

## FINDING AN ACCEPTABLE METHOD FOR MEDICAL WASTE MANAGEMENT IN NIGEIRA\*\*

### **Abstract**

*Medical or Healthcare Waste (HCW) constitutes a special category of waste because they contain potentially harmful materials. The problem of how to manage medical waste has become one of critical concerns in developing countries. Medical waste includes every wastes generated in the process of diagnosis, treatment of patients and other medical procedures from all the types of healthcare institutions. The improper management of medical waste poses serious health risks to people and the environment by contaminating the air, soil and water resources. Health care facilities are supposed to safeguard the health of the patient and community, and where not properly managed can pose an even greater threat than the original disease themselves. A number of studies have indicated that the inappropriate handling and disposal of medical waste poses health risks to health workers who may be directly exposed and to people near health facilities, particularly children and scavengers who may become exposed to infectious wastes. This paper aims at ascertaining the best approach and methods of managing medical/healthcare waste in Nigeria. The paper adopted doctrinal methods of data collection and in doing so, looked at relevant statutory provisions, textbooks, journal articles etc. The study found among other things that there many scientifically approved methods for medical waste management in Nigeria. Healthcare/medical waste generators should as a matter of urgency improve on their technologies for medical waste management. Modern machines and techniques that ensures pollution free waste disposal method should be employed is part of the paper's key recommendations which is believed would ensure that our medical facilities are clean, and free from litters of medical wastes.*

**Keywords:** Waste, Healthcare Waste, Medical Waste Management, Hazardous Waste.

### **1.0.Introduction**

Majority of our healthcare facilities and street corners are littered with hazardous medical waste on daily basis and no one appears to be perturbed Poor waste management leads to bad environment, and bad environment affects the health of man.<sup>1</sup> As is evident, healthcare facilities in any part of the world including Nigeria contributes to the generation of all sorts of medical/healthcare waste. It is therefore important that all hands be on deck in putting forward measures and more practical and effective modes of managing the waste generated on daily basis from medical facilities. Although the volume of medical/healthcare waste generated in healthcare facilities in Nigerian is increasing, the capacity of the agencies with statutory responsibilities of managing these wastes are diminishing.<sup>2</sup> It is not in doubt that Nigeria as a nation has various and well equipped regulations aimed at management of medical waste. However, observations revealed lack of the will power by both government, healthcare waste generators and citizens to protect, manage and or report abuse of our environment.

The issue of environmental protection is very crucial to development. Although there were efforts by government on the protection of the environment *vis-a-vis* management of healthcare wastes in Nigeria, including the making of National Environmental (Healthcare

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\* Jude Okoye (LLB, BL, LLM, PhD and Senior Lecturer, Faculty of Law, Nnamdi Azikiwe University, Awka)

\* Origbakpor Christopher Elom (LLB, BL, LLM, and PhD Student, Department of Public & Private Law, Faculty of Law, Nnamdi Azikiwe University, Awka)

<sup>1</sup>Iguh, Ewulum &Origbakpor, 'Revisiting the Waste Management Framework in Anambra State Under the Current Dispensation', *Journal of Legal Issues, Idemili Bar Journal*, 2021 Vo. 2, p. 1

<sup>2</sup> J U Achor, *Improving the living Environment in slum settlement*, (Lagos: Bedan Company Ltd, 1998) p.83

Waste Control) Regulation, 2021 and other policies, however the obvious fact is that our health facility healthcare wastes are still not properly managed, resulting to increase in pollution and waste related infectious disease. That explains the observation of an environmental activist; Olukanni<sup>3</sup> in his article that,<sup>4</sup> “despite achievements of the past, the present times can testify to the fact that environmental issues have since fallen off our radar. This in no way helps the nation grow economically and socially as ignoring environmental degradation only sabotages any nation’s effort at development. So, how do we start? There is need to also strengthen implementing arms such as the National Environmental Standards and Regulation Enforcement Agency (NESREA) to enable creation of standards and enforcement of our environmental laws. The same action need to be taken to state levels with appropriate institutions and mechanism. Each state need to draw up its programme of action in accordance with its peculiar environmental problems”.<sup>5</sup> This study assessed of the various methods of waste management aimed at ascertaining a more practical and effective mode of management of healthcare waste.

## 2.0. Meaning of Medical Waste

Like every other concept, medical waste appears to have defied certain and comprehensive definition. This is so because majority of the author used ‘waste’ and various related terminologies in their definitions of healthcare/medical waste. For instance Nyekwere<sup>6</sup>, noted that medical waste includes all the wastes generated in the diagnosis, treatment, surgeries, autopsies, or other medical procedures from all types of healthcare institutions, including hospitals, clinics, doctors (dental and veterinary) offices, medical laboratories and research centres related to medical procedures. The author<sup>7</sup> went further to classify medical wastes into Sharp waste, Infectious waste, Pathological waste, Pharmaceutical waste, Cytotoxic waste, Chemical waste, Radioactive waste, and Non-hazardous or general waste. Brenner<sup>8</sup> defined medical waste as any kind of waste that contains infectious material (or material that’s potentially infectious). He went further to state that the medical waste includes waste generated by healthcare facilities like physician’s offices, hospitals, dental practices, laboratories, medical research facilities, and veterinary clinics. For the author, medical waste includes anything that is soaked in blood (gloves, gauze, gowns, etc.), human or animal tissues created during procedures, culture of infectious diseases/agents, any waste produced in patient’s room with communicable diseases, and discarded vaccines. He further noted that medical waste has other names such as, biomedical waste, clinical waste, bio-hazardous waste, regulated medical waste, infectious medical waste and healthcare waste.

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<sup>3</sup> A. Olukanni was the Vice Chairman of environmental NGO, Fight Against Desert Encroachment (FADE) in honorary capacity and current Director-General of the Nigerian Association of Chambers of Commerce, Industry, Mines and Agriculture.

