method is similar to autoclaving, but uses radiation [41] Inactivation of the organisms present in the wastes occurs as a result of radiation spectrum frequencies which range from 30 to 30000MHz [40]. In microwaving, the heating process occurs in the waste material as a result of steam which the shredded waste is treated with first [45].
- iv. **Chemical Disinfection:** This involves the use of chemicals such as chlorine compounds to kill microorganisms present in medical waste [41].
- v. **Land Disposal:** This method involves the final dumping of medical wastes which have been decontaminated using other methods, as well as the wastes which could not be decontaminated [41]. Specialized landfills are set aside for this purpose in such a way that water and soil contamination is avoided [41].

Legislations on Medical Wastes Management

To effectively and efficiently handle the wastes in a country, the first and important step is to set up relevant policies and regulations which will ensure that a sustainable healthcare management system is designed and monitored [46]. Waste management is an increasing challenge of global concern, due to its effect on the health and the environment. This has necessitated the development of the Basel Convention by United Nations to which Nigeria signed into, which provided various provisions for the handling of all kinds of hazardous wastes including wastes generated in the course of healthcare [47, 48]. The convention provides for the Trans boundary conveyance of wastes from countries not well equipped to

handle them to those countries with more capacity and equipment to handle such wastes [49]. The World Health Organization outlined certain principles to be employed by different nations who wish to proffer legislations which border on waste management, and they include the 'polluter principle', which states that a producer of waste is responsible for the safe disposal of the waste produced, and also liable for whatever damage caused by such waste; nevertheless, the 'precautionary principle', which states that if the risks of waste are not clear, then it is presumed to be highly risky; 'the duty of care principle' which states that a person handling waste is ethically responsible for using the utmost care in handling such waste, and lastly the proximity principle which states that the handling and disposal of waste should be carried out as close as possible to the location of its source [49]. These principles are part of the framework on which national policies on waste management are based on, as well as the conventions to which the country is signed into [46].

In Nigeria, there are several laws which place focus on the environment and therefore, touch on the management and disposal of wastes, but there is still a huge dearth in the laws and institutions to efficiently handle wastes disposal and management in the country [50]. The Environmental Protection Law of 2007 established the Lagos State Waste Agency (LAWMA) which has done relatively well in waste management in Lagos state, even though the recorded progress is still a far cry from what is internationally acceptable [51].

However, in the period of the Covid-19 outbreak, several laws and regulations have been made to regulate human movements and actions to boost the efforts to limit the spread of the virus in Nigeria, there still no record of explicit law that is meant to strictly regulate wastes generated in the course of management and prevention of the virus.

Medical Waste Management Associated with COVID-19 Pandemic

The enormous global spread of COVID-19 has increased medical wastes globally, posing a serious challenge to waste management workers all over the world [52]. High demands for personal protective equipment such as facemasks and gloves have skyrocketed following the outbreak of COVID-19 both by private individuals and by various healthcare facilities. In Wuhan, where the COVID-19 outbreak originated, there has been a four-fold increase in medical wastes generated from the city with 200 tons of waste being generated on 24th February 2020 alone, thereby overwhelming their waste management agency with a capacity of handling a maximum of 50 tons of waste daily [53]. Some major clinical protective equipment massively required both by public users and medical workers are facemasks and gloves with over 116 million masks produced daily in China according to China's National Development and Reformation Commission [53].

Face masks, especially those worn by COVID-19 infected people and not handled properly, especially those indiscriminately dumped on sidewalks and walkways could serve as a means of spread of the virus especially to sanitation workers and rag pickers who are prevalent in many underdeveloped and developing nations such as Nigeria, and even in some developed nations [54]. Disturbing reports concerning the indiscriminate dumping of face masks across streets and in public garbage trucks have been widely reported in many areas, and due to the lightness of the masks can be easily moved from place to place by wind [55]. This poses a dangerous trend because face masks which are likely to contain respiratory droplets from the users can transmit the coronavirus especially those from users who are untested but yet positive subjects in the end when finally tested. Therefore indiscriminate dumping of facemasks could serve as a very heavy and potent means of community transmission of COVID -19 in our communities given the trend and situations at hand and also the fact that the virus can live for 72 hours in an objects.

