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Perceived Health Implications of Solid Waste Disposal Systems among Health Workers in Government Hospitals in Edo South Senatorial District, Nigeria

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ABSTRACT: The study conducted an assessment of the Perceived Health Implications of Solid Waste Disposal Systems among Health Workers in Government Hospitals in Edo South Senatorial District, Nigeria. A survey research design was utilized, and 400 respondents were selected using the stratified random sampling technique. Data was collected using a validated 25-item four-point modified Likert scale questionnaire, which demonstrated good reliability with a 0.80 estimate established through the test-retest method. The analysis, conducted using multiple linear regression, revealed a significant influence of waste disposal methods (waste disposal into water bodies, landfill, open dumping, incineration, and recycling) among Health Workers in Government Hospitals in the district. The findings suggest the need for proper disposal of biomedical waste through incineration, approved dumpsites, or recycling. This study contributes to the understanding of the health implications of solid waste disposal systems and recommends specific measures for waste management in healthcare facilities.

Keywords: Waste disposal systems, biomedical wastes, health workers, health, health care centres
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INTRODUCTION

Every day, relatively large amount of potentially infectious and hazardous wastes are generated in the health care hospitals and facilities around the world. 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 (Kralj and 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.

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.

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. WHO (2016) 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 et al., 2019).

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 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.

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. Most wastes are disposed on the land in open dumps. Disposal of solid waste on the land without careful planning and management can present a danger to the environment and the human health. The environment should be clean and less polluted. Insects and rodent vectors are attracted to the waste and can spread diseases such as cholera and dengue fever.

Open land filling of 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 solid wastes by infilling depressions on land. When toxic substances enter a body of water, they will dissolve, become suspended in water or get deposited on the bed of the water body. The resulting water pollution causes the quality of the water to deteriorate and affects man and aquatic ecosystems. Open burning of wastes contributes significantly to urban air pollution. Burning of wastes of chlorinated substances in waste, such as polyvinyl chloride (PVC) plastic, leads to the formation of new chlorinated chemicals, such as highly toxic dioxins, which are released in stack gases, ashes, and other residues. In short, incinerators do not solve the problems of toxic materials present in wastes.

The waste management departments in Local Government Areas in Edo South are statutorily charged with the primary responsibility of wastes disposal. However, the present state of streets and markets places has shown that cleaners in this departments lack the capacity and capability to fulfill this obligation. Several efforts have been made by governments of Edo State, and intervention projects have been put in place over the years to ensure proper disposal of wastes. It is also very worrisome to note that most Local Government Areas do not even have waste management experts or departments and so on. This raises several questions that need answers. What are the wastes generated by health centers? How are these wastes disposed? How does the disposal systems relate to human health?

Purpose of the study

The purpose of this study is to examine the perceived Health Implications of Solid Waste Disposal Systems among Health Workers in Government Hospitals in Edo South Senatorial District, Nigeria.

Research question

The following research questions are posed;

1. What are the wastes generated by health centers?
2. How are these wastes disposed?
3. What are the perceived health impact of the wastes disposal methods to human health?

Statement of hypothesis

The hypothesis states: thus, there is no significant influence of the predictor variables (waste disposal into

water bodies, landfill, open dumping, incineration and recycling) among Health Workers in Government Hospitals in Edo South Senatorial District, 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.

According to the World Health Organization, 18 years ago it was estimated that injections with contaminated syringes caused 21 million hepatitis B virus (HBV) infections (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 (Eludoyin and Oyeku, 2020). 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.

A study by Effangah and Effiom (2010) 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.

Unsafe water has severe implications for human health. According to UNESCO 2021 World Water Development Report, about 829,000 people die each year from diarrhea caused by unsafe drinking water, sanitation, and hand hygiene, including nearly 300,000 children under the age of five, representing 5.3 percent of all deaths in this age group. Data from Palestine suggest that people who drink municipal water directly are more likely to suffer from diseases such as diarrhea than those who use desalinated and household-filtered drinking water (Yassin et al., 2023). In addition to disease, unsafe drinking water, and poor environmental hygiene can lead to gastrointestinal illness, inhibiting nutrient absorption and malnutrition. These effects are especially pronounced for children. Improper disposal of waste also includes that of sharp objects (such as syringes, razors, and blades) that directly pose serious health hazards to waste pickers and disposal workers. Data revealed that more than 250 million people are infected with the Hepatitis B virus, 70 million with Hepatitis C, and 38 million with immune deficiency infections worldwide, primarily due to exposure to infected syringes and blades (Cheru, 2021).