<sup>4</sup> A Olukanni, “Bringing Back Environmental Issues to Centre Stage”, published in *Daily Sun Newspaper*, Thursday, 27 June, 2019) p.35.

<sup>5</sup> *Ibid.*

<sup>6</sup> EH Nyekwere, “Legal Assessment of the Impact of the Improper Disposal of Medical waste in Nigeria” *Nnamdi Azikiwe University Awka Journal of International Law and Jurisprudence*, 2012, vol 1, p.25.

<sup>7</sup> *Ibid.*, p. 27

<sup>8</sup> Ben Brenner, *What is Medical wastes? Definition, Types, Examples*; [www.medprodisposal.com](http://www.medprodisposal.com). Last visited on 6<sup>th</sup> March, 2023 @2:06pm.

For Zarook,<sup>9</sup> medical waste is limited to infectious, hazardous, and any other wastes that are generated from health care institutions, such as hospitals, clinics, dental offices, and medical laboratories<sup>10</sup>. Longe and Williams,<sup>11</sup> defined medical waste to mean any solid waste generated in the diagnosis, treatment, or immunization of human beings or animal, in related research, production or testing of biologicals from all types of healthcare institutions, including hospitals, clinics, doctor (dental and veterinary) offices, and medical laboratories.

According to research,<sup>12</sup> healthcare waste are the total waste stream generated in healthcare facilities, including solid waste and wastewater. For Nagaraju *et al*<sup>13</sup>, unwanted materials generated during diagnosis, treatment, operation, immunization or in research activities including production of biologicals is termed biomedical waste. They noted that day to day activities in health institutions generate a lot of waste which is biological in nature and are potential sources of infection transmission especially hepatitis B and C, HIV, and tetanus. According to Babatola<sup>14</sup> hospital waste as material, containing pathogens in sufficient concentrations or quantities that, if exposed, can cause diseases. This he noted includes waste from surgery, autopsies on patients with infectious diseases.

Section 48 of National Environmental (Healthcare Waste Control) Regulation<sup>15</sup> defined healthcare waste to mean wastes which is generated;

- a. During the diagnosis, treatment, immunization of humans, animals, in research or activities pertaining thereto or in the production or testing of biological experiments, and
- b. In medical and health institutions (dispensaries, hospitals, polyclinics and outpatient departments, dental clinics, veterinary stations, pharmacies, patent medical shops, etc.) as a result of use or contamination during diagnosing, medical treatment and prevention of diseases in humans and animals<sup>16</sup>.

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<sup>9</sup>MS Zarook, "Medical waste management and Control", *Journal of Environmental Studies*, January, 2012, American University of Sharjah, UEA, Vol. 3, pp. 1625 – 1628, accessed online on 6<sup>th</sup> March, 2023.

<sup>10</sup> See also, US Congress, Office of Technology Assessment, "Issues in Medical Waste Management-Background Paper," US Government Printing Office, Washington DC, 1988.

<sup>11</sup> EO Longe and A Williams, "A Preliminary Study of Medical Waste Management in Lagos Metropolis, Nigeria", *Iran Journal of Environmental Health Sciences and Engineering*, 2006, Lagos, Vol. 3, No. 2 Pp.133-139. Accessed online on 11<sup>th</sup> March, 2023.

<sup>12</sup>Gawad M A Alwabr, Ahmed S Al-Mikhlaifi, Saif A. Al-Hakimi, and Munira A Dughish "Determination of Medical Waste Composition in Hospitals of Sana'a City, Yemen", *Journal of Applied Sciences and Environmental Management*, 2016, Yemen, Vol.20 (2) 343-347. Accessed on line at [www.ajol.info](http://www.ajol.info) on 11<sup>th</sup> March, 2023 by 2:00pm.

<sup>13</sup> B Najaraju, GV Padmavathi, DS Puranik, MP Shantharaj, and SP Sampulatha, "A Study to Assess the Knowledge and Practice on Bio-Medical Waste Management Among the Health Care Providers Working in PHCs of Bagepalli Tulak with the View to Prepare Informational Booklet", *International Journal of Medicine and Biomedical Research*, vol.2, issue 1, January, 2013. Accessed online at [www.ajol.info](http://www.ajol.info) on 11<sup>th</sup> March, 2023 by 4:00pm.

<sup>14</sup> JO Babatola, "A Study of hospital Waste Generation and Management Practice in Akure, Nigeria", Accessed online at [www.ajol.info](http://www.ajol.info) on 11<sup>th</sup> March, 2023 by 12:00pm.

<sup>15</sup> 2021

<sup>16</sup> National Environmental (Sanitation and Waste Control) Regulation 2009 s. 106

The law<sup>17</sup> further defined healthcare waste generator to mean any person whose act or process produces healthcare waste and includes, but not limited to a provider of healthcare. The law also categorized healthcare waste into non-hazardous healthcare waste and hazardous healthcare waste. The law in addition defined waste management to mean the-

- a. Planning, handling, transportation, treatment, processing and disposal, including the supervision of these operations as well as the measures for protection of human health and the environment during the operation of the facilities and installations for waste disposal, and the care taken after the ruminantion of their operation and of its negative impact on human health and the environment, including waste handling, and
- b. Administrative and operational activities that are used in handling, packaging, treating, conditioning, reducing, recycling, reusing, storage and disposal of waste<sup>18</sup>.

The common ground from the definitions is that medical wastes are substances produced or used in diagnosis, research, treatment of humans or animals in hospitals, veterinary offices or laboratories which are no longer in use or by virtue of their use lost their immediate value and therefore hazardous or are potentially hazardous if improperly managed.