Another major problem of improperly disposed of facemasks is the tendency of some unscrupulous petty traders to pick up and sell for reuse of some of these masks that may have been infected as was the case of a trader arrested in Thanes, India with over 100,000 used and washed masks meant for reselling to unsuspected victims [54, 55]. Nevertheless, trends of this nature are most probably likely to promote community spread in our localities especially among those with weak and lack of adequate knowledge on health education towards preventing or cutting off the chains of transmission.

Medical Wastes of Public Health Concern Generated during the COVID-19 Pandemic Outbreak

In the course of the management and prevention of COVID-19, much equipment is used in managing the disease. It is proved that COVID-19 can survive for hours when they settle on some of these surfaces [56]. This implies that some of these accessories can serve as a potent means of transmission, if they are not disposed of properly after use, or if littered indiscriminately. They include:

i. Surgical Glove Wastes

Surgical gloves wastes are gloves that have been used and discarded. Disposable gloves are made up of latex, nitrates and polyurethane materials. They are used basically in the time of pandemics such as COVID-19 to protect individuals from respiratory droplets believed to be a chain or medium of transmission of the disease. They are also used when cleaning and disinfecting surfaces which are contaminated with pathogens where they serve as a barrier between the skin and what you touch. However, gloves not properly disposed of after use can cause the virus to spread more easily than imagined. Thousands of tons of these wastes are generated daily across the countries isolation and treatment centres, banking industries, supermarkets, barbing shops etc. These wastes are disposed of without applying proper healthcare waste management protocols to ensure proper collection and disposals [57].

ii. Face Mask Waste

Like the gloves, masks are worn basically for protection against pathogen especially during pandemic periods. It is worn to cover the major entry route of the nasal and vocal cavities to the virus. Masks vary in type and quality depending on the material used in making the mask. The World Health Organization recommends the N-95 grade mask in the COVID-19 period especially for the caregivers and other health workers engaged in patient management. However, cloth mask which can be mass-produced and recycled by washing with soap after daily use is encouraged. Unlike the gloves, masks are used by people from all walks of life across the country to break the chain of transmission of COVID-19. Millions of tons turned out daily into the streets and drainage channels because of the absence of proper waste management system in Nigeria [57].

iii. Sanitary Wipes Wastes

Sanitary wipe wastes are used and discarded sanitary wipes. They are made of paper towels with alcohol (alcohol-based) used for cleaning and decontaminating, an example is the baby wipes. Furthermore, the sanitary wipe is a very easy and convenient way to keep hands free of germs. Items like phone screens, lens, glasses and granite are cleaned using sanitizer wipe. Consequently, its demands and consumption increased following the outbreak of COVID-19 pandemic across the country in the last few months. It may be described as an elitist precautionary measure used by those with high income and high return on investment, the volume generated have risen within the last few months of the outbreak of the pandemic all over the country [57].

iv. Plastic Hand Sanitizer Containers

Hand sanitizers are stored and dispensed from plastic containers. These containers vary in their sizes, from big to medium and small. The smallest size which is the most affordable by those within the lowest per capita can serve a family of four for about three days if effectively used. The greater majority of the Nigerian population falls into this category. It therefore implies that millions of these containers will be turned out weekly as wastes which litter the streets, waste receptacles and dumpsites across the country [57].

v. Hazmat Suit Waste (Coverall).

Coverall is part of the protective materials worn by healthcare givers in times of a pandemic. It helps to protect health workers and other caregivers or those handling dead bodies of those who died as a result of highly infectious diseases like the COVID-19 disease. The coverall wastes which are recyclable and reusable are not properly handled and treated by some experts [57]. An example is an incidence that happened at the Gudu Cemetery in Abuja where coverall wastes used by one of the corpse handlers was disposed behind the fence of the cemetery [58]. This singular case represents other cases of the sort going on around the country within the Covid-19 period.