A dumpsite is a favorable environment for the proliferation of disease-carrying organisms (i.e., rats, flies, cockroaches, and mosquitoes) that can be carriers for serious human pathogens (WHO, 2022). Sensitivity index of different physic-chemical parameters surrounding the dumpsite areas can characterize the management status of dumpsites in risk-based approaches and recommend improving the management strategies through a decision tool (Ojuri et al., 2018). The open burning of certain wastes has scientifically been proven to produce air toxins. Harmful pollutants of particular health and environmental concern from open-air burning include: fine particulates; black carbon (soot) particles; polychlorinated dibenzo dioxins (PCDDs) and polychlorinated dibenzo furans (PCDFs); and polyaromatic hydrocarbons, including known carcinogens such as benzo (a) pyrene. Saskatchewan's Environmental Management and Protection Act (EMPA,

2020). Young children and older adults, especially those with existing respiratory conditions (e.g., asthma, chronic obstructive pulmonary disease etc.) are most susceptible to the immediate negative health effects from open-air burning. The disposal of waste at landfill sites has an effect on people living in the site neighborhoods (Njoku et al., 2019). A study showed that 78% of participants living near a landfill site reported significant air pollution due to bad odors, and 56% of those living near the landfill site expressed concerns for their health in the future. The prevalence of diarrhea in households was found to be 14.4% in a cross-sectional epidemiological analysis (Yongsi et al., 2018). One of the most serious health consequences of dumping waste in inhabited areas is the risk of infectious diseases through water. Endemic zoonotic diseases, which are highly correlated with fecal material at waste disposal sites, are usually flushed away by rain into the surface or ground water, thus polluting the water source. Contaminated water contains fecal coliform counts of up to 15.25 MPN/100 mL of water, as compared to the recommended level of 0 MPN/100 mL, which makes it extremely unhealthy for drinking purposes (Karija et al., 2023); the health effects of heat metals Most Probable Number (MPN) in waste can also be life threatening and may range across headache, irritability, memory deterioration, diminished intellectual capacity, kidney damage disease, and liver and bioaccumulation leading to cancer (Hyder et al., 2023).

For recyclable wastes, various studies demonstrate wide ranges of Green House Gases emissions when raw materials are produced by recycled and virgin materials. For recyclables, climate co-benefits are generated by diverting recyclables from being landfilled and are recycled as raw materials. Eriksson (2015) studied different Municipal Solid Waste Management scenarios in three Swedish municipalities and found that implementation of material sorting followed by reutilization of energy-rich wastes and recyclable materials is superior to putting all wastes into landfill in terms of GHG emissions.

MATERIALS AND METHODS

Experimental setting

The study utilized a survey research design. According to Salaria (2012), it is a research design that is used when the goal of a survey is to gather information about the examined phenomena from a representative of the entire population with the hope of generalizing the findings to the entire population.

Participants/Sample

The area of the study is Edo South Senatorial District. Edo South senatorial district in Edo State covers seven local governments which include Oredo, Ovia South West, Egor, Ovia North East, Orhionmwon, IkpobaOkha and Uhunmwode local government areas. Oredo LGA is the headquarters (collation centre) of Edo South. The population for the study comprised of 9,129 health care workers in the seven Local Government Areas that make up Edo South Senatorial District of Edo State, Nigeria (Source: Ministry of Health (Headquarters), Benin City, 2023). Stratified sampling technique was used to place the number of Health workers in stratum from were the sample was drawn. Furthermore, two Local Government Areas and a sample size of 400 health care workers from six hospitals were used for the study. The study used the accidental sampling approaching in administering the research instrument on the respondents as at the time of administration of the instrument.

Instrumentation

The instrument for data collection was a questionnaire titled: Perceived Health Implications of Solid Waste Disposal Systems among Health Workers Questionnaire (PHISWDHWQ). The instrument contained 35 items ranging from Section A, B and C. The instrument was subjected to face validity and the reliability estimate of the instrument was ascertained using the test-retest method and the result was .80.

Statistical analysis

The findings were given in frequencies, percentages, Tables, and inferential statistics because the hypothesis was tested using multiple linear regression statistical tool at 0.05 level of significance (i.e., 95% confidence interval).

