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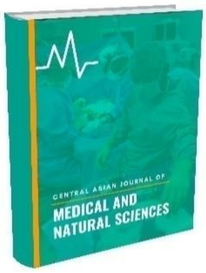

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Survey on Biomedical Waste Management in Laboratories in Rivers State University Teaching Hospital, Port Harcourt

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Abstract: Biomedical waste (BMW) generated in Nigeria on daily basis is immense and contains infectious and hazardous materials. It is crucial on the part of the employees to know the hazards of biomedical waste in the work environment and make its disposition effective and in a scientific manner. It is critical that the different professionals engaged in the healthcare sector have adequate knowledge, attitudes and practices (KAP) with respect to biomedical waste management. Many studies across the country have shown that there are still deficiencies in the KAP of the employees in the organizations, hence, it is necessary to make the appraisal of the same in Rivers State Teaching Hospital. The paper adopted contingency and bureaucratic theories. To ascertain the levels of and the expanse of gaps in knowledge, attitudes and practices among doctors, post graduates, staff nurses, laboratory technicians and house-keeping staffs in a tertiary care teaching hospital in Rivers State Teaching Hospital, a cross sectional study was carried out using questionnaire as the study tool among the health care professionals in a tertiary care teaching hospital. The study demonstrated gaps in the knowledge amongst all the cadres of the study respondents. The knowledge in relation to BMW Management including the hospital BMW protocols was more desirable among doctors, but practical facets were better in nurses and the lab technicians. Knowledge, Attitude and Practice amongst the different cadres of staff members were found to be significant statistically. Based on the findings, the study recommended that training and re-training at all laboratory staff Biomedical waste management should be treated like security issues if it should be carried out irrespective of class as infections organisms or agent does not respect class or rank to be infected. All laboratory personnel should be acquainted with safe handling at both hazardous and non-hazardous waste.

INTRODUCTION

Public interest in the sustainable management of Biomedical Waste in Laboratories (MBWL) has increased due to the health risks connected with human exposure to potentially hazardous wastes generated in laboratories (Tudor, et al., 2005; Ferreira, 2003; Da Silver, 2005). The nature and quantity of laboratories waste generated as well as institutional practises with regards to sustainable methods of biomedical waste management, including waste segregation and waste recycling, are frequently poorly examined and documented in a number of countries around the world despite the h (Farzadika et al.. 2009; Oke, 2005). Inadequate documentation of the level of awareness, particularly among health professionals, about Healthcare waste is also cause for grave worry. Biomedical waste in laboratories is a unique type of garbage since it frequently contains potentially hazardous substances that might cause illness in individuals who are exposed to it. The World Health Organization estimates that there are 8 to 16 million new cases of Hepatitis B virus (HBV), 2.3 to 4.7 million new cases of Hepatitis C virus (HCV), and 80,000 to 160,000 new cases of human immunodeficiency virus (HIV) each year as a result of unsafe injections and very poor waste management systems (WHO, 1999; Townend & Cheeseman, 2005).

In developing nations such as Nigeria, where several health issues compete for little resources, it is not unexpected that the management of biological waste in laboratories has gotten less attention and importance than it merits. Unfortunately, practical information on this crucial component of laboratory waste management is insufficient, and research on the public health consequences of inappropriate management of laboratory wastes is restricted in scope and number. It is believed that several hundreds of tonnes of Biomedical waste in laboratory are deposited openly in waste dumps and surrounding environments, frequently along with nonhazardous solid waste. Obtaining reliable records of the quantity and nature of Biomedical waste in laboratory and the management techniques necessary to dispose of these wastes has remained a challenge in many developing countries of the world (Alagoz and Kocasay. 2007; Abah & Ohimain, 2010). Others have observed an almost total absence of institutional frameworks for 1-ICW in Nigeria (Coker *et al.,* 1998). In laboratories throughout the world, biomedical waste has been evaluated and quantified using a variety of methods. They consist of physical observation, questionnaire administration, and quantitative analysis (Adegbita et al., 2010; Olubukola, 2009; Phengxay et al., 2005), as well as checklists (Townend and Cheeseman, 2005) and private and public data (Coker et al., 2009). Recent studies in Nigeria have suggested that waste generation ranges from 0.56 to 0.67 kilogrammes per bed per day (Longe and Williams, 2006) and can reach 1.68 kilogrammes per bed per day (Olubunmi, 2009). According to the research, there may not be a significant variation between the waste management practises of various health care organisations in Nigeria. A good example is provided by the findings of Olubukola's study in Lagos, which reported the similarity in waste data and Biomedical waste management practises in two General hospitals, which were characterised by a lack of waste minimization or waste reduction strategies, poor waste segregation practises, the absence of instructive posters on waste segregation, and the disposal of laboratory waste management with general waste (Olubukola, 2009).

Problem Statement

There are a number of problems associated with the management of management waste, including poor storage, frequent dumping, infectious waste, and inadequate management of medical waste, among others. Implementation of biological waste management legislation is one of the main hurdles due to low financing. Eliminate chlorinated plastic bags, gloves, and blood 4 bags, and install a bar code system for bays/containers, etc.

Objectives of the Study

The major objective of the study is assessing biomedical waste management practice in the laboratory in Rivers State University Teaching Hospital. This is to be achieved through the following specific objectives:

1. Assess the current waste management practices in terms of type of wastes and quantities of waste generated in the various units of the laboratory in RSUTH and the waste handling and disposal practices.
2. Assess the level of awareness of health workers regarding biomedical waste practices in the laboratories management.
3. Assess the level of compliance with recommended best practices for the sustainable management of laboratories waste management based on the United Nations Environmental Programme/World Health Organization (UNEP/WHO, 2005) and the Townend and Cheeseman 2005 guidelines.

Research Questions

1) What are the various waste management practices in the various units of the laboratories in RSUTH?
2) What is the level of awareness of Health workers as regards waste management practices in the laboratories?
3) What is the level of compliance with recommended best practices?