Guidelines for Handling Medical Wastes during COVID-19 Outbreak

The high infection rate of COVID-19 has made the use of personal protective equipment indispensable, especially in the course of providing healthcare. Such personal protective equipment include gloves, aprons, gowns, respirators, face masks, goggles etc. Hospital-grade protective equipment's which are meant for single-use such as facemasks, gloves and hazmat suits are expected to be discarded using standard infection control precautions [59]. In England, personal protective equipment is classified under infectious wastes by the National Health Service and the method provided for disposal is majorly by incineration, as well as landfill dumping and recycling, depending on the particular type of personal protective equipment and the usage [59].

The Central Pollution Control Board, which is the highest pollution monitoring board have mandated the use of double-layered bags and colour-coded bins in COVID-19 quarantine and isolation facilities which is following its 2016 guidelines for handling contagious viruses like HIV [60]. Such containers and bins should be clearly labeled as COVID-19 and disinfected daily by the use of 1% hypochlorite solution [60].

According to the World Health organization, there is no evidence yet that unprotected human contact in the course of handling COVID-19 waste has resulted in the transmission of COVID-19, nevertheless, all COVID-19 wastes are considered potentially infectious and are to be treated preferably on-site before being sent to sites of dumping or incineration [56].

Discussion

Medical waste management is a leading Public Health problem in both developed and developing countries, and has increased with the advent of the COVID-19 pandemic outbreak [61, 56]. Nevertheless, while some developed nations have more robust medical waste management system strategies and legislations to enable them effectively manage these challenges, the reverse is the case in the developing communities with a strong evidence base of lack of focus and weak implantation strategies to manage the hazard accruable from the medical waste in our fragile environment, already saturated with pollution from oil and gas activities in the Niger Delta. Furthermore, several other developing nations are yet to formulate well-structured waste management integrated systems and legislation to tackle the ugly trend [62, 56].

However, in a research work, carried out by Ogbonna et al., [36] among 5 hospitals in Port Harcourt, it was discovered that majority of the

hospitals preferred open dumpsites method for waste disposal which aligns with the findings made by Coker *et al.*, [63], on the method of waste disposal in Nigerian hospitals, as well as those made by Mato and Kaseava, [64] in Dares Salaam hospitals, Tanzania. This practice could lead to soil and water pollution, and in the era of COVID-19 pandemic, it may probably serve as a potential means of spreading the virus to municipal workers and dump-sites scavengers, especially when the viral particles are still living and potent enough to cause an infection from a freshly disposed of clinical waste materials, when it comes in contact with the unsuspecting members of the public, due to poor waste disposal method [65, 66]. Furthermore, in a study also carried out by Ogbonna *et al.*, [36], the researchers observed that the reason many medium and small scale hospitals were unable to dispose of waste properly was based on their inability to afford incinerators, due to high cost of the technology and also the cost of the facility maintenance, especially in the remote communities where access to experts in biomedical engineering remains massively scanty [36].

Nonetheless, it is strongly probably believed that the inability to transfer waste management protocols of waste to wealth strategy into practice in Nigeria is one of the major challenge, that country like Nigeria face in the fight against medical wastes management [50]. The various stages involved in waste management are generation (as the weight of material discarded as solid waste by one person in one day), storage (safekeeping of solid waste in place or containers by individuals for the refuse collection agency or agent), collection (transportation of the waste from one point of storage to point of disposal) and disposal (as the final destination of solid waste at approved dump sites) [67, 68]. The present waste management system practiced in Nigeria has failed to integrate the various stages of waste generation, storage, collection and disposal in managing any solid waste including the COVID-19 pandemic waste [50]. This agrees with the position of the United Nations Environmental Program (2015), that current challenges of waste generation across the globe calls for an integrated waste management policy as a strategic approach, to the sustainable management of wastes covering all sources and aspects of generation, segregation, transfer, sorting, treatment, receiving and disposal in an integrated manner, with critical emphasis on efficiently maximizing the use of available resources towards solving the problem [69, 70].

