OPEN LANDFILL BIOMEDICAL WASTES DISPOSAL SYSTEM AND IMPACT ON HEALTH AS PERCEIVED BY HEALTH WORKERS

Abstract

This paper examined the influence of open land fill as a biomedical wastes disposal system and perceived impact on health among health workers in Calabar Education Zone of Cross River State, Nigeria. One hypothesis was formulated to guide the study. Literature review was carried out based on the variable under study. Ex-post facto research design was considered most suitable for the study. Purposive and simple random sampling techniques were adopted in selecting the 401 respondents sampled for the study. A validated 30 item four point modified likert scale questionnaire was the instrument utilized for data collection. The reliability estimate of the instrument was 0.91 using Cronbach Alpha method. To test the hypotheses formulated for the study simple linear regression statistical too was used at 0.05 level of significance. The findings revealed that there was a significant positive influence of open land fill of biomedical wastes on health as perceived by health workers in Calabar Education Zone of Cross River State. It was recommended among others that dumpsites should be properly located and managed to minimize its effects on residents and government and municipalities should revise laws regarding the locations of the dumpsites.

Key words: Open landfill, biomedical wastes, perceived impact, health workers

Introduction

Every day, relatively large amount of potentially infectious and hazardous wastes are generated in the health care hospitals and facilities around the world. An important issue of human health protection process is the waste disposal systems that include responsible planning of collecting, transporting, processing and disposing of hazardous and non-hazardous waste materials. A special concern focuses on effective disposal of biomedical waste incorporating an appropriate waste reduction and neutralization component. Along with this idea, a systemic approach of biomedical waste is compulsory, since without proper guidance, the hazardous medical waste management may compromise the quality of patient caretaking.

Medical care is vital for our life and health, but the waste generated from medical activities represents a real problem to nature and human health. World Health Organization (2011) stated that high-developed countries produce an average of 0.5 KG of hazardous waste per hospital bed per day while the figure for developing countries was only 0.2 KG per hospital bed per day. Eighty-five percent of generated waste from hospitals and other health care facilities were in fact non-hazardous while the remaining 15% is considered to be hazardous materials that may be radioactive, toxic or infectious.

An increase and expansion in the number of hospitals and health care facilities cause an increase in the utilization of disposable medical materials, which further contributed in production of a large amount of biomedical wastes in these health care facilities. The introduction of more complicated equipment and overall medical advancement also results in increase in waste production per patient in health care facilities globally (Radha, Kalaivan, & Lavanya, 2009). The increased production rate of biomedical waste was combined by mishandling and poor disposal methods. The risk of disease transmission was raised among the health care workers and other environmental issues such as pollution. On the basis of these facts, incorporation of an integrated biomedical waste management system for hospitals and health care facilities was becoming a cross cutting issue.

Main purposes of waste management and disposal are to clean up the surrounding environment and to identify the appropriate systems for waste neutralization, recycling and disposal. Within waste disposal, the health care waste management (HCWM) is a process that helps to ensure proper hospital hygiene and safety of health care workers and communities. Health care workers and patients are concerned about planning and procurement, staff training and behaviour, proper use of tools, machines and pharmaceuticals, proper methods applied for segregation, reduction in volume, treatment

and disposal of biomedical waste. Studies have demonstrated that there is not a single method of biomedical waste treatment or disposal that completely eliminates all risks to humans or to environment. The first step of this approach focuses on the risks caused by an inappropriate biomedical waste management and disposal

Biomedical waste is produced in all conventional medical units where treatment of (human or animal) patients is provided, such as hospitals, clinics, dental offices, dialysis facilities, as well as analytical laboratories, blood banks, university laboratories. This form of wastes refer to all materials, biological or non-biological, that are discarded in any health care facility and are not intended for any other use Within a health care facility or hospital, the main groups submitted to risks are: - Doctors, medical nurses, healthcare unit workers and maintenance staff; -Patients; -Visitors; - Workers in ancillary services: laundry, medical supplies store, those charged with collecting and transporting waste; - Service workers dealing with waste treatment and disposal of health unit.