REVIEW OF RELATED LITERATURE

Laboratory Wastes

Rapid population expansion and concurrent increases in the demand for healthcare services have resulted in the emergence of new and more complicated socioeconomic issues. The proper management of healthcare wastes generated during diagnosis and treatment at healthcare institutions and facilities, research centres, and laboratories is one such challenge. According to studies, 75-90% of the waste generated in healthcare facilities is not infectious and is comparable to household waste, while 10-25% is infectious or hazardous in some way. WHO classifies laboratory waste as infectious, pathological, sharps, pharmaceutical, genotoxic, chemical, heavy metal, pressurised container, and radioactive (Pruss et al., 1999). Clinical laboratories generate a significant amount of infectious waste. Mixing common non-infectious waste with infectious waste causes possible economic and health issues. Improper waste management in clinical laboratories can lead to increased health hazards for individuals exposed, contamination of the sanitary waste stream, and environmental contamination (Reinhardt et al., 2001).

Treatment and Disposal

According to Ananth et al. (2010), different types of garbage must be handled differently. Healthcare waste treatment systems, particularly for infectious waste, are frequently categorised as burn and non-burn technologies, each with their own strengths, drawbacks, and application criteria (Hossain et al. 2011). Incineration is the most frequently cited treatment method for healthcare waste. Incineration is regarded as the gold standard treatment method, although there is a trend to employ it exclusively for the most challenging waste percentage (Blenkham, 2011). Incineration is defined by Mato and Kassenga (1997) as the controlled combustion process that converts solid, liquid, or gaseous waste mostly into carbon dioxide, other gases, and generally non-combustible residue or ash. The gases are discharged into the atmosphere (through a chimney), and the remaining residue is disposed of in a sanitary landfill.

Disposal Procedures

It is the responsibility of all researchers to ensure the safe and proper disposal of all wastes generated during their activity. The law prohibits the improper and irresponsible disposal of chemical wastes. The Aldrich Handbook offers a concise summary of the proper disposal procedure for the majority of chemicals. Due to new legislation, increasingly stringent environmental regulations, and rising disposal costs, it is imperative that the disposal procedures outlined below be strictly adhered to:

Wash down drains with excess water

- Concentrated and dilute acids and alkalis 4
- Harmless soluble inorganic salts (including all drying agents such as CaCI2, MgSO4, Na2SO4, P205)
- Alcohols containing salts (e.g. from destroying sodium)
- Hypochlorite solutions from destroying cyanids, phosphines, etc.
- Fine (tic grade) silica and alumina

It should be noted in particular that no material on the 'Red List' should ever be washed down a drain. This list is as follows:

- compounds of the following elements:- antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, tellurium, thallium, tin, titanium, uranium, vanadium and zinc.
- organohalogen, organophosphorus or organonitrogen pesticides, triazine herbicides, any other biocides.
- cyanides
- mineral oils and hydrocarbons
- poisonous organosilicon compounds, metal phosphides and phosphorus element
- fluorides and nitrites

Laboratory waste bins and controlled waste

Except for recyclable paper and glass, all waste appropriate for collection by the local government is referred to as "regulated waste." These items, which include soiled paper, plastic, rubber, and wood, should be placed in the garbage containers provided in each laboratory, and the cleaners will collect them. However, each laboratory must additionally include a container for objects that cannot be placed in the standard trash cans. Broken laboratory glassware, sharp metal or glass objects, fine powders (preferably in a bottle or jar), and dirty sample tubes or other items lightly contaminated with chemicals should be placed in this special controlled waste container. The controlled waste bins in a laboratory must be frequently emptied and never allowed to overflow. Under no circumstances should glass, sharp metal, or fine powder be placed in a standard laboratory trash can. Each bottle's cap must be removed prior to disposal, and there should be no detectable chemical odour emanating from any bottle.

Waste for special disposal

This is a troublesome and expensive method of disposal and the quantity of special waste must be kept to an absolute minimum. Only the following items should be disposed of in this way:

1. Schedule 1 poisons (but not cyanides) and other highly toxic chemicals
2. Materials heavily contaminated with substances in (i)
3. Materials contaminated with mercury
4. Carcinogenic solids including asbestos.

Special trash must be collected and disposed of in a separate, labelled bottle or jar. Under no circumstances may different types of garbage be combined. Before undertaking any project that would generate waste requiring special disposal, the School Safety Coordinator should be consulted to ensure:

- the waste can be disposed of
- it is collected in the most suitable form so as to minimise the cost involved and
- it will be stored under suitable conditions.

It is emphasised how important it is to report garbage for special disposal to the School Safety Coordinator as soon as the container is full or the work is complete. The accumulation of hazardous waste in laboratories is prohibited. On the appropriate University form, all Special Waste should be reported to Environmental Health and Safety Services.

Glass recycling

The recycling of glass is advocated for environmental reasons, but only certain types of laboratory waste glass are allowed for recycling. Each laboratory should have a container for glass recycling. Only clean glass bottles, such as those used to transport chemicals, and broken or discarded plate glass are permitted. Broken laboratory glassware, chemically tainted materials, sample tubes, droppers, and glass wool must be discarded as controlled waste. If any of these illegal goods are located in a recycling bin, the recycling service will refuse to empty the bin.

Bottles for bulk solvents

It is emphasised how important it is to return the specifically labelled Winchesters for solvents purchased in bulk to the Store for immediate refilling. They should not be polluted in any way, nor should they be washed. Under no circumstances may sodium-containing bottles be returned directly to the Store. When sodium is first added to a bottle of solvent, a label (available from the Store) confirming this should be affixed. When the bottle is empty, the sodium must be destroyed in a safe manner by adding ethanol or ethylated spirit, and the label must be removed. The bottle must then be washed, dried, and returned to the store in order to be refilled immediately.

Winchester bottles may be repurposed, for example, for the disposal of waste solvents. If they contained a corrosive or hazardous chemical, such as concentrated acid or ammonia, they must first be washed with water.

Biohazard/Sharps Disposal - Syringes and Needles

Sharps contaminated with biologically hazardous substances must be collected in specialised containers and incinerated. At the request of the Fife Council, all syringes and needles of any type must also be disposed of in the same manner. Never place syringes or needles in a laboratory waste bin or a controlled waste container.