In continuation, with the recording of the index case of COVID-19 in Nigeria, the Nigerian Centre for Disease Control listed certain precautionary measures that were necessary to limit the spread of the virus [71] with the use of facemasks and use of other personal protective equipment being the basic measures [56]. However with increasing production of hospital-grade and local cloth facemasks, as mandated by both federal and state governments in Nigeria [72], very little health education on adequate disposal of these wastes has been done on the users to minimize re-infecting themselves from the probably already contaminated facemask from positive subjects. Consequently, these wastes which may have been contaminated by the COVID-19 virus [13] are littered along the streets and mixed up with everyday household wastes and picked up by unsuspecting, untrained and poorly kitted waste collectors, who dump them in public waste receptacles. This practice negates the measures put in place by the Nigerian Center for Disease Control and World Health Organization as possible prevention and containment measures of the COVID-19 pandemic transmission. The situation is worrisome as little or no tangible action has been taken by all levels of government to enlighten the populace about the COVID-19 pandemic wastes, and the Public Health risk associated with improper handling of the waste materials, and potential dumping of the waste without decontamination. It is probably believed that the dumping of the used face mask materials of different colours, even when the majority of the facemasks are made from non-clinical fabrics with myriads of washable inks of different colours, may have a negative implication of

unfriendly environmental practice. These may grossly contaminate the farmlands, planted with fresh to eat vegetables and pollution of the water sources like the streams and walls, which potentially serves as sources of drinking water in our remote communities. Even as the washable colour inks when deposited in high concentration in the environment may probably be toxic and mutagenic when it comes in contact with the living creatures that form the food web network of the ecosystem, thus affecting the environment negatively. These should be checked in good time to avoid irreparable destruction of the environment, which is of immense benefit for men and animals sustainability and stability in an ecosystem.

However, another worrisome aspect of the use of facemask during this pandemic is the use of facemask for many days and re-using it again, even when it is physically evidenced to be dirty. The inability of the government in Nigeria at all levels to provide free clinical structured facemask remains a challenge towards containing and prevention of community transmission in Nigeria, as friends and family members share one facemask, not knowing the positive or negative status of each other, thus in an event where one person is asymptomatic, the likelihood of sharing it to the entire family remains eminent and unavoidable.

Guidelines for the management and disposal of healthcare wastes, such as the Covid-19 virus, are done with internationally approved protocols as contained in the World Health Organization (WHO) 'Blue Book'. These were tailored for low and middle-income countries like Nigeria, where the infrastructure and national guidelines might not be fully developed [49]. Furthermore, World Health Organization stated that measures to ensure the safe and environmentally sound management of healthcare wastes can prevent adverse health and environmental impacts from such wastes, including the unintended release of chemical or biological hazards into the environment, thus protecting the health of patients, health workers and the general public [57]. This entails proper and full treatment of all healthcare wastes like masks, gloves, wipes and sanitizer containers which are currently being generated in large tons following the COVID-19 pandemic before disposal [56]. However, the prevalent practice in Nigeria is the disposal of untreated healthcare wastes in landfills that are not properly constructed and protected which agrees with findings made by Coker *et al.*, Ogbonna *et al.*, and Ike *et al.* [63, 36, 19]. Also, surface and groundwater which serves as sources of drinking water for many are equally contaminated by pathogens and toxic pollutants [73]. It is firmly believed that reasons for the abysmal failure in applying internationally approved protocols in the handling and disposal of healthcare wastes in Nigeria, could probably be linked to the followings:- (i) Lack of awareness on the health hazard that are linked to healthcare wastes (ii) Inadequate or absence of training of personnel in proper wastes management skills (iii) Absence of the right wastes management and disposal system (iv) Lack of competent personnel (v) Low priority given to healthcare waste management and control (vi) Lack of domestication of protocols and regulations or the lack of enforcement where regulations exist. The present scenarios in environmental waste management approach must change, if we must make a significant progress towards protecting our environment, and also protecting the life of our citizens from infectious epidemic outbreaks of different strata.