Regarding the health care workers, three infections are most commonly transmitted: hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency (HIV) virus. Among the 35 million health care workers worldwide, the estimations show that each year about 3 million receive hard exposures to blood borne pathogens, 2 million of those to HBV, 0.9 million to HCV, and 170,000 to HIV (Cole, 2015; Kralj & Stamenkovic, 2006). Also, the workers involved in the collection and disposal of the biomedical waste are exposed to a certain risk and these risks have health implications such as cancers (especially lung and larynx cancer, leukemia, lymphoma, soft tissue sarcoma), respiratory symptoms and congenital malformations, low birth weight, birth defects, cholera, plague, tuberculosis, hepatitis B, diphtheria etc., in either epidemic or even in endemic form and thus is a major problem for healthcare facilities, their employees, and the community at a large.

Waste disposal systems usually relate to all kinds of planned activities concerned with the proper handling and disposal of wastes from the point of generation to the point of final disposal. Wastes disposal systems are comprehensive, integrated, rational and systematic approach towards the achievement and maintenance of acceptable human health. Modern systems of wastes disposal have emerged in response to the recognition of health impact. Basically, there are various systems of wastes disposal among workers and patients in the health sector, these include but not limited to the following: incineration, open dumping, open landfill, disposal of wastes into water bodies and recycling etc.

Open land filling of biomedical waste is a common waste disposal system and one of the cheapest systems for organized waste management in many parts of the world. Landfill practice is the disposal of biomedical wastes by infilling depressions on land. The depressions into which wastes are often dumped include valleys (abandoned) sites of quarries, excavations, or sometimes a selected portion within the residential and commercial areas in many urban settlements where the capacity to collect, process, dispose of, or re-use solid waste in a cost-efficient, safe manner is often limited. The practice of landfill system as a system of waste disposal in many developing countries is usually far from standard recommendations (Mull, 2005; Adewole, 2009; Eludoyin & Oyeku, 2010).

The urban population of Calabar is growing at alarming rates. While generally Nigerian population is increasing by about 2.8% per annum, the rate of urban growth is as high as 5.5% per annum, and this has increased the number of patients in hospitals and the number of hospitals in the zone (Thomas, Peng, Lezhong, Yaoliang, Emmanuel, Wang & UN-Habitat, 2006). As Nigeria aspires to improve her economic status by 2019, a healthier and wealthier population will generate more of all types of waste (domestic,

commercial, industrial and hazardous). There is therefore need for urgent action based on a clear national strategy, plans and programmes to manage this trend. Several efforts have been made by governments across Nigeria, and intervention projects have been put in place over the years to ensure proper disposal of biomedical wastes. It is also very worrisome to note that most health care facilities do not even have waste management experts or departments and so on.

This raises several questions that need answers. What are the biomedical wastes generated by health centers? How are these wastes disposed? How does the disposal systems relate to human health? Hence this study investigated the influence of open landfill biomedical wastes disposal systems and perceived impact on health among health workers in Calabar Education Zone of Cross River State, Nigeria.

Literature review

Waste from hospitals and clinics are an additional source of Municipal Solid waste (MSW). Most of the countries do not have any specific technique of managing hospital and clinical wastes. So, they are mixed with MSW and pose a threat to human population and surrounding environment. Unsuitable disposal of biomedical wastes causes all types of pollution: air, soil, and water. Indiscriminate open dumping of wastes contaminates surface and ground water supplies. In urban areas, MSW clogs drains, creating stagnant water for insect breeding and floods during rainy seasons. Open land filling of biomedical waste is a common waste disposal system and one of the cheapest systems for organized waste management in many parts of the world. Landfill practice is the disposal of biomedical wastes by infilling depressions on land. The depressions into which wastes are often dumped include valleys (abandoned) sites of quarries, excavations, or sometimes a selected portion within the residential and commercial areas in many urban settlements where the capacity to collect, process, dispose of, or re-use

solid waste in a cost-efficient, safe manner is often limited. The practice of landfill system as a system of waste disposal in many developing countries is usually far from standard recommendations (Mull, 2005; Adewole, 2009; Eludoyin & Oyeku, 2010).

According to the World Health Organization, 18 years ago it was estimated that injections with contaminated syringes caused 21 million hepatitis B virus (HBV) infection (32% of all new infections), two million hepatitis C virus (HCV) infection (40% of all new infection) in the world. When compared to the 2017 estimate of about 34 million hepatitis B caused by contaminated syringes, four million hepatitis C virus infections, and more than 1.1million HIV infections in the world, it is important to note that the impacts are increasing on daily and perhaps yearly basis.