### **3.0.Methods of Control, Disposal and management of Medical Wastes.**

Generally, method of medical waste management can be classified into modern and traditional method. However, this research adopts a holistic approach. Nwokike<sup>19</sup> observed that waste is collected at a central open dumpsite and burnt periodically. Occasionally, the wastes are buried by covering with a layer of earth. No prior treatment takes place. Human body parts such as placenta and amputated limbs are either disposed with the general waste or returned to the patient for disposal. Used swabs and dressings as well as pharmaceutical wastes are disposed with general waste. Sharps are collected separately in sharp proof containers and disposed by burying. Achor<sup>20</sup> noted that every citizen of this country has roles to play in the search for effective waste management options. He further noted that since waste generation which is a by-product of household consumption, collection, handling and ultimate disposal are directly upon the members of each household. The management of solid wastes should involve a properly planned system of collection, transportation, storage, treatment and disposal of these wastes, combined with appropriate aftercare of the disposal sites. He added that ideally, the collection and disposal of wastes should be effective, efficient, and predictable. However, this is not the case in Nigerian cities. What obtains is an admixture of private and public initiatives that ultimately culminates in collection of refuse from one area and their

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<sup>17</sup>National Environmental (Healthcare Waste Control) Regulation, 2021.

<sup>18</sup>*Ibid.*, section, 48. See also National Environmental (Sanitation and Waste Control) Regulation 2009 s. 106

<sup>19</sup>F I Nwokike, "Nigeria in Search of sustainable Healthcare Waste Management Strategies: Any Legal and Institutional Prospect", *International Review of Law and Jurisprudence*, 2020, Vol. 2(3) p.100

<sup>20</sup>J A Achor, *Improving the living Environment in Slum settlement*, (Lagos, Bendan Company Limited, 1998) p.116.

disposition somewhere else within the neighborhood or at open dumpsites. Incineration he pointed out, has been tried in some states of Nigeria as a final operation costs, and use of unsuitable machinery. At present, there exists a need for applied research to develop effective and sustainable methods of waste management in Nigeria.<sup>21</sup>

Adamu<sup>22</sup> observed that disposal of hazardous wastes means getting rid of such wastes. The disposal of wastes can either be through dumping in water bodies, landfill, incineration at sea or on land, reclamation and recycling. Of the various forms of hazardous wastes disposal, none is completely satisfactory though all are very expensive. This assertion he noted further, is a truism more with regard to radioactive hazardous wastes than with regard to toxic hazardous wastes. Again, particular forms of disposal suits certain types of wastes while being unsuitable for other waste types. He further noted that the Management of Solid and Hazardous Wastes Regulations provides that; no person or body corporate shall operate and maintain a landfill site without a permit issued by the Agency.<sup>23</sup> Regulations 76 (1) provides for minimum requirement to be considered by the Authority before issuing a landfill permit.<sup>24</sup>

The Pollution Abatement in Industries and Facilities Generating Wastes Regulations<sup>25</sup> in its part provide that “solid wastes generated by an industry or facility shall be disposed of in an environmentally safe manner.<sup>26</sup> Regulation 16 (2)<sup>27</sup> provides that no industrial solid wastes shall be disposed of in any municipal landfill. Section 1 (2) (a) of Harmful Wastes (Special Criminal Provisions etc) Act, 1988 provides that any person who without lawful authority deposits, dumps, or causes to be deposited or dumped or is in possession for the purpose of deposition or dumping any harmful wastes on any land or in any territorial waters or contiguous zone of Nigeria or its inland water ways, shall be guilty of a crime under this Act.<sup>28</sup>

Okonkwo<sup>29</sup> noted that waste management strategies in modern day would include open dumping, sanitary landfill, incineration, composting, and resource recovery plant.<sup>30</sup>

For Omaka,<sup>31</sup> there are several methods of wastes reception and management. The method to adopt in reception and management of waste generally will depend on the type and volume of waste, relative cost and efficiency of each process to a particular case. Omaka identified recycling, refuse reclamation, land filling, surface impoundment, incineration,

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<sup>21</sup>*ibid.* p.114 to 115.

<sup>22</sup> K U Adamu, *Environmental Protection Law and Practice. Op. cit.* p. 123

<sup>23</sup>*ibid.* See Regulation 76 Solid and Hazardous Wastes Regulations, 1991. (This position by the author would be different now with the coming into force of National Environmental (Healthcare Waste Control) Regulation, 2021)

<sup>24</sup>*ibid.*

<sup>25</sup> 1991.

<sup>26</sup> Regulation 16 (1), Pollution Abatement in Industries and Facilities Generating Wastes Regulations, 1991.

<sup>27</sup>*ibid.*

<sup>28</sup> Harmful Wastes (Special Criminal Provisions etc) Act, 1988 s.1

<sup>29</sup> T Okonkwo, *The Law of Environmental Liability*, (Lagos: Fine Finishing Limited, Afrique Environmental and Education (AEDE) 2010)p.761.