Conclusion

While the high generation of medical wastes may be inevitable due to the COVID-19 pandemic outbreak, it is necessary that various measures that will ensure the proper treatment and disposal of these wastes are followed according to international world environmental and health bodies' approved standard. The medical wastes disposal practices in Nigeria entirely negate the established protocols set up by these bodies and therefore, calls for huge worry of concern in Nigeria. However, this trend will persist if a holistic approach is not adopted in the management of Covid-19 related wastes as well as other medical wastes. Therefore to successfully limit the spread of Covid-19 in Nigeria, sample collection,

testing, tracing of contact person and treatment should be integrated with the management of waste generated from the isolation and management centres, homes and offices through proper identification and classification of different types of waste generated. Furthermore, adequate financial investment in proper and effective healthcare waste management outcome, healthcare givers training and re-training is needed across the thirty-six (36) states of the country to improve, and modernize existing waste management facilities to internationally acceptable standards, for the treatment and disposal of all healthcare wastes that will be generated across the country within and beyond this period of the Covid-19 pandemic era. Also, existing protocols and regulatory frameworks for proper healthcare waste management strategies should be prioritized, and activated for proper service delivery as a factor to mitigate the spread of the virus and other infectious pathogenic outbreak that may occur in future.

Smart recommendations

The following recommendations are hereby suggested to improve the overall outcome if firmly implemented:

1. Strict enforcement of healthcare waste management regulations.
2. Provision of proper wastes management and disposal facilities across the thirty-six (36) states.
3. Activation and training of various states environmental health officers to the current trend of waste management approach.
4. The Presidential Task Force should prioritize awareness campaign programs across the Country using the National Orientation Agency (NOA) and States environmental health officers, so as to reach our remote communities on proper face mask waste disposal plan.

Acknowledgement: We are sincerely grateful to Prof. S.D Abbey, Prof. G.N Wokem and Prof. F.B Sigalo for all their moral support and encouragement at all time. We are also indebted to Dr Azuonwu, Goodluck, Sir Benneth Azuonwu and Flourish Obi-Azuonwu for all the prayers support thus far.