Laboratory Solid Wastes and Its Effect on Environment Classification of Laboratory Waste

Biomedical waste is only made up of the following: According to the "Guide to Laboratory Disposal of Waste 2005" from the Vanderbilt Environment Health and Safety Programme.

(a) Animal waste includes dead animals, body parts, and bedding from animals that have been infected or inoculated with human pathogenic microorganisms that are harmful to humans.

(b) Biosafety level 4 disease waste is waste that is contaminated with blood, excretions, exudates, or secretions from humans or animals that are isolated to protect others from highly contagious infectious diseases that have been identified as pathogenic organisms and given a biosafety level 4 by the centres for disease control, national institute of health, biosafety in microbiological and biomedical laboratories, current edition.

(c) Cultures and stocks: These are wastes that can make people sick. They include specimen cultures, cultures and stocks of etiologic agents, wastes from making biological and serums, discarded live and attenuated vaccines, and laboratory waste that has come into contact with cultures and stocks of etiologic agents or blood samples. This waste includes, but is not limited to, culture dishes, blood specimen tubes, and tools used to transfer, inoculate, and mix cultures.

(d) Human blood and blood products are waste blood and blood parts that have been thrown away, as well as materials that have blood and blood products that are free to flow.

(e) Pathological waste: This type of waste comes from surgery, obstetrical procedures, and autopsies. It includes biopsy materials, tissues, and body parts that come from a human source. "Pathological waste" does not include teeth, human bodies, remains, or parts of the body that are meant to be buried or burned.

(f) Sharps waste includes all hypodermic needles, syringes with needles attached, IV tubing with needles attached, scalpel blades, and lancets that have been taken out of their original sterile packaging.

Medical Waste Generation

Adnane et al. (2016) say that medical waste is also called pathological waste or infectious waste. The term will not include waste that is toxic, dangerous, or radioactive. But these wastes can also be made in labs, and depending on their unique properties, a private contractor may or may not be responsible for them.

Infectious Waste:

Mukesh and Anii (2005) in Biotreatrment of industrial efficient the common procedures followed at laboratories in managing medical waste. Many of these procedures will influence the contractor’s point of waste collection.

1. General non-medical waste should be handled within the laboratory facility’s domestic refuse system.
2. Sharps should all be collected together, regardless of whether or not they are contaminated. Sharps containers should be puncture-proof and usually are made of metal or high-density plastics. Sharps containers should be tamperproof and fitted with covers that do not allow access to the sharps contained within. The containers should be rigid and impermeable so that they safely retain not only the sharps but also residual liquids from syringes.

3. Bags for infectious waste should be red and marked with the international infectious substance symbol.
4. Bags and containers should be removed when they are no more than three quarters full to enhance their safe handling. Some bags can be closed by tying the neck of the bag while heavier gauge bags may require plastic sealing ties of the self-locking type.
5. Cytotoxic waste should be collected in strong, leak proof containers that are clearly labeled as cytotoxic wastes.
6. Large quantities of obsolete or expired pharmaceuticals stored at hospital wards or departments should be returned to the pharmacy for disposal.
7. Large quantities of chemical waste should be placed in chemical resistant containers and sent to specialized treatment facilities if they are available. The identity of the chemicals should be clearly marked in the containers and hazardous chemical wastes of different types should not be mixed.
8. Wastes with high content of heavy metals such as cadmium and mercury should be collected separately for disposal at appropriate locations.
9. Aerosol containers may be collected with the general health care waste once they are completely empty provided that the waste is not destined for incineration.
10. The internal waste management plan for the health care facility should stipulate regular procedures and schedules by which waste is collected daily or as frequently as required and transported to a designated central storage site which, more than likely, will be the contractor's point of collection.
11. If it is necessary to transport biomedical or laboratory waste from generation locations to the point of collection or storage, laboratories facilities must assure that this is done safely. This may require the use of wheeled trolleys, containers, or carts that are not used for any other purpose. Generally these will meet the following specifications:

Biomedical Waste Environmental Control Plan

The contractor should have to make a plan for controlling the environment around medical waste. This plan should include testing procedures and standards for process air emissions, vented air, effluent, wash-down water, odours, noise, etc. When environmental control standards aren't met, the plan for environmental control should say what needs to be done to fix the problem. Mukesh et al. (2005) say that the testing and control of the environment in this plan should at least include:

1. **Vented Air:** Vented air from the treatment process should be filtered or treated to remove pathogens, dust, and chemical contaminants.
2. **Effluent:** The treatment system should not produce a liquid effluent that does not conform to national and local regulations and limits for waste water.
3. **Off-Site Run-Off:** Surface run-off from precipitation falling outside of the medical waste receiving, holding, and treatment areas and the treated residue holding and loading areas, should be diverted by drainage ditches and swales to off-site drainage features.
4. **Wash-Down Water:** Any place where biomedical waste or treated lab waste residue is handled should separate the washwater from the rest of the runoff, collect it, and put it in a holding tank. At

least once a day, you should clean the holding tank and any water in it. Wash-down water that has been collected can be treated or used in the biomedical waste treatment system if it is technically possible and the government says it is okay. It could also be thrown away at a government-designated wastewater treatment plant.

5. **Litter Control:** The contractor should check the whole building's perimeter every day and pick up all lifters. Lifter that has been collected must be thrown away along with the other BMW that is made every day at the facility laboratory. Because of solid waste in the lab, the people who work in the lab, the people who carry clinical waste, and society as a whole are at risk.

The risk of laboratory staff: That causes the passage of infectious medical wastes are sham and cutting ones. There is at risk of infection of infectious due to errors of using sharp tools and packaging them.

The risk of clinical laboratory waste carriers: The instruments that are dirty and not well packaged are more likely to cause harm. Some risks can happen when medical waste is being dealt with. These are things like the high heat from steam sterilisers or the toxic gases that got into the air. These are bad for your health.

The risk of society: Chemicals left in the sewage system can affect the natural ecosystem and make water sources unsafe to drink. When trash is dumped in the wrong place, it adds to pollution in the environment as a whole. These wastes shouldn't be kept where we can easily get to them.