<sup>30</sup>*ibid.*

<sup>31</sup> C A Omaka, *Municipal and International Environmental Law* (Enugu, Kingdom Age Publications)p.160.

deep well injection, chemical treatment, land treatment, solidification and annular disposal of pumpable drilling waters as some of the methods that are commonly used in the disposal of industrial and petroleum wastes. He noted that research have identified other methods of which are common mostly in rural areas and at times, in urban areas, although not sound waste management systems include tipping on land (open dump), pulverization, tipping in the sea or river, separation and salvage, controlled tipping and composting.<sup>32</sup> Accordingly, choice of method of wastes disposal and management is governed by economic and geographical considerations such as the cost of transport and the availability of wastes reception facilities.<sup>33</sup> Adinna<sup>34</sup> observed that groups of countries, individual countries, organizations and individuals often invoke technological approaches to avert what would have spelt doom for the people. He identified recycling, waste conversion, construction of effective drainage system, the use of chemicals to clear oil spills, dams and irrigation system, and low waste-yielding processes and waste reduction measures as some of the technological strategies which is advised.<sup>35</sup>

Schedule 9 to National Environmental (Healthcare Waste Control) Regulations<sup>36</sup> provides for methods of medical/healthcare waste treatment. Generally, the Regulation listed incineration, steam sterilization, decontamination, grinding, segregation<sup>37</sup>, waste treatment, internment<sup>38</sup> etc. The Regulation prohibit open burning of medical/healthcare waste<sup>39</sup> and discharge of untreated effluents into water course or water body.<sup>40</sup>

Regulation 11 of National Environmental (Healthcare Waste Control) Regulations provides that a healthcare facility or healthcare waste treatment facility that generates healthcare waste shall treat or cause to be treated such waste using Best Available Technology (BAT) and Best Environmental Practices acceptable to the Agency and exercise a duty of care to manage and dispose of the waste safely, and be responsible for the safe handling and ensure sound disposal of the waste they generate and have a responsibility of the waste from the point of generation until its final treatment and disposal.

It should be noted that virtually all methods of waste management generally can pass for medical waste management. For the purposes of this paper, the most common methods of medical waste management generally include microwaving, autoclaving, burying, interment or landfilling, open burning, Chemical disinfection, inertization, recycling, pulverization, incineration, composting, segregation, chemical treatment, open dump and controlled tipping.

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<sup>32</sup>*Ibid.*

<sup>33</sup>*Ibid.* p. 161.

<sup>34</sup> E N Adinna, *Environmental Hazards and Management* (Enugu, Snaap Press, 2001) p. 47.

<sup>35</sup>*Ibid.* See also C A Omaka, *Op.cit.* pp. 161-162.

<sup>36</sup>National Environmental (Healthcare Waste Control) Regulation, 2021

<sup>37</sup>*Ibid.* Regulation 12

<sup>38</sup>*Ibid.* Regulation 26 (2)

<sup>39</sup>*Ibid.* Regulation 16

<sup>40</sup>*Ibid.* Regulation 6.

### 3.1. Microwaving

Microwaving is the insertion of medical wastes into an oven-like container and subjected to heat pressure. Microwaving of medical waste is essentially a steam-based disinfectant process whereby moist heat and steam generated by microwave energy sterilize wastes and destroy infectious agents and pathogenic organisms present in the waste stream. Microwave technology has certain benefits, such as the absence of harmful air emissions, no requirement of chemicals, and reduced volume of waste. However, the investment costs of microwaving are high presently<sup>41</sup>.

### 3.2. Open Burning

Research indicates that medical wastes may be burned in a drum, protected hearth, or an open-pit if it cannot be taken to an incinerator.<sup>42</sup> Observation revealed that uncontrolled and sub-standard burning is extremely practiced creating further environmental problems, as well as the emission of toxic air pollutants which might be present in the gaseous and solid by-product. The smokes might contain heavy metals and other chemical contaminants that eventually may affect the health of site workers and the general public.<sup>43</sup> This mode of waste disposal and management aside being archaic has many disadvantages. It's a serious source of air pollution and environmental degradation. No wonder, Regulation 16<sup>44</sup> prohibit open burning of medical/healthcare waste.

### 3.3. Chemical disinfection

Regulation 7<sup>45</sup> provides that facility or healthcare waste treatment facility shall carry out efficient treatment of its waste at all times, ensure that sludge containing heavy metals or other toxic materials are disposed of in Environmentally Sound Manner (ESM) in a designated disposal site. Also, they are to ensure the treatment and disposal of toxic organics contained in both effluent and sludge as approved by the Agency including ensuring that effluent is not diluted in order to achieve the standards prescribed in the Second Schedule to these Regulations; ensure that wastes containing toxic organics are treated with Best Available Technology (BAT) and by adopting Best Environmental Practices (BEP).<sup>46</sup> By Regulation 8,<sup>47</sup> healthcare facilities, and generators of chemical healthcare waste, shall be responsible for the neutralization, detoxification and removal of heavy metals and other toxic chemicals from wastewater before it is discharged into any environment, where they exceed the permissible limits. Wastewater from radiological investigations shall be neutralized, detoxified or immobilized and treated before it is released into the environment in accordance with the existing National Regulations on Radioactive substances.

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<sup>41</sup>EH Nyekwere, "Legal Assessment of the Impact of the Improper Disposal of Medical waste in Nigeria" *Nnamdi Azikiwe University Awka Journal of International Law and Jurisprudence*, 2012, vol 1, p.32.

<sup>42</sup>*Ibid.* p.30

<sup>43</sup>*Ibid.*

<sup>44</sup> National Environmental (Healthcare Waste Control) Regulation, 2021

<sup>45</sup>*Ibid.*

<sup>46</sup>*Ibid.*

<sup>47</sup>*Ibid.*

According to Zarook,<sup>48</sup> in order to reduce the toxicity of some medical wastes, chemical disinfectants are sometimes used. For solid wastes, disinfection is effective if only waste material are shredded. However, in some cases, the disinfectants themselves are hazardous, thus not recommended for treating pharmaceutical, chemical and some infectious wastes.