Studies have demonstrated that there is not a single method of biomedical waste treatment or disposal that completely eliminates all risks to humans or to environment, and the situation is everywhere in our country. The state of human health in Cross River is so poor and this is evident in the inadequate and poor health facilities (health centers, personnel, and medical equipment) in the state, especially in rural areas. While various reforms have been put forward by the Nigerian government to address the wide ranging issues in the health care system, they are yet to be implemented at the state and local government area levels and Nigeria is still ranked by World Health Organization at 187th position in its health system among 191 member states.

Wastes of different types, mostly medical wastes are the major input of dumpsites/landfills. With respect to the hydrological analysis of groundwater, it flows from areas of higher topography towards areas of lower topography, thereby bringing about the examination of the degradable material which form leachate and contaminate the groundwater of the study area. Landfill practice is the disposal of solid wastes by infilling depressions on land. The depressions into which solid wastes

are often dumped include valleys (abandoned) sites of quarries, excavations, or sometimes a selected portion within the residential and commercial areas in many urban settlements where the capacity to collect, process, dispose of, or re-use solid waste in a cost-efficient, safe manner is often limited. The practice of landfill system as a method of waste disposal in many developing countries is usually far from standard recommendations (Mull, 2005; Adewole, 2009; Eludoyin & Oyeku, 2010).

A standardized landfill system involves carefully selected location, and is usually constructed and maintained by means of engineering techniques, ensuring minimized pollution of air, water and soil and risks to man and animals. It involves placing waste in lined pit or a mound (Sanitary landfills) with appropriate means of leachate and landfill gas control (Alloway & Ayres, 2007; Eludoyin & Oyeku 2010). Land filling of municipal solid waste is a common waste management practice and one of the cheapest methods for organized waste management in many parts of the world (El-Fadel, Findikakis & Leckie, 2007; Jhamanani & Singh, 2009; Longe & Balogun, 2010). Increasing urbanization results in an increased generation of waste materials and landfills become the most convenient way of disposal. Most of these landfills are mere ‘holes in the ground” do not qualify as sanitary means of solid waste disposal. Most of the areas around the Solous dumpsites depend either on dug-up wells or boreholes, which may likely be affected by the generated leachate through waste decomposition from the dumpsites despite the provision of pipe-borne water by government.

According Papadopoulou, Karatzas and Bougiouko (2007), as the natural environment can no longer digest the produced wastes, the development of biomedical waste management has contributed to their automated collection, treatment and disposal. One of the most common waste disposal methods is

landfilling, a controlled method of disposing biomedical wastes on land with the dual purpose of eliminating public health and environmental hazards and minimizing nuisances without contaminating surface or subsurface water resource.

In the study of Ifeoma (2014) on effects of landfill sites on groundwater quality in igando, alimosho local government area, Lagos state. With increasing population comes the concern for waste disposal. The absence of sanitary disposal methods has left most city residents with open landfills as their only source of waste disposal. The resulting leachate formed from the decomposition of these waste materials is highly polluting and finds its way to the underground water supply. The study investigated the effects of open landfill sites on the underground water quality by examining the physical and chemical properties of underground water in hand-dug wells around the Solous landfill sites in Igando, Alimosho Local Government Area of Lagos State. Solous landfill is the second largest landfill by landmass and volume of waste in Lagos State.

Systematic random sampling was used for data gathering. Eighteen hand-dug wells were sampled at increasing distances from the landfill site. Physical, chemical and microbiological parameters were analysed at the Lagos State Environmental Protection Agency (LASEPA). Soil samples were also taken from both the A (0 – 30cm) and B (30 – 60cm) horizons of the water sampling points to determine the soil texture (silt, clay and loamy composition) and to show the impact of soil texture on ground water quality within the sampled area. The level of contamination of groundwater was also determined using the Contamination Index method. The results showed high degree of conformance with WHO standard with respect to the microbiological properties of the sampled groundwater. However, coliform tests indicated the potential presence of pathogens. Of the seven (7) physical parameters

tested, conductivity was higher in one sample. The study of chemical properties from the eighteen wells showed five (5) parameters (dissolved oxygen, total alkalinity, iron, lead, nitrates and copper) above WHO limits in some samples. The water may therefore not be safe for human consumption and there is a serious need to monitor the groundwater quality in the area. The level of contamination of groundwater was also determined using the Contamination Index method. Areas of high and medium contamination were discovered.