Conflict of Interest: None reported among authors

References

1. Ferguson, N. M., Laydon, D., Nedjati-Gilani, G., Imai, N., Ainslie, K., Baguelin, M., Bhatia, S., Boonyasiri, A., Cucunuba, Z., Cuomo-Dannenburg, G., Dighe, A., Dorigatti, I., Fu, H., Gaythorpe, K., Green, W., Hamlet, A., Hinsley, W., Okell, L.C., van Elsland, S., Thompson, H., Verity, R., Volz, E., Wang, H., Wang, Y., Walker, P.G.T., Walters, C., Winskill, P., Whittaker, C., Donnelly, C.A., Riley, S. & Ghani, A.C. (2020). Impact of Non-Pharmaceutical Interventions (NPIs) to reduce COVID-19 Mortality and Healthcare Demand, COVID-19 Reports. Faculty of Medicine, Imperial College, London, UK.
2. John Hopkins University (2020). COVID-19 global confirmed cases by country/region/sovereignty.
3. World Health Organization. (2020). Coronavirus disease (COVID-2019) situation reports.
4. World Health Organization. (2015). Status of health-care waste management in selected countries of the Western Pacific Region.
5. Adnane, M. I., Balkacem, K., Abdulkarim, E. & Mohammed, B. (2013). Medical Waste Management: A case study of the Soussa-Massa-Dara Region, Morocco. *Journal of Environment*, 2013.
6. Dehghani, M. H. Azam, K., Changani, F. & Dehghani, E. F. (2008). Assessment of medical waste management in educational hospital of Tehran University Medical Science, Iran. *Journal of Environmental Health Science and Engineering*, 5(2), 131-136.
7. Alagöz, A. Z., & Kocasoy, G. (2008). Determination of the best appropriate management methods for the health-care wastes in Istanbul. *Waste Management*, 28(7), 1227-1235.
8. Coker, A., Sangodoyin, A., Sridhar, M., Booth, C., Olomolaiye, P., & Hammond, F. (2009). Medical waste management in Ibadan, Nigeria: Obstacles and prospects. *Waste management*, 29(2), 804-811.
9. Coker, A., Sangodoyin, A., Sridhar, M., Booth, C., Olomolaiye, P., & Hammond, F. (2009). Medical waste management in Ibadan, Nigeria: Obstacles and prospects. *Waste management*, 29(2), 804-811.
10. Nascimento, T. C., de Almeida Januzzi, W., Leonel, M., da Silva, V. L., & Diniz, C. G. (2009). Occurrence of clinically relevant bacteria in health service waste in a Brazilian sanitary landfill and antimicrobial susceptibility profile. *Revista da Sociedade Brasileira de Medicina Tropical*, 42(4).
11. Aveyard, H. (2010). *Doing a Literature Review in Health and Social Care*. Open University Press.
12. Africa Centre for Disease Control (2020). COVID-19 and resources outbreak.
13. National Center for Immunization and Respiratory Diseases (2020). National Centre for Immunization and Respiratory Diseases, Division of Viral Diseases.
14. World Health Organization. (2020). Infection prevention and control during health care when novel coronavirus (nCoV) infection is suspected Interim guidance, 19 March 2020.
15. Tchobanoglous, G. (2009). Solid waste management. *Environmental engineering: environmental health and safety for municipal infrastructure, land use and planning, and industry*. Wiley, New Jersey, 177-307.
16. Butu, A. W., Ageda, B. R., & Bichi, A. A. (2013). Environmental impacts of roadside disposal of municipal solid wastes in Karu, Nasarawa State, Nigeria. *International Journal of Environment and Pollution Research*, 1(1), 1-19.
17. Samah, M. A. A., Manaf, L. A., Ahsan, A., Sulaiman, W. N. A., Agamuthu, P. & D'Silva, J. L. (2013). Household Solid Waste Composition in Balakong City, Malaysia: Trend and Management. *Polish Journal of Environmental Studies*, 22(6).
18. Anijiofor, S.C., O.D. Jimoh, T.C. Ogwueleka, 2013. Cost Optimization Model for Effective Solid Waste Management in Minna, Niger State, Nigeria. *Nigerian Journal of Hydrological Sciences*, 2: 16-26.
19. Ike, C. C., Ezeibe, C. C., Anijiofor, S. C., & Daud, N. N. (2018). Solid Waste Management in Nigeria: Problems, Prospects, and Policies. *The Journal of Solid Waste Technology and Management*, 44(2), 163-172.
20. Igbinomwanhia, D. I. (2011). Status of waste management. *Integrated Waste Management*, 2, 11-34.
21. Pukkalanun, N., Inkapatanakul, W., Piputsitee, C., & Chunkao, K. (2013). An analysis of the environmental vulnerability index of a small island: Lipe island, kho sarai sub-district, mueang district, Satun province, Thailand. *Modern Applied Science*, 7(2), 33.
22. United States Environmental Protection Agency, (USEPA), 2012. Guide for Industrial Waste Management Retrieved from <http://www.epa.gov/epawaste/nonhaz/industrial/guide/index.htm>. Retrieved on 15th May, 2020.
23. Aja, O. C., & Al-Kayiem, H. H. (2014). Review of municipal solid waste management options in Malaysia, with an emphasis on sustainable waste-to-energy options. *Journal of material cycles and waste management*, 16(4), 693-710.