Chemical disinfection reduces the pathogenic risk of infectious medical wastes, and that the choice of an appropriate chemical agent and conditions of use are usually determined by the risk assessment, taking into account the identity of the organisms to be treated, the nature of the waste and the presence of organic, protein or particulate matter, and the kind of surfaces, objects or equipment which will be exposed to the chemical disinfectant.<sup>49</sup>

### 3.4. Autoclaving or steam sterilization

This is good for strong objects that can resist heat. Plastic materials cannot be autoclaved. Autoclaving can be carried out on objects such as surgical blades, forceps, syringes and needles. According to the regulation<sup>50</sup>, autoclave means process of heating infectious wastes by steam under pressure. The regulation further provides that culture, stock, contaminated bedding/patient care waste, contaminated small equipment, waste biologicals, surgical waste, human blood or blood product, contaminated laboratory waste, pathological waste, dialysis unit waste, contaminated and unused sharps can be autoclaved or steam sterilized.<sup>51</sup> Autoclaving or steam sterilization involves use of a low heat thermal that is designed to get steam into direct contact with waste for an adequate period to disinfect the waste. Autoclaved waste is further required to be treated to render it acceptable for final disposal. Autoclave may not remove or reduce the non-biological hazards arising from the presence of chemical or physical agents or other elements in the waste.<sup>52</sup> Autoclaving is environmentally safe, and in an autoclave, hot steam kills microorganism.<sup>53</sup>

### 3.5. Inertization

Inertization is the mixing of waste with cement and other substances before disposal to reduce the threat of toxic substances enclosed in the waste migrating into the surface or ground water. This makes the chemical not to readily react with other elements or compounds. This method has been noted to be particularly appropriate for pharmaceuticals and for incineration ashes with high metal content. To carry out inertization of pharmaceutical wastes, the packaging is usually removed, the

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<sup>48</sup> M S Zarook, "Medical waste management and Control", *Journal of Environmental Studies*, January, 2012, American University of Sharjah, UEA, Vol. 3, pp. 1625 – 1628, accessed online on 6<sup>th</sup> March, 2023.

<sup>49</sup> UNEP, Technical Guidelines on the Environmentally Sound Management of Biomedical and Healthcare wastes' Basel Convention series/SBC No.2003/3 (Secretariat of the Basel Convention and UNEP, 2003), p.35. See also, Nyekwere, *Op.cit.* p.30-31

<sup>50</sup> Regulation 48, National Environmental (Healthcare Waste Control) Regulation, 2021

<sup>51</sup> See Nineth Schedule to National Environmental (Healthcare Waste Control) Regulation, 2021

<sup>52</sup> See UNEP Technical Guideline *Op.cit.* p.32-33

<sup>53</sup> Nyekwere *Op.cit.* p.31

pharmaceuticals grounded, and mixed with water, lime and cement. This method is practically not expensive and can be executed using simple equipment.<sup>54</sup>

### 3.6. Recycling

By Regulation 17 of the Regulation<sup>55</sup> a healthcare facility or healthcare waste treatment facility shall provide adequate litter bins and receptacles in accordance with the specifications for a recyclable material at appropriate and easily accessible locations and ensure that all recyclable materials are neatly packed before evacuation for recycling. The National Environmental (Sanitation and Wastes Control) Regulation, 2009 provides for waste recycling as one of the methods of waste management. Regulation 106 of the Regulation define recycling of waste to mean the processing of waste material into a new product of similar chemical composition. This appears to be the trend now. Probably, because of its economic value. It is clear that wastefulness is one of the major problems facing humanity today. Many of our natural resources used as industrial inputs in the production of goods are not available to us in unlimited supply. This is particularly so when one reflected on many metals such as aluminum, copper, iron, and steel, which are discarded in tremendous quantities all over the world and huge amount of money spent annually in importing these materials into the country for various industrial uses. Recycling is therefore the process of converting wastes to finished good. Recycling of some medical wastes will protect the environment, reclaim valuable substances for re-use, and save our natural resources for more economically viable use.<sup>56</sup>Our research revealed that the practice of scavenging for some recyclable medical waste is in vogue.

### 3.6. Open Dumping

The open dump method is the most widely used method of waste reception and management. As a result, when open dump is employed in waste disposal, the site should be in an isolated area, be properly supervised and about seven kilometers from the nearest town or district boundary.<sup>57</sup> Okonkwo<sup>58</sup> noted that this method involves the depositing of solid and liquid wastes in a land disposal site in such a way that the whole thing is left uncovered with little or no regard for control of scavenger, aesthetics, disease, air pollution and water pollution problems. This method he further noted allows for easy management of wastes as all kinds of wastes are easily received. It can be easily put into operation within a short period and it is not capital intensive. However, open dump method is quite gory and can be a disease breeding management strategy. It causes air pollution where such wastes have to be burned.<sup>59</sup> Research revealed that the leaching brings about contamination of ground water and surface water which can in turn affect man, animal and plants. It also creates problems in land use.<sup>60</sup> However, despite the noted difficulties associated with the practice of open dumping, the economic value of this method cannot

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<sup>54</sup>*Ibid.* p.32

<sup>55</sup> National Environmental (Healthcare Waste Control) Regulation, 2021

<sup>56</sup> O A Arbisala; *Raw Material Resources Processes and Environment in Nigeria*, being a paper delivered at FEPA Conference in Lagos, 1992 cited in C. A. Omaka, *op. Cit.* p.163. .

<sup>57</sup>*Ibid.*, P. 164.

<sup>58</sup> T Okonkwo, *Op.cit.*, p. 761

<sup>59</sup>*Ibid.* p.761.