There was no area with low contamination level in the area sampled. Contamination levels were mapped to show the exact levels of contamination in the study area. The results of the soil analysis showed that the study area had soil that was mostly sandy in nature which may suggest an increase in parameters over time with significant health implications for the people who depend on surrounding wells for domestic use. The study also showed no significant variation in water quality with increasing distance from the dumpsite. Findings also indicated that the water around Solous 1 was of better quality for domestic use than groundwater around Solous 2 and 3 due to temporal reduction of contaminant concentration. There is therefore a need for adequate and proper planning, design and construction, and strategic management disposal of waste, as well as the implementation of a better sustainable environmental sanitation practice.

The disposal of wastes in landfill sites has increasingly caused concern about possible adverse health effects for populations living nearby, particularly in relation to those sites where hazardous waste is dumped. Studies on the health effects of landfill sites have been carried out mainly in North America and existing reviews focus entirely on this literature (Upton, 2008; National Research Council, 2009). Recent publications of large studies both in and outside North America warrant an update of

evidence presented in previous reviews. Up-to-date knowledge about epidemiologic evidence for potential human health effects of landfill sites is important for those deciding on regulation of sites, their siting and remediation, and for those whose task it is to respond to concerns from the public in a satisfactory way.

Martine (2010) examined health effects of residence near hazardous waste landfill sites: a review of epidemiologic literature. This review evaluates current epidemiologic literature on health effects in relation to residence near landfill sites. Increases in risk of adverse health effects (low birth weight, birth defects, certain types of cancers) have been reported near individual landfill sites and in some multisite studies, and although biases and confounding factors cannot be excluded as explanations for these findings, they may indicate real risks associated with residence near certain landfill sites. A general weakness in the reviewed studies is the lack of direct exposure measurement. An increased prevalence of self-reported health symptoms such as fatigue, sleepiness, and headaches among residents near waste sites has consistently been reported in more than 10 of the reviewed papers. It is difficult to conclude whether these symptoms are an effect of direct toxicological action of chemicals present in waste sites, an effect of stress and fears related to the waste site, or an effect of reporting bias.

Although a substantial number of studies have been conducted, risks to health from landfill sites are hard to quantify. There is insufficient exposure information and effects of low-level environmental exposure in the general population are by their nature difficult to establish. More interdisciplinary research can improve levels of knowledge on risks to human health of waste disposal in landfill sites. Research needs include epidemiologic and toxicological studies on individual chemicals and chemical mixtures, well-designed single- and multisite landfill studies, development of

biomarkers, and research on risk perception and sociologic determinants of ill health. Key words: epidemiology, hazardous waste, health effects, landfill, residence, review.

Jeffrey (2013) investigated the management of biomedical pollutants in the Accra Metropolitan Area in Ghana, using a qualitative case study approach involving interviews, focus-group discussions, and observation techniques. A state of precariousness was found to characterize the management of biomedical pollutants in the study area, culminating in the magnification of risks to the environment and public health. There is neither a single sanitary landfill nor a properly functioning incineration system in the entire metropolis, and most of the healthcare facilities surveyed lack access to suitable treatment technologies. As a result, crude burning and indiscriminate dumping of infectious and toxic biomedical residues were found to be widespread. The crude burning of toxic biomedical pollutants was found to provide environmental pathways for carcinogenic substances. These include polynuclear aromatic hydrocarbons (PAHs), polychlorinated dibenzofurans (PCDFs), polychlorinated dibenzopara-dioxins (PCDDs), polychlorinated biphenyls(PCBs), hydrogen, lead, mercury, cadmium, chlorobenzenes, particulate matter, and chlorophenols. The improper disposal of biomedical pollutants in open dumps and unsanitary landfills also carries a risk of providing environmental entry points for volatile organic compounds (VOCs), inorganic macro components, heavy metals, and xenobiotic organic compounds.

