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Assessment of Medical Wastes Management Protocols: A Case Study of Abakaliki Capital Territory (Act), Ebonyi State, Nigeria

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ABSTRACT

Proper management of medical waste is a global challenge particularly in developing countries. A careful designed study was conducted in Abakaliki Capital Territory (ACT) with the aim of assessing the current medical wastes management practices. A range of sampling strategies and data gathering techniques were used including; questionnaires, interviews, visits and observations. The study revealed that there is no available information on waste generation rate in the health institutions. Waste segregation and coding ethics are not adhered to. It was also observed that there is no enacted law to regulate medical waste management in ACT, and as a result waste are managed without due consideration to environmental and health implications. The two method of medical waste management common in ACT was found to be landfills (burial) and open burning. The study also discovered that the waste handlers are labourers without the needed training, knowledge and skills. These poor practises could potentially contaminate the environment and promote transmission of communicable diseases.

Keywords: Medical waste; Abakaliki capital territory; Health risk; Landfill and open burning

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INTRODUCTION

In recent times, population increase, man's activities associated with modern lifestyles and consumption patterns have resulted in the generation of huge volumes of different types of wastes [1]. Although, nature in constant cycling of matter and energy reuses its waste, man has developed a series of synthetic materials that are difficult to recycle. Such synthetic materials pile up, disrupt the natural equilibrium, and create economic, ecological and health risk for man and his environment. Consequently, public concern over the waste management and the pollution challenges associated with waste generation have attracted significant attention and a great deal of research has been conducted to evaluate appropriate waste treatment options, so as to minimize environmental pollution and maximize resource recovery. Medical waste are materials that are produced in the course of health protection (immunization), medical treatment and medical research laboratories [2]. However, the principal generators of medical waste (MW) are hospitals and clinics, particularly those providing acute services including; operating theatres, maternity ward, accident & emergency, mortuary, intensive care, isolation wards, pharmacy and pathology laboratories [3-4]. The growth of these medical sector around the world over the last decade combined with an increase in the use of disposable medical products has contributed to the large amount of medical waste being generated [5-6]. The generation of wastes is not the contention but the disposal of generated wastes.

The World Health Organization (WHO) has advocated that medical wastes should be treated as special wastes [7]. Also, the US Environmental Protection Agency (EPA) has defined this waste as hazardous [8]. This is because medical waste may play an important role in the transmission and intensification of disease [9-10]. It has been reported [11-12] that if medical wastes is not handled appropriately, it could cause injury, infection and environmental pollution. A study [13] has shown that priority contaminants commonly associated with medical wastes that are of significant importance with respect to human health risks based on environmental persistence, bioaccumulation and emission rate are: polycyclic aromatic hydrocarbons (PAH); polychlorinated biphenyls (PCB); particulate matter (PM10); sulphur (IV) oxide (SO_2) and potentially toxic elements (PTEs). Potentially toxic elements that are of greatest concern are: arsenic (As), cadmium (Cd), chromium (Cd), mercury (Hg),

molybdenum (Mo) and nickel (Ni). These PTEs as well as their compounds have been widely used in the medical field and eventually end up in the environment as wastes. For example, arsenic trioxide (Al_2O_3) has been used over the years for the treatment of patients with acute promyelocytic leukamia and also used in the preparation of Thomas Fowler's solution used empirically to treat a variety of disorders [15]. Cadmium is a component of dental instrument, while Cr is used in the electroplating of medical instruments, Zn is used in galvanizing of medical instruments and Hg is used in thermometers [16]. In addition, surgical stainless steel (an alloy of Cr, Mo and Ni) is a type of steel well-suited for making surgical instruments because they are strong, easy to clean and sterilize; and corrosion-resistant [17].

Obviously, the presence of toxic substances in MW represents a significant health and environmental risk; particularly in developing countries of the world where wastes are poorly managed [18-20] .Of particular concern is the possible infection of those who are directly exposed to these wastes and the emissions emanating therein. People in this category are basically health workers, patients and waste handlers. It is important to note that emitted toxic substances have the potential to travel long distances [21] and can also enter the human body through any of the exposure pathways (oral, inhalation and dermal) [22]. Despite the environmental and health risk associated with poor medical waste, studies [23-26] has shown that current medical waste management in Nigeria is poor and without legislation. These studies revealed that dominant disposal methods are: open burning, burial and unregulated incineration. Literature survey shows that no study has investigated MW management in ACT, thus, the indispensability of this study as a result of low-level health facilities in ACT. This is an original research aimed at determining, waste generation rate; collection, and disposal methods. The paper will also explore the environmental and health risk associated with these practices and suggests methods with less risk.