<sup>60</sup> . Omaka C A, *op. Cit* p. 164.

be overruled. The habit of reclaiming valleys and low-lying areas at low cost by controlled tipping is not uncommon. Although the method is hardly properly controlled in the strict sense. However, local authorities favours the land reclamation method, partly because of the comparatively low disposal cost per ton of refuse and partly because of the potentials which is provided by this form of disposal for enabling the development of various schemes for reclamation of land.<sup>61</sup> Priest observed that the advantage of land reclamation cannot be denied, but it is a primitive method of waste disposal associated with many nuisances, which are not always avoided even where the standards of workmanship are comparatively high.<sup>62</sup>

### 3.7.Composting

This is the method of waste management whereby putrescible medical waste is allowed to decompose for use as artificial manure. The system involves sorting out putrescible materials from non-putrescible ones. The putrescible wastes are then arranged in open heaps where they are turned over regularly for mixing and aeration. Under suitable conditions like a temperature of up to 70% some pathogenic bacteria are destroyed while the organic or putrescible portion of the waste is broken down by aerobic action.<sup>63</sup>

According to Okonkwo,<sup>64</sup> composting has been described as soil bank for the future. Effective composting requires careful sorting to ensure that only garbage pack of the waste is converted. In Nigeria, it has been in practice for long as a traditional waste management strategy. It is used to improve farm yields.

It need be pointed out that this practice is not consciously seen as a waste management strategy. The practice of composting is a traditional waste management method and is prone to disease generation and pollution especially when improperly managed.

### 3.8.Incineration

According to Regulation 106 of National Environmental (Sanitation and Wastes Control) Regulation, 2009, incineration means the controlled burning of solids, liquids, gaseous combustible waste to produce gases and residues containing little or no combustible materials.<sup>65</sup> This practice is carried out using an incinerator. Incinerator is a specific facility/machine designed or used for the primary purpose of destruction of waste by combustion. This is a waste management strategy whereby solid, semi-solid, liquid or gaseous combusting material are burnt as a means of waste disposal. This is done using a special machine called, incinerator. In the process of incineration, a secondary combustion chamber in which burning at a high temperature is contrived to complete the combustion process. Thereafter, flues wherein the gases of combustion are cleaned take effect, before

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<sup>61</sup>*Ibid.*, P. 164.

<sup>62</sup>MA Priest *Modern Textbook of Personal and Community Health for Nurses* (London: Williams Heinemann Medical Books Ltd. 1997) cited in C. A. Omaka *Op. cit.*, p. 164.

<sup>63</sup>*Ibid.*, P.166.

<sup>64</sup> T Okonkwo, *The Law of Environmental Liability*, (Lagos: Fine Finishing Limited, Afrique Environmental and Education (AEDE) 2010)p.762.

<sup>65</sup> See also, Regulation 48, National Environmental (Healthcare Waste Control) Regulation, 2021

they are conveyed to a chimney and consequently to the atmosphere.<sup>66</sup>This method has been noted to be capital intensive and requires technological know-how.<sup>67</sup> Okonkwo noted that unless very costly control measures are installed, incineration as a waste management strategy can cause air pollution.<sup>68</sup>This method is satisfactory, and there is need for providing a forced draught and to prevent noxious gas and smoke from polluting the atmosphere.<sup>69</sup> Sometimes in most urban cities, residents are tempted to set fire on overflowing refuse bins when it is not evacuated for days. In some developed countries of the world, sophisticated incinerators in have the advantage that all types of refuse/wastes can be dumped into them without previously sorting them out. This is because of their ability to separate incombustible from combustible waste.

Regrettably, some local incinerators in developing countries are usually unable to perform these functions with result that highly inflammable objects are dumped and abandoned in the incinerators making subsequent burning impossible.<sup>70</sup> It has been observed that incineration is the most practical means of disposing hazardous medical waste through high temperature and burning of solid waste after separating the non-combustibles.<sup>71</sup> She noted that incinerator functions at much higher temperatures than an open fire, so that the infectious medical wastes are eradicated, and smoke emission is less. For reasons of emission control and operational safety and reliability, it is desirable to incinerate medical wastes from as many hospitals as possible in one central unit. Emissions in the air, water, and soil are usually reduced by the use of effective and advanced incineration and emission control techniques under technically and economically viable conditions, taking into account the location of the plant.<sup>72</sup> Schedule nine of the Regulation<sup>73</sup> provides that contaminated animal carcasses, contaminated beddings/patient care waste, contaminated small equipment, waste biological, surgery waste, human blood, autopsy waste, human blood product, pathological waste and contaminated and used sharps should be incinerated. It provides further that there should be no chemical pre-treatment before incineration, and chlorinated plastics shall not be incinerated.

### **3.9. Sanitary Land Filling, Burying or Interment**

Third Schedule to National Environmental (Healthcare Waste Control) Regulations, 2021 provides that deep safe burial shall be an option available only in towns with population less than five hundred thousand and in rural areas. Regulation 106 of National Environmental (Sanitation and Wastes Control) Regulation, 2009 define “sanitary landfill” to mean the method of disposing of refuse on land without creating nuisance or hazards to public health or safety, but utilizing the principles of engineering to confine the

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<sup>66</sup>R K Turner, *Municipal Solid Waste Management: An Economic Perspective*, in A.D. Bradshaw, R. South worth, and F. Warner (eds.) “The Treatment and Handling of Wastes” (London: Chapman and Hall, 1992) pp. 83 to 102.

<sup>67</sup> C A Omaka *Op. cit* p. 165.

<sup>68</sup>T Okonkwo *Op.cit.* p.762.

<sup>69</sup> C E Turner, *Op. Cit.*

<sup>70</sup>F E Bruce, “Water Supply, Sanitation and Disposal of Waste Matters” cited in W. Hobson (Ed.). *The Theory and Practice of Public Health* (London: Oxford University Press, 1999) P.35-48.

<sup>71</sup> A O Awosusi, “Assessment of Environmental Problems and Methods of Waste Management in Ado Ekiti, Nigeria”, *African Research*, (2010) Vol. 4, p. 331-343.