RESULTS

From the result of 400 respondents used in the research, 209 respondents (52.25%) were males while 191 respondents (47.75%f) were females. This outcome is as shown in (Table 1) and these results showed that there are more males than females in the area of the study. in terms of age distribution, of the 400 respondents, 192 respondents (48.00%) were 30 years old or younger, 152 (38.0%) were in the range of 31-50 years old, while 56 respondents (14.0%) were 51 years of age or older.

Furthermore, the results of respondents' on working experience showed that out of the 400 respondents used in the research, 149 (37.251%) have 10 years' experience or less, 154 (38.5%) have working experience of 11-30 years, 97 (24.25%) have working experience of 31 and above years.

In terms of the types of wastes generated by health centers, the results showed that out of the 400

Table 1: Demographic variables of respondents.

Variable	Variables	Frequency	Percentage
Sex	Male	209	52.25
	Females	191	47.75
	Total	400	100
Age	≤30 years	192	48.00
	31-50 years	152	38.00
	≥51 years	56	14.00
	Total	400	100
Working experience	10 years and less	149	37.25
	11-30 years	154	38.5
	31-above years	97	24.25
	Total	400	100
Marital status	Single	101	25.25
	Married	189	47.25
	Divorced	110	27.5
	Total	400	100
Respondents' opinion of the types of wastes generated by health centers			
What type of wastes are mostly generated by your health center?	Infectious wastes	139	34.75
	Pathological wastes	92	23.0
	Sharp wastes	53	13.25
	Chemical wastes	48	12.0
	General wastes	68	17.0
	Total	400	100
Respondents' opinion on the methods of wastes disposal in their health centres			
What methods of wastes disposal do you use in your health center?	Open land fill	115	28.75
	Open dumping	91	22.75
	Disposal into water bodies	82	20.5
	Recycling	54	13.5
	Incineration/wastes burning	58	14.5
	Total	400	100
Respondents' opinion on the perceived health impact of wastes disposal methods to human health			
What is the perceived health impact of the wastes disposal to human health?	Skin diseases	155	38.75
	Cholera	78	19.5
	Typhoid	46	11.5
	Others	121	30.25
	Total	400	100

Source: Field work (2023)

respondents used in the study,139 (34.75%) agreed that they produce infectious wastes, 92 (23.0%) agreed that they produce pathological wastes, 53(13.25%) agreed that they produce sharp wastes, 48(12.0%) agreed that they produce chemical wastes, 68(17.0%) agreed that they produce general wastes.

In terms of methods of wastes disposal in their health centres, out of 400 respondents, 115 respondents (28.75%) agreed that they practice open landfill method, 91 (22.75) agreed that they practice open dumping, 82(20.5) agreed that they practice disposal of wastes into water bodies, 54(13.5) agreed that they practice recycling, while 58(14.5) agreed that they practice incineration/waste burning.

In terms of the perceived health impact of wastes disposal methods to human health, out of 400 respondents, 155 respondents (38.75%) agreed that it causes skin diseases, 78 (19.5) agreed that it leads to cholera, 46(11.5) agreed that it leads to typhoid, while 121(30.25) agreed that wastes disposal leads to other diseases not mentioned here.

Test of Hypothesis

There is no significant influence of the predictor variables (waste disposal into water bodies, landfill, open dumping, incineration and recycling) among Health Workers in Government Hospitals in Edo South Senatorial District, Nigeria. The choice of multiple linear regression (modelling application) was to help explain the linear relationship that exist between and among the predictor variables at $p < 0.05$. The results are presented in (Table 2).

The regression equation is given thus:

$$Yi = B_o + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + e_i \quad ...Eqn1.1$$

Where:

Y is the predicted value of the DV (Health of workers)
X_1= waste disposal into water bodies
X_2= landfill
X_3=open dumping

Table 2: Regression Model Summary of all the predictor variables (waste disposal into water bodies, landfill, open dumping, incineration and recycling) among Health Workers in Government Hospitals in Edo South Senatorial District, Nigeria.