EXPERIMENTAL SECTION

Materials and method

Study area

Ebonyi State is one of the 36 States in Nigeria with Abakaliki as its capital. The Capital Territory is a rapidly growing urban population. It is predominantly urban covering a total area of 5533 km^2. As of 2006 census conducted by National Population Commission (NPC), Ebonyi State had a population of 2, 176, 947, out of which the capital territory comprising of 271, 833 [27].

It is to be noted that this population must have increased by at least 40 % after nine years considering the rate of birth and urbanization in developing countries. The capital territory (longitude 6^o 25/N and latitude 8^o 08/E) is located basically in the North senatorial zone of Ebonyi State. Figure 1 shows the map of ACT. Rapid population growth and improved living standards of people has led to the establishment of many hospitals (government owned, private and missionary). As a result of this the Capital Territory is facing a crisis in medical waste management with no legislation, or an integrated scheme for its sustainable management.

Sampling protocol (data collection)

In order to ensure excellent coverage of the study area as well as collection of representative samples, hospitals (health centres) in ACT were grouped into 4 groups, namely: government owned hospitals (Group 1); missionary hospitals (Group 2); registered private hospitals (Group 3). Group 4 consists of other medical activities outside the aforementioned groups which generate waste and they include: medical laboratories, pharmacy (chemist) shops and other personalised (unregistered) medical activities (miscellaneous).

The key tools used in data collection were questionnaires, interviews, visiting and personal observation. Questionnaires were distributed to cover all the different health workers and their respective departments. Several visits were made to the various health institutions; the Ebonyi State Environmental Protection Agency (EBSEPA) (EBSEPA is governmental agency authorised to manage waste in Ebonyi State); Ebonyi State Ministry of Health specifically to interview some workers and also for the purpose of collecting needed information as well as physically observation.

The questionnaires and interviews were restricted to three different classes of employees namely:

i) Staffs who are directly or indirectly involved in patient care, including medical unit staff (doctors and nurses), laboratory staff, Ambulance staff, and other support staff.
ii) Mortuary attendants (for health institutions with mortuary facility).
iii) Those who handle internal and external waste.

The target in any of these was on evaluation of waste generation rate, assessing the use of sustainable and safe procedures of handling and disposing medical waste, waste disposal method and evaluation of risks associated with these protocols. The exercise lasted for 6 months (March 2015 to September 2015).

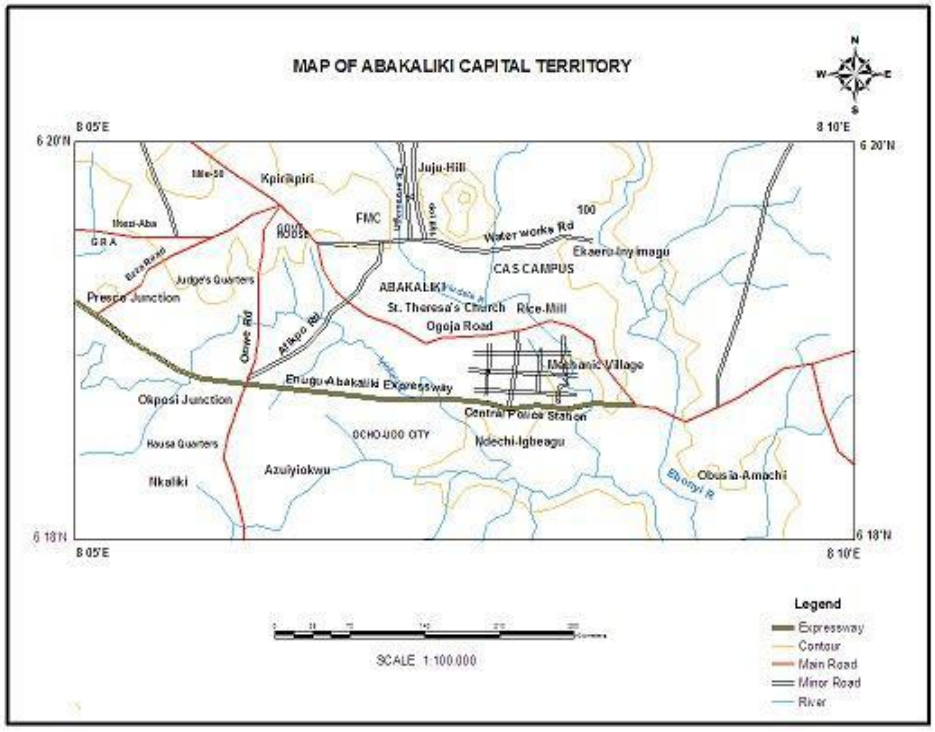

Figure 1: Showing the map of Abakaliki Capital Territory (ACT)