<sup>72</sup>Nyekwere, *op.cit.* p.29

<sup>73</sup> National Environmental (Healthcare Waste Control) Regulation, 2021

refuse to the smallest practical area, to reduce it to the smallest practical volume, and to cover it with a layer of earth at the conclusion of each days operation or at such more frequent intervals as may be necessary. It involves the burying of infectious and medical waste in a pit or an approved landfill site. It is the most convenient waste disposal technique worldwide and is cheap and most affordable technology. A standardized landfill system involves a carefully selected location and usually constructed and maintained using engineering techniques, ensuring minimized pollution of air, water, and soil and risks to man and animals. It involves placing medical wastes in line up pits or a mound with appropriate means of leachate and landfill gas control.<sup>74</sup>

This strategy or method is slightly an upgraded version of open dumping. It involves the use of land site that is located to minimize water pollution from turn-off and leaching. This strategy requires the waste to be spread in thin Layers, compacted, and covered with a fresh layer of soil each day to minimize pests and aesthetics loss, disease, air pollution and water pollution problems. This method is very useful for land reclamation or enhancing the value of sub marginal land. Nevertheless, in situation where the strategy is poorly managed, it can degenerate into an open dump. One major constraint of this strategy is the need for large land space to be used as landfill sites. It could be pretty difficult to come by such sites, especially in countries where there is not enough land space for other human activities such as construction of houses, farming and provision of social infrastructures. Okonkwo<sup>75</sup> noted that for this strategy to be adapted in Nigeria where land space is supposedly not the problem, our wastes management authorities require a high degree of commitment and change of attitude. They need sincerity of purpose and effective prioritization. It is only through this that this strategy can be effectively managed.<sup>76</sup>

### 3.10. Secured Land Filling

This method of medical waste management involves the use of a land site for the storage of hazardous solid and liquid wastes, which are normally stored in containers and buried. Such sites are restricted and continually monitored. The danger in this strategy is that transporters of such wastes always capitalize on the ignorance and poverty level of people to secure such site. Hence, the health effect becomes unavoidable for the neighboring inhabitants. This is not a strategy one would recommend for any community.<sup>77</sup>

### 3.11. Pulverization

Pulverization method uses specialized refuse vans to crush solid wastes by its grinding mechanism. The ground material is then tipped on land or sea. The special vans have compactor system, which grinds the refuse reducing them to tiny particles, as they are loaded into the van. The refuse being so grinded makes it unattractive to flies and other animal disease vectors. The reduced refuse provides useful mixture for fertilizing and

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<sup>74</sup>Nyekwere, *Op.cit.* p.30

<sup>75</sup> T Okonkwo, *Op. cit* p. 761.

<sup>76</sup>*Ibid.* p.761.

<sup>77</sup>*Ibid.*, pp. 761-762. See further, Iguh, Ewulum &Origbakpor, "Revisiting the Waste Management Framework in Anambra State Under the Current Dispensation", Nigeria Bar Association Idemili Bar Journal, 2011, Vol. 2, p.8

lightening heavy soil.<sup>78</sup> Pulverization is a valuable process not only as a preliminary to composting but also as a means of reducing the volume of refuse before tipping. According to Omaka,<sup>79</sup> a battery of heavy hammer rotating inside a robust casing effect the method. Research revealed that pulverized refuse/waste is less offensive to humans and less attractive to flies and rodents than crude refuse/waste<sup>80</sup>. Pulverization as a method of waste management have been recommended by authors as good for use in urban centres.<sup>81</sup>

### 3.12. Tipping into the Sea or River

Tipping into the sea or river is also one of the methods of waste disposal and management especially amongst coastal state. Although this method have been condemned and heavily criticized because it pollutes territorial waters, rivers and lagoons,<sup>82</sup> it is still common among people living around coastal regions. This method of waste management and disposal came under increasing critical pressure as the lighter material finds its way back to the beaches with the winds and the tides.<sup>83</sup> Even the National Environmental (Sanitation and Wastes Control) Regulation, 2009 is also not in support of this practice. Hence, the said Regulation did not only prohibit this practice but also in the definition section of the Regulation described ‘fly-tipping’ as “the illegal dumping of all kinds of waste such as household, animal carcass, disused vehicle parts and tyres, and those from building and demolition work”.<sup>84</sup>

### 3.13. Segregation

Segregation involves sorting to separate different kinds of wastes mixed together for ease of disposal or management. Here, dust is extracted first and used for lightening heavy soil or disposed on any suitable land. Metals are magnetically removed, and sold as scrap. Bones are salvaged and used for glue making. Bottles and glassware are also salvaged while the remaining waste is then automatically fed into incinerators to be burnt, pulverized or control-tipped. These processes are expensive and usually work out on a costly basis. Researchers have suggested that this strategy could be effectively used in industrial tours.<sup>85</sup> Regulation 106 of National Environmental (Sanitation and Wastes Control) Regulation, 2009 defined segregation as any activity that separates waste materials for processing.<sup>86</sup> Regulation 12 of the National Environmental (Healthcare Waste Control) Regulations, 2021 provides that a health care facility or healthcare waste treatment facility that generates healthcare waste, shall at the point of generation and at

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<sup>78</sup>C. N. Sucking *Trandormation and Re-use* in A.D. Bradshaw, R. South Worth, and F. Warner (Eds.) “The Treatment and Handling of Wastes (London: Chapman and Hall, 1992) pp. 51-54, cited in C. A. Omaka *Op. cit.* p.164

<sup>79</sup>*Op. cit.* p. 164

<sup>80</sup>*Ibid.*

<sup>81</sup> For instances, see I. Nwimo and C. A. Omaka, *Nigerian Environmental Law Review*. Vol.1. No.1 (Enugu: a Publication off Nigerian Environmental Law Society.2007) p.44.

<sup>82</sup>C A Omaka *op. cit.* p.165.

<sup>83</sup>I Nwimo and C A Omaka *Op. cit.* p. 45

<sup>84</sup> Regulation 106 of National Environmental (Sanitation and Wastes Control) Regulation, 2009.