Model	R	R square	Adjusted R square	Std error of the estimate	
1	0.559	0.313	0.306	2.145	
Source of Variables	Sum of Squares	Df	Mean square	F	Sig.
Regression	1002.327	5	200.465	43.547*	.000
Residual	2200.423	478	4.603		
Total	3202.750	483			
Variables	Regression weight				
	B	Std error	Standard. Coef.	t.value	Sig.
(constant)	5.761	.922		6.248	.000
Waste disposal into water bodies	.058	0.058	.046	.998	.319
Landfill	-.029	0.052	-.032	-.569	.570
Open dumping	-.121	0.040	-.151	-3.00.	.003
Incineration	-.558	0.054	-.563	-10.428	.000
Recycling	-.095	0.043	-.119	-.119	.029

DV = perceived impact on health of workers

X_4=incineration
X_5= recycling
Bo is the Y-intercept and
e_i is the error of prediction known as residuals.

The results in Table 2 reveal that the combination of all the predictor variables (waste disposal into water bodies, landfill, open dumping, incineration, and recycling) are joint predictors of health workers' perceived health. The predictor factors explained 31.3% of the variance in workers' health, indicating a significant fit to the data.
The regression ANOVA showed that the predictor factors had a moderate combined contribution to workers' health ($F(5, 478) = 43.547$; $p < 0.05$).

The adjusted R2 value of 0.36 indicates a reduction from the unadjusted value of 0.313, suggesting that the model's generalizability to the population has improved. The study's results reveal significant impacts on workers' perceived health from various forms of waste disposal, including trash disposal into water bodies, landfill, open dumping, incineration, and recycling. Individual predictors such as garbage disposal into aquatic bodies, landfills, open dumping, incineration, and recycling also demonstrate substantial influence on workers' perceived health.

According to the findings in (Table 2), open dumping, incineration, and recycling all have a substantial impact on workers' perceived health. This is a negative association (refer to the beta sign), indicating that the more health workers engage in open dumping, incineration, and recycling, the lower their impact on worker health. Finally, waste disposal into aquatic bodies and landfills does not appear to anticipate the influence on worker health. A higher β value indicates a bigger contribution of the predictor variable.

Therefore, the regression equation is expressed thus:

Biodiversity conservation = B_o + B_1 waste disposal into $water_i$ + B_2 open $landfill_i$ +B_3open $dumping_i$ + $B_4incineration_i$ + B_5recycling (1)

= -5.761 + (.058 waste disposal into $water_i$) – (.029 open $landfill_i$) – (121 open $dumping_i$) – (.558 $incineration_i$) – (.095 $recycling_i$)

Therefore, we can conclude that, there is a significant influence of the predictor variables (waste disposal into water bodies, landfill, open dumping, incineration and recycling) among Health Workers in Government Hospitals in Edo South Senatorial District, Nigeria..

DISCUSSION

The finding of the study showed that there is a significant influence of the predictor variables (waste disposal into water bodies, landfill, open dumping, incineration and recycling) among Health Workers in Government Hospitals in Edo South Senatorial District, Nigeria. This study highlights the importance of good waste disposal systems in health care centres. The study supports Yassin et al., (2023) that data from Palestine suggest that people who drink municipal water directly are more likely to suffer from diseases such as diarrhea than those who use desalinated and household-filtered drinking water. In addition to disease, unsafe drinking water, and poor environmental hygiene can lead to gastrointestinal illness, inhibiting nutrient absorption and malnutrition. The finding of the study also supports Njoku et al., (2019) that the disposal of waste at landfill sites has an effect on people living in the site neighborhoods. A study showed that 78% of participants living near a landfill site reported significant air pollution due to bad odors, and 56% of those living near the landfill site expressed concerns for

their health in the future. The prevalence of diarrhea in households was found to be 14.4% in a cross-sectional epidemiological analysis (Yongsi et al., 2018).

Conclusion

The study concludes that the predictor factors (waste disposal into water bodies, landfill, open dumping, incineration, and recycling) had a substantial impact on Health Workers in Government Hospitals in the Edo South Senatorial District, Nigeria. It has been discovered that as the global population grows and demand for food and other necessities rises, so does the amount of waste generated by each home on a daily basis. This poses a major health concern while also destroying biodiversity in the area's terrestrial and marine ecosystems. Poor storage systems in homes and institutions may exacerbate the situation, allowing flies, mosquitoes, and rats to spread disease.

Recommendations

Based on the outcome of the study, it was recommended that ;

1. Biomedical wastes should be burnt; or disposed off in approved dumpsites or recycled.
2. 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.

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