24. Olukanni, D. O., Azuh, D. E., Toogun, T. O., & Okorie, U. E. (2014). Medical waste management practices among selected health-care facilities in Nigeria: A case study. *Academic Journals*, 9(10), 431-439.
25. Hanumantha Rao, P. (2008). Report: Hospital waste management—awareness and practices: a study of three states in India. *Waste management & research*, 26(3), 297-303.
26. Tudor, T. L., Noonan, C. L., & Jenkin, L. E. T. (2005). Healthcare waste management: a case study from the National Health Service in Cornwall, United Kingdom. *Waste management*, 25(6), 606-615.
27. Da Silva, C. E., Hoppe, A. E., Ravello, M. M., & Mello, N. (2005). Medical wastes management in the south of Brazil. *Waste management*, 25(6), 600-605.
28. Adedigba, M. A., Nwhator, S. O., Afon, A., Abegunde, A. A., & Bamise, C. T. (2010). Assessment of dental waste management in a Nigerian tertiary hospital. *Waste management & research*, 28(9), 769-777.
29. Abdulla, F., Qdais, H. A., & Rabi, A. (2008). Site investigation on medical waste management practices in northern Jordan. *Waste management*, 28(2), 450-458.
30. Fadipe, O. O., Oladepo, K. T., Jeje, J. O., & Ogedengbe, M. O. (2011). Characterization and analysis of medical solid waste in Osun State, Nigeria. *African Journal of Environmental Science and Technology*, 5(12), 1027-1038.
31. Coker, A., & Sridhar, M. K. (2010). Increase in healthcare facilities and rapid environmental degradation: A technological paradox in Nigeria's urban centres. *African Journal of Environmental Science and Technology*, 4(9), 577-585.
32. Shiferaw, Y., Abebe, T., & Mihret, A. (2012). Sharps injuries and exposure to blood and bloodstained body fluids involving medical waste handlers. *Waste management & research*, 30(12), 1299-1305.
33. Abah, S. O., & Ohimain, E. I. (2011). Healthcare waste management in Nigeria: A case study. *Journal of Public Health and Epidemiology*, 3(3), 99-110.
34. Idowu, I., Alo, B., Atherton, W., & Al Khaddar, R. (2013). Profile of medical waste management in two healthcare facilities in Lagos, Nigeria: a case study. *Waste Management & Research*, 31(5), 494-501.
35. Prüss-üstün, A., Chartier, Y., Emmanuel, J., Pieper, U., Rushbrook, P., Stringer, R., Townsend, W., Wilburn, S., & Zghondi, R. (2014). *Safe management of wastes from healthcare activities, 2nd edition*, WHO, Geneva, pp. 328.
36. Ogbonna, D. N. (2011). Characteristics and waste management practices of medical wastes in healthcare institutions in Port Harcourt, Nigeria. *Journal of Soil Science and Environmental Management*, 2(5), 132-141.
37. Shinee, E., Gombojav, E., Nishimura, A., Hamajima, N., & Ito, K. (2008). Healthcare waste management in the capital city of Mongolia. *Waste management*, 28(2), 435-441.
38. Prüss-üstün, A., & Townsend, W. K. (1999). *Safe management of wastes from health-care activities*. World Health Organization.
39. Visvanathan, C. (1996). Hazardous waste disposal. *Resources, conservation and recycling*, 16(1-4), 201-212.
40. Babanyara, Y. Y., Ibrahim, D. B., Garba, T., Bogoro, A. G., & Abubakar, M. Y. (2013). Poor Medical Waste Management (MWM) practices and its risks to human health and the environment: a literature review. *Int J Environ Ealth Sci Eng*, 11(7), 1-8.
41. Neller B. J. (2020). Key methods for disposing of medical waste
42. Jang, Y. C., Lee, C., Yoon, O. S., & Kim, H. (2006). Medical waste management in Korea. *Journal of environmental management*, 80(2), 107-115.
43. Levendis, Y. A., Atal, A., Carlson, J. B., & Quintana, M. D. M. E. (2001). PAH and soot emissions from burning components of medical waste: examination/surgical gloves and cotton pads. *Chemosphere*, 42(5-7), 775-783.
44. Segura-Muñoz, S. I., Takayanagui, A. M. M., Trevilato, T. M. B., Santos, C. B., & Hering, S. E. (2004). Trace metal distribution in surface soil in the area of a municipal solid waste landfill and a medical waste incinerator. *Bulletin of environmental contamination and toxicology*, 72(1), 157-164.
45. Pruthvish, S., Gopinath, D., Jayachandra, R. M., Girish, N., Bineesha, P., & Shivaram, C. (1998). Health-Care Waste Management Cell, Department of Community Medicine, MS Ramaiah Medical College. *Bangalore, India Information Learning Units for Health-Care Waste*.
46. Townsend, W. K. (2009). Healthcare waste management: policies, legislations, principles and technical guidelines. *Waste Management World Magazine*, 10(4).
47. United Nations Environment Program (2000) "Minimizing Hazardous Wastes": A Simplified Guide to the Basel Convention; France.
48. Nwufu, C. (2010). Legal framework for the regulation of waste in Nigeria. *African Research Review*, 4(2).
49. World Health Organization. (2017). *Safe management of wastes from health-care activities: a summary* (No. WHO/FWC/WSH/17.05). World Health Organization.
50. Ifeoma P. (2018). Waste Management in Nigeria through Effective Policy: Strengthening the Legal Framework— Bolaji Ramos.
51. Iriruaga, E.T., 2012. Solid Waste Management.
52. International Solid Waste Agency (2020). Covid-19 response: International knowledge sharing on waste management.
53. Waste4change. (2020). Understanding Medical Waste Management to Curb the Transmission of COVID-19.
54. Mallapur, C. (2020). Sanitation Workers At Risk From Discarded Medical Waste Related To COVID-19 (2020).
55. Vaishali, R. A. (2020). Discarded masks biggest potential carriers of coronavirus, say experts.
56. World Health Organization. (2020). *Water, sanitation, hygiene, and waste management for the COVID-19 virus: interim guidance, 23 April 2020* (No. WHO/2019-nCoV/IPC_WASH/2020.3). World Health Organization
57. WHO/UNICEF Joint Water Supply, Sanitation Monitoring Programme, & World Health Organization. (2015). *Progress on sanitation and drinking water: 2015 update and MDG assessment*. World Health Organization.
58. Olu, T. (2020). Outrage as man who handle Abba Kyari's corpse disposes protective gear improperly.
59. Fletcher C. (2020). What happens to waste PPE during the coronavirus pandemic?
60. Central Pollution Control Board. (2020). Central pollution control board.
61. Seadon, J. K. (2006). Integrated waste management—Looking beyond the solid waste horizon. *Waste management*, 26(12), 1327-1336.
62. Marshall, R. E., & Farahbakhsh, K. (2013). Systems approaches to integrated solid waste management in developing countries. *Waste management*, 33(4), 988-1003.
63. Coker, A. O., Sikiru, K. A., Syidhar, M. K. C., & Sangodoyin, A. Y. (1999, August). Characterization and management of solid hospital wastes. In *WEDC CONFERENCE* (Vol. 25, pp. 331-334).