Sharifah, Syed and Latifah (2013) examined the challenge of future landfill: A case study of Malaysia. Landfilling is the most frequent waste disposal method worldwide. It is recognised as being an important option both now and in the near future, especially in low- and middle-income countries, since it is the easiest and the cheapest technology available. Owing to financial constraints, landfills usually lack of

environmental abatement measures, such as leachate collection systems and lining materials. As a result, a lot of contamination is inflicted upon the environment. Importantly, even with proper abatement measures in landfills, there is no guarantee that contamination will be prevented. Another major concern is the appropriate location for landfills to ensure the impact towards the environment are minimised. There is a tendency of landfill to be built on unsuitable area such as near to residential area or on agricultural land where most of the land are grading as high prospect value to be developed as business or industrial area that are more profitable.

More so, the rate of deaths and exposures to several diseases caused by biomedical wastes disposal has become one of the critical concerns even when there are well defined rules for handling such wastes. Unfortunately, laxity and the quality and availability of disposal facilities are generally poor and inadequate. Considering the increasing rate of perceived impact of biomedical wastes disposal on health workers, researchers have conducted researches in other part of the world on Bacterial Treatment and Metal Characterization of Biomedical Waste Ash. Also, some researches were carried out on open dumping of municipal solid waste – impact on groundwater and soil, Assessment of Open Dumps and Landfill Management in the Federal Capital Territory, Nigeria, Effect of open medical waste dumping on its surrounding surface water bodies in Cross River State. This shows that the issues of open land fill biomedical wastes disposal system and perceived impact on human health among health workers may not have been adequately studied and addressed in the study area. It is based on this background, the researcher sought to answer the question: what is the perceived influence of open land filled disposal of biomedical wastes among health workers in Calabar Education Zone of Cross River State? This

study may serve as an empirical study for any other researcher who may have a similar curious mind.

Methodology

The ex-post facto research design is considered most suitable. Ex-post facto literally means 'after the fact'. It basically studies phenomenon after they have occurred. Ex-post facto design is so important for opinion and studies of attitude because it relies solely on questionnaire and interview as a means of data collection. The design was considered appropriate for this research because it allows the researcher to make use of a representative sample of the population from where generalization of the study result will be. The area of the study is Calabar Education Zone of Cross River State, Nigeria. There are seven Local Government Areas namely Akamkpa, Akpabuyo, Bakassi, Biase, Calabar Municipality, Calabar South and Odukpani that make up the zone. It lies within latitude $4^{0}27^{0}$ N and $5^{0}32^{0}$ N and longitude 7^{0} 50^{0} and $9^{0}.30^{0}$ E of the equator and has a landmass of 9,980 square kilometers.

The population of the study comprised registered laboratory scientists, pharmacists, nurses/midwifes and cleaners in major public health care facilities. This study adopted the stratified random sampling technique. This study adopted the multi stage sampling technique. First, using stratified random sampling, all the government health care facilities in Calabar Education Zone was stratified into seven Local Government Areas while proportionate sampling technique was used to select the 30% of health workers from each health facility sampled for the study and simple random sampling technique was employed to select the respondents from the health care facilities sampled for the study. The sample for this study consists of 401 respondents proportionately and randomly selected from eleven public health care

facilities in Calabar Education Zone of Cross River State. The instrument that was used for data collection was a questionnaire. Each item elicited information from respondents on a four point modified Likert scale, Strongly Agree (SA) 4 points, Agree (A) 3 points, Disagree (D) 2 points, and Strongly Disagree (SD) 1 point. Simple linear regression statistic was utilized for data analysis.

In order to analyse the data, the raw scores of all the items in each variable were summed together to show the result for each variable. Data was analyzed using Statistical Package for Social Sciences (SPSS) program version 20. Results were presented in frequencies, percentages and tables as well as inferential statistics as all hypotheses were tested using simple linear regression at 0.05 level of significance (i.e. 95% confidence interval). The hypotheses were stated in null form and simple linear regression satistic was used for data analysis.

Results and discussions

The hypothesis states that open landfill disposal system has no significant influence on health as perceived by health workers. The independent variable in this hypothesis is open landfill while the dependent variable is influence on human health as perceived by health workers. Simple linear regression test statistic was employed in testing the data for this hypothesis. The results of the analysis are presented in table 1.