Components of the questionnaires: The key components of the questionnaires include: general information of the respective establishments; waste generation and handling protocols; waste storage; waste segregation; treatment and disposal method and management issues.

General information on the respective establishments: This aspect of the questionnaire focused on the general information such as the number of health workers and departments in the various establishments: government owned hospitals (Group 1); missionary hospitals (Group 2); registered private hospitals (Group 3). Group 4 (miscellaneous) and the average number of patients served daily in each of these establishments.

Waste generation and handling: This part of the questionnaires investigated the rate of waste generation in terms of quantity; types (chemical, pharmaceutical, sharps, radioactive and genotoxic wastes) with emphasis on solid waste. Staff attitude towards the use of protective gears were also investigated.

Waste segregation: Investigations were made to cover the following areas: whether there is segregation of waste in any of the facilities or not; if coding and colour practice were observed; the filling level of bags; the type of containers used in waste collection and if those containers were readily available all the time for use. Also the filling capacity of the bins and their number per unit were investigated

Waste storage: Here the questionnaires were designed to examine waste storage facilities available in the respective health institutions; the number and quantity of temporary storage facilities, how they are stationed (is it accessible to only medical staff), and evacuation frequency (for example, daily, every two days or weekly). This part also investigated the presence of any hand washing facility and a written Standard Operating Procedure (SOP) for waste management in the facilities. So the time from the responses was compared to this standard time.

Waste treatment protocol: The study investigated the existing waste disposal facilities available in the respective institutions for those who treat theirs within the premises and those who need to transport the waste outside the premises were also asked ways of transportation and regularity of the practice. Available facilities were examined to ascertain their condition and functionality.

RESULTS AND DISCUSSIONS

General information on the health institutions

In terms of number of registered health institutions in ACT, available information [28] showed that private hospitals (group 3) have the highest number of health institutions (60 %), followed by group 4 (miscellaneous) 20 %), then group 2 (15 %) and group 1 (5 %) respectively. In overall, a total of 90 health institutions currently exist in ACT. Figure 2 shows their percentage distributions. The investigation revealed that daily average staff to patient ratio in the government health institutions is 1:21 while in the missionary health institutions, it is 1: 16. No record exist for other health institutions, however, it was observed that most of the private other health institutions had only one doctor or none at all but depend on visiting doctors. A situation where health institutions depend on visiting doctor, result in risking the life of patients, particularly in case of emergency.

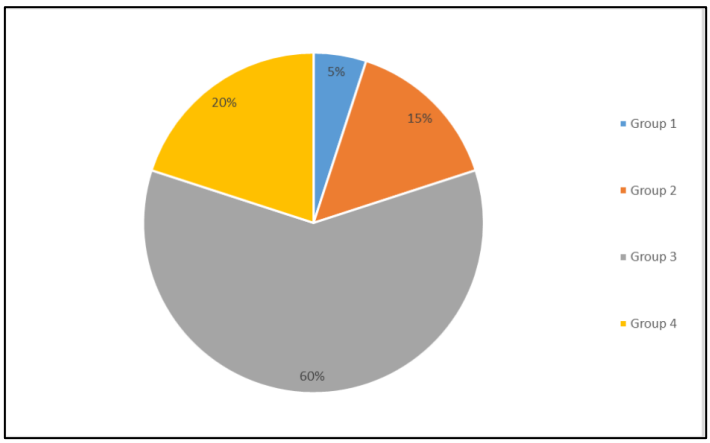

Figure 2: **Percentage distribution of health institutions in Abakaliki Capital Territory**