<sup>85</sup>C A Omaka, *Op. Cit.*, p.166

<sup>86</sup> Regulation 106 of National Environmental (Sanitation and Wastes Control) Regulation, 2009

all stages, segregate the waste using colour-coded containers and specified bin liners as prescribed in the Seventh Schedule to these Regulations<sup>87</sup>.

### 3.14. Nuclear and toxic waste disposals

Nuclear wastes are those vast range of materials which are radioactive and are therefore dangerous to most forms of life for hundreds if not thousands of years. Such radioactive wastes are usually generated by nuclear industries and uranium mills. Toxic wastes are those generated from toxic chemicals and metals which are poisonous to human beings and wildlife. Some of the metal waste which could be toxic include, lead, arsenic, mercury and cadmium. The method of disposing these waste have not been too environmentally friendly. Crump<sup>88</sup> while sharing this view observes that the problem of what to do with radioactive waste has remained unresolved. He maintains that majority of highly radioactive waste take a very long number of years to decay. Hence, most rich and powerful nation prefers to dump their wastes in poor countries. A typical example was the Koko waste dump of 1988.

Another method of disposing these wastes is the storing of such wastes especially radioactive wastes in stainless steel tanks, which are constantly cooled and monitored with the ultimate goal of solidifying the wastes in glass through the process of verification. However, the risk of earthquakes cannot guarantee the safety of any site for the length of time the waste has to be kept.

The inadequacies call for another method, which involves exporting such wastes to deserts. Typical example is Germany which exports nuclear wastes to china for burial in Gobi Desert.<sup>89</sup> However, this is not a good method of waste management. It is usually politically and economically motivated. In this case the developed countries of the world usually look for poor countries that are in serious need of economic assistance, and could then offer to dump the wastes in such countries for special funds to be released.

The effect of all these improper methods of nuclear and toxic waste disposal, are numerous on man, the flora and fauna in our environment. These results in health problems, (depending on the type of waste) that range from, convulsion, dermatitis, irritation of the nose and throat, a plastic anemia, blood disorders, skin burns, chest pains, weight loss, lung cancer, stomach pain, vomiting and diarrhea, weakness in the legs, throbbing headache, and death within a short time of poisoning.

Major industrial accident in nuclear and chemical plants over the past decades has also led to the general destruction of lives and property.<sup>90</sup> The fact that radioactive emission cannot be easily detected by human sense makes it highly dangerous and threatening to man's survival and damaging to all forms of living organisms.

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<sup>87</sup> Regulation 12, National Environmental (Healthcare Waste Control) Regulation, 2021

<sup>88</sup>Cited in T Okonkwo, *Op. cit.* p. 763

<sup>89</sup>*Ibid.*

<sup>90</sup>*Ibid.*

#### 4.0. Conclusion

As noted earlier, improper disposal of medical waste; whether hazardous or non-hazardous in nature poses great risk to the health facility. Report indicates that over 20 million infections of Hepatitis B, C and HIV occur yearly due to unsafe injections practice (re-use of syringes and needles in the absence of sterilization). Improper disposal of waste also poses indirect risks to humans through direct environmental effects by contaminating soil and ground waters.<sup>91</sup> Research revealed that present methods of medical waste in Nigeria are unsustainable<sup>92</sup> and should not be relied upon to protect human life, medical facilities or the environment. Observations reveals that some of the methods of medical waste management discussed above are scientifically healthy and ensures sound environmental protection. However, most of them especially those requiring high technology are cost effective and unavailable in most medical facilities. Inadequate technical know-how in places where these technologies exist are another major problem observed. Government and private hospital facilities also lack the willingness to procure and effectively managed waste management equipment. Corollary to the above is the indiscriminate disposal and littering of our environment with healthcare waste resulting in spread of waste related infections. Adequate medical waste treatment and disposal is the solution to safeguard the Nigerian environment and provide healthy, hygienic living environments for the citizens.<sup>93</sup> While some of the methods of medical waste management discussed above are scientifically healthy, some are prone to health risks especially when improperly managed.

#### 5.0. Recommendations

This paper therefore recommends as follows;

1. Healthcare/medical waste generators should as a matter of urgency improve on their technologies for medical waste management. Modern machines and techniques that ensures pollution free waste disposal method should be employed.
2. The National Environmental Sanitation Regulation and Enforcement Agency should establish more offices across states of the country so as to monitor the enforcement of the provisions of National Environmental (Healthcare Waste Control) Regulations, 2021 effectively with respect to medical waste collection, disposal and or management.
3. Open dumping, burning and disposal of harmful medical wastes in canals and waterways should be out rightly banned and stiffer punishment provided for its violation.
4. Training and retraining of sanitation staff and waste managers should be carried out from time to time to update their knowledge on modern medical waste management techniques.
5. The National Environmental Sanitation Regulation and Enforcement Agency constitute monitoring committee that will be saddled with regular inspection of healthcare waste generating facilities to ensure compliance to the Regulation.

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<sup>91</sup>F I Nwokike, "Nigeria in Search of sustainable Healthcare Waste Management Strategies: Any Legal and Institutional Prospect", *International Review of Law and Jurisprudence*, 2020, Vol. 2(3) p.104

<sup>92</sup>*Ibid.* p. 105

<sup>93</sup>Nyekwere, *Op.cit.* p45

6. Polluter pay principle enshrined in the National Environmental Sanitation Regulation and Enforcement Agency Act, 2007 and the National Environmental (Healthcare Waste Control) Regulations, 2021 should be vigorously and thoroughly enforced.
7. Segregation of medical wastes at point of generation in healthcare facilities should be encouraged, and sanitation staff adequately rewarded.
8. More awareness and information on the importance of healthy environment and dangers of healthcare wastes should be carried out from time to time.