64. Mato, R. R. A. M., & Kaseva, M. E. (1999). Critical review of industrial and medical waste practices in Dar es Salaam City. *Resources, Conservation and Recycling*, 25(3-4), 271-287.
65. Coker, A., Sangodoyin, A., Sridhar, M., Booth, C., Olomolaiye, P., & Hammond, F. (2009). Medical waste management in Ibadan, Nigeria: Obstacles and prospects. *Waste management*, 29(2), 804-811.
66. Echegaray, M., Rodriguez, R. A., Udaquiola, S. M., & Hektor, K. (2002). Heavy metals in the ash fraction of medical waste incineration. *Ingenieria Quimica*, (21), 12-17
67. Adewumi, I. (2001, November). Waste management in Nigeria: Issues and prospects. In *Conference Paper Presented at PAEHON Conference Lagos, Nigeria*.
68. Longe, E. O., & Williams, A. (2006). A preliminary study of medical waste management in Lagos metropolis, Nigeria. *Journal of Environmental Health Science & Engineering*, 3(2), 133-139.
69. Johannessen, L., Dijkman, M., Bartone, C., Hanrahan, D., Boyer, M. G., & Chandra, C. (2000). *Healthcare waste management guidance note*. World Bank, Health Population and Nutrition Team.
70. Wilson, D. C., Rodic, L., Modak, P., Soos, R., Carpintero, A., Velis, K., & Simonett, O. (2015). *Global waste management outlook*. UNEP.
71. Nigeria Centre for Disease Control. (2020). An update of COVID 19 outbreak in Nigeria.
72. Africanews. (2020). Covid-19: Lagos State makes mask wearing compulsory.
73. Chua, T., Puziah, A. L., & Subramaniam, A. K. (2012). Medical waste management in private medical clinic Taipin, Perak. In International conference on Ecological Environmental and Bio science.