Waste generation and handling

The investigation revealed that the rate of waste generation vary from department to department (unit to unit). It was not possible to quantify the amount of waste generated because none of these health institutions weigh and keep record of their waste. However, it was observed that each of the health institutions particularly government owned ones generate large quantities of waste. This was attributed to disposable nature of most kits. The composition of the solid waste were the same in most of the health institutions; consisting mainly of radioactive substances (x-rays, gamma-rays as well as alpha and beta particles); sharps (syringes, needles, blades); anatomical wastes and other hazardous substances. It is to be noted that lack of waste generation records in these health institutions could adversely affect planning and implementation of strategies on waste minimization. The use of protective gears such as gloves, boots, aprons, coats and masks by staff handling waste were observed basically in the government owned hospitals and missionary hospitals especially during official hours (8am – 4pm). The use of only gloves was common during non-official hours and weekends. Private health institutions and the miscellaneous group use mainly only gloves when handling waste.

Waste segregation

The approach to waste segregation in all the health institutions in ACT is poor and unregulated despite the availability of specific containers for waste collection in some locations especially in the government owned institutions. In most of the institutions, no proper segregation exists as all medical waste was observed mixed in common collection vessels. Proper segregation of healthcare waste must follow a particular pattern in order to reduce environmental risk associated with these waste. When waste are segregated, the risk associated with these waste are reduced but when the reverse is the case, people handling the waste as well as other individuals within the vicinity are exposed to health risk. The use of different colour bags such as red and yellow in medical waste segregation was not observed in these institutions.

Waste storage

Results from the questionnaires, interviews and spot observation showed that in most of the health institutions, provision were made for temporary and permanent storage facilities (waste bins). All the departments and wards have temporary storage facilities for storable waste and need to be evacuated after every shift (every 12 hours). Unfortunately, it was observed that in some of these institutions these wastes are allowed for days and as a result overflow the containers before empting them, also many bins were without cover. Obviously, such practices could lead to unprotected people particularly children being infected by communicable disease. It is possible

that children can easily pick objects from such waste bins. It has been demonstrated that children who exhibit 'pica' behaviour (the habit of ingesting non-food objects) are at the risk of ingesting contaminated materials [29]. It was also observed that wastes from departments are dumped in a designated open area within the premises, only a handful of them had storage facilities in such areas. About 90 % of the health institutions in ACT dump waste on open ground as shown in Figure 3.

Waste treatment protocol

Results from EBSEPA (governmental agency responsible for waste management in Ebonyi State) revealed that initially there was an agreement between EBSEPA and government owned institutions on waste management; where EBSEPA collect waste from these health institutions and dispose them through burying. This agreement was short lived and each institution manages their waste. Inability of EBSEPA to oversee medical waste management in ACT was traced to lack of necessary legislation empowering the agency to do so. Thus, there is no enacted legislation regulating medical waste management in Ebonyi State, though the study observed that some of the health institutions have their internal legislation but the absence of State legislation to regulate internal legislation (ethics) have made them not to adhere to the documented guideline. Results from the various institutions showed that the two method of medical waste disposal currently in use are basically open burning and landfill (burial).

Literature survey in other States of Nigeria has shown that open burning and burial (landfills) are indeed common method of medical waste treatment in Nigerian health institutions. For example, in Abuja a study [30] that investigated the characterization and management of solid wastes in Federal capital Territory revealed that open burning is the most prevalent method. Studies from Jos Metropolis (Plateau State) [31] as well as Kano State [32] also showed that open burning is the common practice. Whilst, in Bayelsa State [33], Osun State [34] and Rivers State [35], landfills and open dump were found to be dominant. Studies [35-36] have revealed that management of medical waste via burial and open burning may pose significant environmental hazards through groundwater, soil and air pollution

Figure 3: Indiscriminate dumping of Medical Waste at a Health Institution in Abakaliki Capital Territory

Environmental and public health risks associated with poor medical waste management

Apparently, when wastes are not properly handled, the hazardous components of the waste have the potential to endanger the environment and health of those who handle the wastes, waste dump scavengers as well the general public. It is important to note that the hazards of medical waste can become risks to the exposed population if a pathway exists between the source (waste) and receptor (environment or humans). Potential pathways are direct contact, contact through vectors, airborne transmission and the contamination of water, soil and air. In the case of direct contact, sharps are considered to be the most dangerous category of waste as people could be injured when they come in contact with indiscriminately dumped syringe, needles and other related objects.