The result of analysis which is presented in Table 1 showed that the predictor or independent variable (Open landfill of biomedical wastes) significantly influence the predicted variable (influence on health as perceived by health workers) in Calabar Education Zone of Cross River State. The predictor variable accounted for 25.9% of the influence in health as perceived by health workers in the study area.

Again, the regression ANOVA revealed there was a significant influence of open land fill of biomedical wastes on health as perceived by health workers F (1,

399) = 139.209; p<.05. This result indicated that there is a moderate positive contribution of open landfill of biomedical wastes on health as perceived by health workers in the study area. From this result it can be assumed that if the approach adopted in open landfill disposal of biomedical waste is improved, there will be a significant reduction in the influence on health as perceived by health workers in the study area. Furthermore, if the approach adopted in open landfill disposal of biomedical waste does not improve, there will be higher influence on health as perceived by health workers.

The finding of analysis indicated that the null hypothesis was rejected. This showed that there was a significant positive influence of open landfill of biomedical wastes on health as perceived by health workers in Calabar Education Zone of Cross River State. This finding could be as a result of the fact that land filling of municipal solid waste is a common waste management practice and one of the cheapest methods for organized waste management in many parts of the world. The finding of the study agrees with the finding of Papadopoulou, Karatzas and Bougiouko (2007) which asserts that one of the most common waste disposal methods is landfilling, a controlled method of disposing biomedical wastes on land with the dual purpose of eliminating public health and environmental hazards and minimizing nuisances without contaminating surface or subsurface water resource. However, the result of the study contradicts the result of Martine (2010) which stated that increased risk of adverse health effects (low birth weight, birth defects, certain types of cancers) have been reported near individual landfill sites and in some multisite studies, and although

TABLE 1

Simple linear regression analysis of the influence of open landfill of biomedical wastes on health as perceived by health workers (N = 401)

	R= .509	R^2 =.259	Adj.R^2 =.257	St= .8053	
Source of variance	SS	Df	MS	F	Sig
Regression	90.283	1	90.289	139.209	.000
Residual	258.769	399	.649		
Total	349.051	400			

biases and confounding factors cannot be excluded as explanations for these findings, they may indicate real risks associated with residence near certain landfill sites. An increased prevalence of self-reported health symptoms such as fatigue, sleepiness, and headaches among residents near waste sites has consistently been reported in more than 10 of the reviewed papers. It is difficult to conclude whether these symptoms are an effect of direct toxicological action of chemicals present in waste sites, an effect of stress and fears related to the waste site, or an effect of reporting bias. Although a substantial number of studies have been conducted, risks to health from landfill sites are hard to quantify. There is insufficient exposure information and effects of low-level environmental exposure in the general population are by their nature difficult to establish. More interdisciplinary research can improve levels of knowledge on risks to human health of waste disposal in landfill sites.

The result of this study is in contradiction with the result of Ifeoma (2014) on effects of landfill sites on groundwater quality in Igando, Alimosho Local Government Area, Lagos State. The absence of sanitary disposal methods has left most city residents with open landfills as their only source of waste disposal. The resulting leachate formed from the decomposition of these waste materials is highly polluting and finds its way to the underground water supply. The disposal of wastes in landfill sites has increasingly caused concern about possible adverse health effects for populations living nearby, particularly in relation to those sites where hazardous waste is dumped.

Conclusion

The purpose of this study was to investigate and present results on open land fill as a biomedical waste disposal system and perceived impact on health as perceived by health workers in Calabar Education Zone of Cross River State. In line with the statistical

finding obtained from this study, it was therefore concluded that: there was a significant positive influence of open land fill of biomedical wastes on health as perceived by health workers in Calabar Education Zone of Cross River State.

Several health impacts have been found to be related to biomedical wastes disposal systems. The importance of health in the life of an individual cannot be over emphasized. A healthy person is able to carry out various functions that would contribute to the realization of organization objectives. In the health profession, healthy workforce is required to carry out the day-to-day functions required to maintain a healthy population. The exposure of health personal to hazardous substances that impair their health is a risk and requires urgent attention.

Recommendations

Based on the finding obtained in the study, the following recommendations were made;

1. Dumpsites should be properly located and managed to minimize its effects on residents and government and municipalities should revise laws regarding the locations of the dumpsites.
2. Biomedical wastes should be burnt; or disposed off in approved dumpsites or recycled.

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