(4) The laboratory department may adopt rules to implement this section.

Harmful Effects of Healthcare Wastes

According to Zafar (2016), there has been a worldwide increase in the understanding of the necessity for proper handling of laboratory waste. 15–25 percent of total healthcare waste consists of infectious waste (or biological waste), which poses the biggest threat to human health (Zafar, 2016). Infectious wastes may include all waste items contaminated with or suspected of containing body fluids, such as blood and blood products, used catheters and gloves, cultures and stocks of infectious agents, wound dressings, nappies, discarded diagnostic samples, contaminated materials (swabs, bandages, and gauze), disposal medical devices such as sharps and syringes, contaminated laboratory animals, etc. The amount of waste generated in a laboratory is proportional to the national income and the type of facility involved. A university hospital in a high-income nation may generate as much as 10 kg of garbage per bed per day, across all categories (Zafar, 2016),

Improper laboratory waste management in hospitals, clinics, and other facilities poses occupational and public health concerns to patients, healthcare professionals, trash handlers, and the general public. Additionally, it may result in contamination of the air, water, and soil, which may damage all kinds of life. In addition, if waste is not disposed of properly, individuals of the community may be able to acquire disposable medical laboratory equipment (especially syringes) and resell these potentially infectious materials. Salman Zafar (2016),

According to the World Health Organization, roughly 5% of hospitalised individuals contract hospital-associated infections (HAl). The sophistication of infections Problems with biomedical waste and the recent surge in the occurrence of diseases such as AIDS, SARS, and Hepatitis B increase the danger of contamination due to improper handling and disposal methods (Zafar, 2016). Inadequate biomedical waste management can contribute to environmental contamination, the growth and proliferation of vectors such as insects, rodents, and worms, and the transfer of illnesses such as typhoid, cholera, hepatitis, and AIDS via injuries from infected syringes and needles. In addition to the health dangers connected with improper handling of biomedical waste, the impact on the environment must also be considered.

The Different categories of laboratory wastes include:

Medical waste: It refers to materials accumulated as a result of patient diagnosis, treatment or immunization of human beings;

Infectious waste: Refers to the portion of medical waste that is in contact with a patient who has infectious disease and it is capable of producing an infectious disease.

Domestic waste: Refers to additional forms of garbage comparable to those generated in typical domestic and business environments. These wastes can be found at disposal in their respective categories or as combined wastes, and most commonly in varying volumes and distinct laboratories (Aniefiok Uduak Bassey Inyang, 2017). The indiscriminate disposal of laboratory trash renders such wastes potentially hazardous (Pimental et al, 1998). The amount of biomedical waste generated varies based on hospital regulations and practises as well as the type of care delivered. The available statistics from affluent nations indicate a range of 1 to 5 kg per bed per day, with large intercountry and interspecialty variations. Insufficient data from underdeveloped nations indicate that the range is roughly identical, but the numbers are smaller, namely -2 kg per day per patient (Soncuya *et al*, 1997; Altin *et al*, 2003; Lee et al, 2004). Approximately 85% of Biomedical wastes are non-hazardous, while 10% are infectious (hazardous).

According to Aniefiok et al. (2017), when these circumstances are mitigated, the environment is maintained to support meaningful life, hence reducing the prevalence of ill health and the burden on biomedical facilities. According to Butin (2017), in many nations, hazardous and household wastes are still handled and disposed of jointly, posing a significant health risk to municipal workers (Pimental *et al*, 1998), the general public, and the environment (Abor, 2007). The safe disposal and subsequent destruction of biomedical waste is a crucial step in the prevention of environmental pollution and the reduction of illness or injury caused by contact with potentially dangerous chemicals (Blenkharn, 2006). As different types of waste are disposed of differently, laboratory waste has been categorised into nine distinct groups to facilitate the type of disposal and treatment that is appropriate (Aniefiok *et al*. 20l 7). According to Malik (2007), the human anatomical waste, animal waste, and microbiology & biotechnology waste that can be disposed of & treated by incineration or deep burial system; for sharps, incineration or disinfection, chemical treatment, or mutilation For solid waste (blood & body fluids) and solid waste (disposable items), autoclave or chemical treatment or burial options can be used; for liquid waste (blood & body fluids), disinfection by chemicals discharge into drains is an option; for Incineration Ash, disposal in municipal landfills is an option; and for chemical waste, chemical treatment or source landfill would be a suitable option (Malik, 2007). In the ward or clinic, medical waste is placed in appropriately labelled, color-coded plastic sacks or hard containers before being disposed of correctly (Blenkharn, 2006).

This is done to separate infectious waste from non-infectious waste and to make identification, management, and disposal easier, but more significantly, it helps to control and limit environmental contamination caused by improperly managed medical waste. In addition, he stated that the different colours indicate which kind of trash should be placed in the bins: This requires fundamental training to maintain efficiency and avoid confusion, as the process could get muddled if not understood. The knowledge gap on the environmental impacts of healthcare products and services highlights the need for health professionals to gain a deeper awareness of the vital connections between human health and environmental health (Malik, 2007).

In medical school, the average physician receives little to no occupational health training. A 1994 survey of medical school deans revealed "little" environmental education emphasis (Kaiser et al, 2001). Curriculums in nursing programmes that typically do not include environmental education programmes place nurses in a similar position. This educational gap is especially problematic as it pertains not only to the potential repercussions of healthcare product choices, but also to the comprehension of attributing factors to disease processes. According to some researchers, 45 percent of deaths worldwide are attributable to various environmental factors, particularly organic and chemical pollutants. These chemicals are likely bio accumulative and bio persistent, and their cumulative effects are potentially hazardous. In light of this, environmental information should be incorporated into the educational activities of healthcare professionals in order to keep up with evolving disease and illness patterns and to heighten their awareness of the appropriate use and disposal of medical resources. This necessitates specialised management that integrates diverse personnel into the biomedical waste control process so that their contributions result in an effective waste control procedure. Without proper, regular, and consistent documentation, the evaluation of waste management procedures may not be effective. Consequently, all activities associated with biomedical waste management must be documented, as is the case in Europe.