Open burning significantly reduces solid medical waste to non-combustible residual ash and gases. However, it has been reported [37-38] that ash and gases released as a result of open burning of medical waste contain potentially toxic substances (PTS) including; polychlorinated dibenzo-p-dioxins (PCCDs), polychlorinated dibenzofurans (PCDFs), polychlorinated biphenils (PCBs), polycyclic aromatic hydrocarbons (PAH), carbon monoxide (CO), particulate matter (PM10), sulphur (IV) oxide (SO_2), arsenic (As), cadmium (Cd), chromium (Cd), lead (Pb), mercury (Hg), molybdenum (Mo) and nickel (Ni). When these toxic substances are released

during burning, they are either found circulating in the atmospheric air, deposited in the water bodies, vegetables and fruits or deposited in soil (dust) [40]. Figure 4 shows open waste burning in one of the health institutions in ACT.

Figure 4: **Open burning of Medical Waste at a Health Institution in Abakaliki Capital Territory**

The presence of these substances signifies a significant risk to human health as they could enter the human body via the exposure pathways (mouth - oral ingestion, respiratory tract - inhalation, and skin - dermal absorption). These substances have the potential to travel long distances from their various point sources [41]. Those deposited in the soil or dust could enter the body through the mouth (i.e. oral ingestion). Oral ingestion of soil or dust occurs intentionally or unintentionally. Intentional ingestion is common among children with the age of 2 – 6 years. Children within this age group easily ingest any object in their hand via hand to mouth habit. Unintentional ingestion of soil and dust occurs when people eat dropped food, fruits and vegetables without thorough washing as well as shaking of contaminated hands followed by sucking of the hand. It is also important to mention that when these contaminants accumulate in the soil over a long time, they could enter the food chain as most plants would readily absorb them. Drinking of untreated water is common in different parts of Nigeria and since contaminants released from burning of medical waste could be deposited in water bodies, this route also serves as another entry point through which they enter the human bodies. Considering the fact that inhalation is necessary and continuous for the wellbeing of mankind, people who are exposed to these released contaminants would unavoidable inhale them. In addition, these contaminants can also enter our bodies via dermal absorption particularly in the occupational settings where the human skin comes in direct contact with burnt products.

In addition, disposal of medical waste via burial (landfill) could lead to the discharge of toxic substances into the environment. These chemicals interrupt the natural ecosystems and may contaminate ground water, especially low-lying areas subject to frequent flooding as well as agricultural soils. Soil pollution has become an important environmental concern in developing countries, such as Nigeria, due to changes in land use patterns (urbanization, industrialization, infrastructure development, hazardous waste disposal as contaminants) over the last few decades. The potential increase of PTS in agricultural soils through hazardous waste dumping and burial may not only result in soil contamination, but also lead to elevated PTE concentration in food crops and plants [42]. This is one of the significant pathways for the entry of these PTS into the human body [43]. Obviously, the metal-contaminated food can seriously deplete some important nutrients in the human body which may cause weakening of immunological defences, intrauterine growth retardation, impaired psycho-social faculties, disabilities with malnutrition and a high frequency of upper gastrointestinal cancer rates, spontaneous abortion and occurrence of birth defects [44].

CONCLUSION AND RECOMMENDATIONS

Our observations and survey results have revealed poor management of medical waste in ACT. The current management protocols are unsustainable and cannot be relied upon to protect human health and environmental integrity. There is no adequate funding and necessary planning. There are serious gaps in the current medical waste management in ACT. The existing protocols are not in line with WHO detailed guidelines for control and disposal of medical waste in recognition of the serious hazards to medical workers, waste workers, and the general public [45].

In order to prevent or reduce the challenges and risks associated with medical waste management in ACT, the following recommendations are proposed.

i) Implementation of proper segregation of waste and labelling as guided by WHO, including constant training, promotional activities and behavioural awareness dealing with the risks associated with

medical waste, both to health workers and waste workers and to the general population. Waste should be properly segregated at the point of its generation.

ii) Adequate and secure storage facilities for toxic waste followed up by appropriate safe final disposal, such as the use of controlled incineration, autoclave, shredder or microwave.

iii) Sufficient external funds are needed to support medical waste management (monitoring and evaluation) from governmental and non-governmental agencies.

iv) Health institutions in ACT should have a database to account for day-to-day waste generation tin order to facilitate proper planning.

v) All health institutions in ACT should be provided with Standard Operating Procedures so as to act according to those procedures. Furthermore, there should be adequate policies and legislation covering medical waste management in ACT followed by strict monitoring, and defaulters prosecuted accordingly.

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