Storage

Before collection and eventual disposal, waste must be contained; it should not pile in corridors, wards, or other publicly accessible areas. There are a variety of containers designed to hold various forms of garbage. These include variously sized plastic bags and hard containers. When containers reach the required capacity, waste is taken from collection locations within 24 hours of their creation. Waste should not be stored for longer than 48 hours (Gob, 1996; Hassan et al, 2008; WHO, 2010). According to Prusset et al. (1999), temporary waste storage is the location where hospital waste is kept before being transported to final disposal sites. The location and size of any waste storage facility is determined by the quantity, type, and frequency of clinical waste production and collection. Access to bulk storage locations should be restricted to people responsible for the waste's treatment, transportation, incineration, and final disposal, while wild and domestic animals, birds, rats, and insects should be contained in a secured wire mesh cage. Each internal and external storage container must be kept clean, disinfected, and conveniently drainable. In the event of a spill, disinfectants should be placed in close proximity to waste. According to Prusset, *et al.* (1999) and Sim (2009), the following are characteristics of an appropriate area for storage of medical waste:

- Identified as being for only medical waste.
- Well lit and ventilated area.
- Away from food preparation or storage area.
- Vermin free.
- Away from pedestrian and private or public transportation routes

Clinical Waste Management

From garbage generation to eventual disposal, waste management includes a variety of tasks. It includes the generation, classification, quantification, storage, treatment, collection, transportation, and disposal of waste. In addition, it addresses the administrative, technological, and remediation methods involved in the correction of existing waste management practises, as well as the ongoing plan for guaranteeing sustainable waste management in a given area (Olatoye, 2009). Samarakoon and Gunawardena (2011) define healthcare waste management as a vital component of hygiene and infection control within a healthcare facility, which contributes to the prevention of nosocomial infections. According to lnsaet al. (2010), medical waste management involves collecting, transporting, and treating this material to recover recyclable or valuable components prior to its eventual disposal in a landfill or incinerator. The phrase waste management typically refers to materials generated by human activities, and the procedure is typically performed to lessen their impact on public health, the environment, or aesthetics. According to Crick (2012), the waste management process consists of several crucial and interdependent steps. These stages include separation, collection, storage, treatment, transportation, and disposal.

Clinical waste management has become a crucial concern and a focal point of many nations' public health policies (Bdour *et al*, 2007). Without adequate separation, handling, transportation, and disposal, clinical waste can pose threats to the health and safety of workers, the general public, and the environment (Abor, 2007; Clarke, 2008). All those exposed to inappropriate healthcare waste management are potentially at risk for injury or infection. The most vulnerable categories include physicians, nurses, janitorial people, and hospital maintenance personnel. As a result of healthcare waste, patients seeking treatment at healthcare institutions, their visitors, and the general public are all at danger of being damaged (Pruss et al., 1999; Cheng et al, 2009; Hossain et al, 2011).

Improper waste management can result in environmental pollution (water, air, soil), unpleasant odours, the growth and proliferation of insects, rodents, cockroaches, and vermin, and the transmission of diseases such as typhoid, cholera, human immunodeficiency virus, and hepatitis (B and C), as well as contamination of the underground water table by untreated medical waste landfills (Nemathaga et al., 2008; Taghipour & Mosaferi, 2009; Abd ElSalam, 2010).

In order to reduce the negative effects of clinical waste, hospitals must have an effective waste management system. Careful handling of clinical waste is necessary for the safe management of clinical waste. Therefore, hospitals and other healthcare facilities have an ethical obligation to ensure proper medical waste management. This includes the identification of waste sources, waste classification, generation rate, safe handling practices, segregation, storage, transportation, and disposal. According to Kagonji and Manyela (2011), effective medical waste management should also include clear definitions of medical waste and the scope of legislation pertaining to it, fundamental principles to promote the reduction of waste generated at the source and homogeneous classification of waste, and the implementation of environmentally friendly waste management technologies.

Theoretical Framework

The study is founded on the bureaucratic theory of management and the notion of contingencies. The bureaucratic management paradigm is one of the oldest in use today, according to Eric Feigenbaum (2017). It is utilised by businesses of all sizes and in numerous industries. Few individuals at the top of bureaucratic management make decisions, while a hierarchy of intermediate managers and lower-level employees carry out defined responsibilities with limited authority. In a military-like fashion, orders are issued from the top down. Additionally, he stated that health care institutions, particularly hospitals and insurance firms, have historically employed bureaucratic management because it fosters uniformity and accuracy. Through specialisation, each member of the organisation does a small set of tasks often and, allegedly, with great proficiency. On instance, nurses care for their patients without considering wider organisational concerns. Similarly, nurse supervisors supervise their nurses but do not bother themselves with medical staff difficulties. (Eric Feigenbaum, 2017).

Contingency

According to Feigenbaum (2017), the health care business is in a perpetual state of change. In addition to changes in medical practise, insurance, Medicare, and laws are also subject to regular alterations. According to the principle of contingency management, management must be adaptable and capable of restructuring structurally and procedurally as necessary to meet changing demands and requirements. The resource theory complements the contingency theory by proposing that organisations must sometimes manage depending on the resources available in their contexts. That is, as expenses, labour, materials, and staff specialties fluctuate. Instead of allowing external factors to produce organisational fear, businesses can employ change-based management strategies, according to both views.

The Study Area and Methodology

This study was conducted in the teaching hospital of Rivers State University in Port Harcourt. The selection of this study region was influenced by the health workers' involvement in HCW management in Port Harcourt. This study uses survey research methodology. The selection of this study strategy was deemed appropriate due to its ability to identify characteristics of a large population from a small sample. University Teaching Hospital was used as a case study to evaluate the Management of Biomedical Waste in Laboratories, hence the design was appropriate. This study included the entire personnel of the University Teaching Hospital in Port Harcourt, Rivers State. As a result of the researcher's incapacity to effectively analyse the entire organization's employees (population). A representative number was selected as the population sample size. The sample consisted of sixty-eight (68) employees. Simple random sampling was employed in selecting 68 staff members of laboratory in Rivers State University Teaching Hospital. Data were acquired from primary and secondary sources. The primary data was collected through questionnaires and personal interviews with the commission's management and senior staff. This strategy was adopted so that respondents might provide additional, independent information not covered by the questionnaire. Secondary data sources included published reports, books, the Internet, journals, newspapers, and magazines. A review of existing papers was judged essential for the comparative analysis and accurate collection of facts and numbers.

The respondents completed a questionnaire that was carefully crafted and conducted. The questionnaire covers sections A and B. Section A provides respondents' personal information. Section B is the questionnaire's major body. This section contains fifteen (15) using a four (4) point scale of Strongly Agree (4), Agree (3), and Disagree (2), Strongly Disagree (I), which sought the opinions of the respondents. The validity of the research instrument was assessed by the supervisor and other experts in the waste/ management. These experts evaluated the relevance of each item in respect to the study's aims and the comprehensibility of each item in relation to the respondents' cognitive level. They validated the instrument by making any necessary modifications, analysing the content, and determining both the clarity of concepts and the suitability of the items. In this application, reliability refers to the consistency of the instrument used to elicit relevant and desirable replies from respondents, such that the objectives can be reliably and meaningfully attained. In order to determine the reliability of the instrument used in the study, the corrected questionnaire was administered randomly on selected staff of the laboratories and some members of the public. The reliability was determined using Cronbach's Alpha, and a coefficient of 0.65 was found. During office hours, the researcher personally distributed surveys to responders. The exercise was conducted with the assistance of the operations director of laboratory services. This increased the number of completed questionnaires returned. The gathered information was evaluated using the mean and standard deviation.

DATA ANALYSIS AND DISCUSSION

This chapter coves the analysis and interpretation of the various data collected through the use of questionnaires and interview as per objectives of the study.

Research question 1: What are the various waste management practices in the various units of the laboratory in Rsuth?

Table 4.1: Mean and standard deviation showing various waste management practices in the various units of the laboratory in RSUTH

S/NO	Item	Mean	Std.dev	Decision
1	Different coloured bags are used to dispose different types waste	3.51	0.68	Agreed
2.	Yellow plastic bag is usually used to dispose human and animal waste, soiled dressing (impression materials) in your hospital/ clinic/ laboratory	3.73	0.44	Agreed
3.	In our hospital, clinics, laboratory waste sharps are usually put in blue/white translucent plastic bag/puncture proof container	3.16	0.87	Agreed
4.	Black plastic bag is used as primary contains in putting discarded medicines and cytotoxic drugs, incineration ash	2.94	0.89	Agreed
5.	BMW are usually disposed off regularly	1.72	0.80	Not Agreed

Table 4.1 shows the various waste management laboratory in RSUTH. The result reveals that all the items than the criterion mean of 2.50. it was agreed that different types of waste, Yellow plastic bag is usually used to dispose human and animal waste, soiled dressing (impression materials) in your hospital/clinic/laboratory, respondents as well agreed that in their hospitals, clinics, laboratory waste sharps are usually put in blue/while translucent plastic bag/puncture proof container, black plastic bag is used as primary contains in putting discarded medicines and cytotoxic drugs, incineration ash. Respondents did not agree to the fact that BMW are usually disposed off regularly.

Research question 2: What is the level of awareness of health workers as regards waste management practices in the laboratories?

Table 4.2: Mean and standard deviation showing level of awareness of health workers as regards waste management practices in the laboratories?

S/NO	Item	Mean	Std.dev	Decision
6.	There are guidelines or procedures laid down by the federal government of Nigeria for Biomedical waste management	3.01	1.02	Agreed
7.	There is biomedical waste disposal policy in your hospital, clinic or medical laboratory	3.05	0.84	Agreed
8.	There are defined procedures for collection and handling of waste from specified units in the hospital	2.98	0.90	Agreed
9.	There is RSUTH waste plan in our hospital, clinics, medical laboratories	3.10	1.03	Agreed

The result in table 4.2 reveals that all the items had mean greater than the criterion mean of 2.50. This is an indication that most health workers have a high level of awareness as regards waste management practices in the laboratories.

Research questions 3: What is the level of compliance with recommended best practices?

Table 4.3: Mean and standard deviation showing the level of compliance with recommended best practices

S/NO	Item	Mean	Std.dev	Decision
10.	Final disposal of RSUTH waste is by landfill	3.44	0.67	Agreed
11.	In our hospital incineration is often used as the last option for final disposal of BMW waste	2.98	0.98	Agreed
12.	At times biomedical wastes are burnt in open field around or hospital, clinic or laboratory	2.79	0.83	Agreed
13.	In our hospital it is the sole responsibility of waste managers only to clean the office	2.92	0.93	Agreed
14.	In our hospital blood bag, syringes and needle are always collected together	3.10	1.03	Agreed
15	Refuge managers are always trained and re-trained	1.98	0.63	Not Agreed
Grand mean		**2.86**		

Table 4.3 shows the level of compliance of health workers with recommended best practices. A grand 2.86 being greater than 2.50 is an indication that health workers are in conformation with recommended best practices.

Conclusion and Recommendations

The management of clinical waste has become a global health and environmental priority. The awareness to appropriately handle and dispose of clinical waste is also increasing. Appropriate handling of clinical waste is an essential necessity since it protects human health and the environment. Therefore, it is essential to note that poor management of clinical waste can have negative health implications by spreading infections and diseases, resulting in environmental issues. Therefore, further training is required to ensure the proper handling of medical waste. Also, doctors are in charge of the majority of hospital departments; therefore, they must lead by example in exhibiting awareness of these vital components of medical waste management.

Based on the major findings, the following recommendations were stated:

1) Biomedical waste management practices in the laboratory should be every, body's concern regardless of class or rank
2) Training and re-training at all laboratory staff Biomedical waste management should be treated like security issues if it should be carried out irrespective of class as infections organisms or agent does not respect class or rank to be infected. All laboratory personnel to be acquainted with safe handling at both hazardous and non-hazardous waste.
3) Equipment and staffing at the laboratory waste management increased as that can guarantee adequacy of their services. The State Sanitation and Management Board of the laboratory should step up to prevent dumping of waste items in undesignated and unauthorized locations.
4) The Hospital management should also increase its advocacy on the gains of separating waste into recyclable and non-recyclable items and the hazards associated with indiscriminate disposal of waste.
5) The Teaching Hospital should sponsor people to lean the technology of waste items into useful harmless products.

6) Government should encourage massive private sector participation in waste management as this will engender employment generation opportunities for the unemployed and the competition that would consequently arise would reduction of the cost of waste management for the residents.
7) Waste should be evacuated from the collection sites regularly and disposed of adequately by the laboratory management to avoid accumulation and its fallouts.
8) There is need to have a constant supply of the equipment, more importantly the segregation bags to ensure that there is strict adherence to the regulations set and also to prevent injuries during the staff interaction with the wastes. This also could be emphasized by the fact that segregation scored the lowest in the awareness section which could only mean that the staff need to be trained more on segregation and also the risk involved in handling the wastes so that they understand clearly why they ought to follow the segregation rules.
9) Another recommendation is for regular training sessions and seminars on medical waste management for the healthcare personnel.
10) There is need to have a dedicated waste manager. The supervisor in charge of general services and has waste management as part of his job schedule.

REFERENCES

1. Abd El-Salam, MM. (2010): Hospital waste management in El Beheira Governorate Egypt. Journal of Environmental Management, 91, 618-629.
2. Abdulla, F., Qudais, H.A. and Rabe, A. (2008): A site investigation of medical waste management practices in Northern Jordan. Journal of Waste Management, 28, 2; 450-458.
3. Abor, P.A. (2007): Medical waste management practices in a southern African hospital. Journal of Applied Science Environment Management, 11, 3; 91-96. http://www.bioline.org brad accessed 7 February 2013.
4. Abor, P.A. and Bouwer, A. (2008): Medical waste management practices in a Southern African Hospital. International Journal of Health Care Quality Assurance, 21, 4; 3 56-3 5 7.
5. Agumuth, P. (2010): Waste management in developing Asia: Can trade and cooperation help? The Journal of Environment and Development, 17, 1; 1-25.
6. Al-Khatib, A. and Sato, C. (2009): Solid healthcare waste management: Status of healthcare centers in the West Bank Palestinian Territory. Journal of Waste Management, 29, 2398-2403.
7. Alagoz, A.Z. and Kocasoy, G. (2008): Determination of the best appropriate management methods for the healthcare at Istanbul. Waste management, 28, 1227-1235.
8. Alam, M.M., Sujauddin, M., Igbal, G.M. and Huda, S.M. (2008): Report: healthcare waste characterization in Chittagong Medical College Hospital, Bangladesh. Waste Management and Research, 26, 3; 291-296.
9. American Chemical Society, Task Force on Laboratory Waste management. Less Is Better. Washington, DC: American Chemical Society, 1993. http:// portal. acs.Org/ portal/ FIleFetch/C/WPCP 01 2290/pdf’ WPCP 012290.pdf.

10. Ananth, A.P., Prashanthini, C. and Visvanthan, C. (2010): Healthcare waste management in Asia. Journal of Waste Management 30, 145-161 www.moonprint.atesco,co,za accessed 6 September 2012

11. Approaches to Safe Nanotechnology: Managing the health and safety concerns associated with engineered nanomaterials (NIOSH Pub. 2009-125) http://www. cdc.gov/niosh topics/nanotechi Armour, Margaret-Ann. Hazardous Laboratory Chemicals Disposal Guide, 3rd Edition. Boca Raton, FL: Lewis Publishers. 2003. www.crcpress.com/product/isbn/978 1566705677

12. Artiola, F.J. (2010): Clinical waste management in Malaysia: A case study at Teluklntan Hospital. Canada: Prentice Hall.

13. Askarian, M., Vikili, M. and Kabir, G. (2004): Results of hospital waste in private hospitals in Far Provinces, Iran. Journal of Waste Management, 24, 347-352.

14. Balogh, C. (1997) Policy regarding discharge of 2-4% Glutaraldehyde disinfectant solutions to King County Sanitary Sewer Seattle, WA: King County Department of Natural Resources. Blair, David 2000 (October.) Personal communication. Focus Environmental Sendees.

15. Bauer, C. (2010): Climate, Energy Efficiency and Energy Conservation in the Building Sector in Botswana. Gaborone: Macmillan.

16. Bdour, A., Altrabsheh, B., Hadadin, N. and Al-Shareif, M. (2007): Assessment of medical waste management practice: A case study of northern part of Jordan. Journal of Waste Management, 27, 746-759.

17. Bendjoudi, Z., Taleb, F., Abdelmalek, F. and Addou, A. (2009): Healthcare management in Algeria and Mostaganen Department. Journal of Waste Management, 29, 1383- 1387.

18. Birpinar, M.E., Bilgili, M.S. and Erdogan, T. (2009): Medical waste management in Turkey: A case study of Istanbul. Journal of Waste Management, 29, 445-448.

19. Blenkharrt, 3.1. (1995): Waste disposal. What rubbish? The disposal of clinical waste. Journal of Hospital Infection, 30, 295-297.

20. Blenkharn, J.1. (2006): Medical waste management in Brazil. Journal of Waste Management, 26, 315-317.

21. Blenkharn, J.J. (2008): Standards of clinical waste management in UK hospitals. Journal of Hospital Infection, 62, 300-303.

22. Blenkharn, J.1. (2011): Clinical waste management. London: Blenkham Environmental Ealing.

23. Brink, H., Walt, C. and Rensburg, G. (2006): Fundamentals of Research Methodology for Healthcare Professionals (2nd Ed). Cape Town: Juta.

24. Bums, N. and Grove, S.K. (2005): The Practical of Nursing Research Conduct: Critique and Utilisation. Philadelphia: Elsevier.

25. But, T.E., Lockley, E. and Oduyemi, K.O.K. (2008): Risk assessment of landfill disposal: Site state of Art Journal of Waste Management, 28, 952-964.

26. Central Statistics Office (CSO) (2011): Botswana Demographic Survey CSO.

27. Cheng, Y.W., Sung, F.C., Yang, Y.C., Lo, Y.H., Chung, Y.T. and Li, K.C. (2009): Medical waste production at hospitals and associated factors. Journal of Waste Management, 29, 440-444.

28. Clarke, J. (2008): Clinical waste in developing countries. Journal of Nepal Health Research Counci4 28, 1; 44-67.

29. Clover, P. (2009): Safe management of healihc are waste guide. London: Royal College of Nursing.

30. Coker, A.. Sangodoyin, A., Sridhar, M., Booth, C. and Olomolaiye, p. (2009): Medical waste management in Ibadan, Nigeria: obstacles and prospects. Journal of Waste Management, 29, 804-811.

31. College of the Redwoods. No- Waste Lab Manual for Educational Institutions. Sacramento, CA: California Dept. of Toxic Substances Control. 1989. www.p2pavs.org/ref/02/0I565.pdf

32. Creswell, J.W. (2003): Research design: qualitative, qualitative and mixed method approaches. South Africa: Sage.

33. Crick N. (2012): Waste management. Environment Watch Botswana, 16, 12-15.

34. Da Silva, C.E., Floppe, A.E., Ravanello, M.M. and Mello, N. (2005): Medical waste management in the South of Brazil. Journal of Waste Management. 25, 600-605.

35. Dasimah, O., Siti, N.N. & Subramaniam, A. L. K. (2012): Clinical waste management in District hospital of Tumpat, BatuPahat and Taiping. Procedia Social and Behavioral sciences, 68, 134-145.

36. Davis, Michelle, E. Flores, .1. Hauth, M. Skumanich & D. Wieringa. (1996) Laboratory Waste Minimization and Pollution Prevention, A Guide for Teachers. Richiand, WA: Batteile Pacific Northwest Laboratories.. www.p2ppvs.org/ref/0l /text/00779/index2 .htm.

37. De Vos, A.S., Strydom, H., Fouche, C.B. and Delport, C.S.L. (2010): Research at grassroots (4th Ed,). Pretoria: Van Schaik.

38. M.l-I., Azam, K,, Changani, F. and Fard, E.D. (2008): Assessment of medical waste management in educational hospitals of Tehran University medical sciences. Iranian Journal of Environmental Health Science and Engineering, 5, 2: 291-295.

39. Department of Surveys and mapping (2011): Active learning primary atlas for Botswana Capetown: Mapstudio.

40. Diaz, L.F., Eggrerth, L.L. and Savange, G.M. (2008): The characteristics waste. Journal of Waste Management, 28, 7; 1219-I 22

41. G.M. and Eggerth, L.L. (2005): Alternative for the treatment and healthcare waste in developing countries. Journal of Waste 25, 625-637.

42. Environmental Protection Agency. (2005) Labs for the 2P' Century. Washington, DC: http://www.labs2 I centurv.gov/.

43. Fernandes, A. (2005) (June.) Personal communication, Washington Department of Ecology.

44. Field, R. A. (1990) Management strategies and technologies for the minimization of chemical wastes from laboratories. Durham, NC: N.C. Departthent of Environment, Health, and Natural Resources Office of Waste Reduction,www.n2ruvs.orWref/01/00373.pdf

45. Fisher, S. (2005): 1-lealthcare waste management in the UK, the challenges facing healthcare waste producers in the light of changes in legislation and increased pressures to manage more efficiently. Journal of Waste Management, 25. 572-574.

46. Flinn Scientific Inc. Chemical and Biological Catalog Reference Manual 2006. Batavia, IL: Flinn Scientific Inc. 2006. www.flinnsci.com/Sections/Safetv/safetv.asp

47. Frost, E. and Sullivan, M. (2009): US Clinical Waste Management and Disposal Market: A concern in the World Washington: Clofts.

48. Gluszynski, P. (1999): Information on the management of medical waste in Poland, Waste Prevention Association “3R “. Nursing, health and the environment conference: London.

49. Goddu, V.K., Duvvuri, K. and Bakki, V.K. (2007): A critical analysis of healthcare waste management in developed and developing countries. Case studies from India and England. Journal of Waste Management, 7,2; 134-141.

50. Gordon, M. (1998): Research design: A dictionary of http://wwwencyclopedid. corn accessed 5 March 2013.

51. Government of Botswana (GoB) (1996): Botswana Clinical Waste Management Code of Practice. Gaborone: Government Printer.

52. Government of Botswana (GoB) (1997): Guidelines for Disposal of Waste by Landfill. Gaborone: Government Printer.

53. Government of Botswana (GoB) (1998): Botswana Clinical Waste Management Plan. Gaborone: Government Printer.

54. Government of Botswana (GoB) (1998): Botswana Strategy for Waste Management. Gaborone: Government Printer Sociology.

55. Government of Botswana (GoB) (2007): Performance audit report on clinical ii’aste management ax rrfrnd hospitals: Princess Marina, Nyangwabgwe and Lobatse

56. Mental Hospital. (Report no.3) Gaborone: Government Printer

57. Gwimbi, P. and Dirwal. C. (2003): Research methods in Geography and Environmental Studies. Harare: Zimbabwe Open University

58. Nassan, M.M., Abmed, S.A., Rabman, K.A. and Biswas, T.K. (2008): Pattern of medical waste management: Existing scenario in Dhaka city, Bangladesh. BMC Public Health, 8, 36; 1471-2558. http://wwwbiomedcentral.com accessed 12 February 2013.

59. Holmes, J.R. (2009): Managing waste in developing countries. New York: Wiley.

60. FIotze, K. (2002): Ortho-Phthalaldehyde: Ecotoxicological evaluation of acute toxicity to Rainbow Trout (Oncorhyncus mykiss) Unpublished Study #S2041-02, Performing Laboratory ESG International Inc., Guelph, Ontario, Canada for the Dow Chemical Co., Piscataway, N. l.