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Solid Waste Management in a Leprosarium in Southwestern Nigeria

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Abstract
Waste from healthcare institutions generally ought to be treated and disposed hygienically. However, the type of institution normally determines the material component and the nature of the waste generated whether it is hazardous or non-hazardous, infectious or non-infectious waste. Also health status of an individual or community is a function of standard of living, medical services available, social amenities and hygienic environment normally determined through impact assessment. These have been examined in relation to the leprosarium in Ogbomosho, Southwestern Nigeria.
The leprosarium under study consists of a clinic and three camps located at about 1000m from the clinic. The leprosarium housed 30 patients, while the camps served as home for about 140 people under rehabilitation together including their children. As one of the health institutions, it is apparent that the waste generated is heterogeneous mixture of both general municipal waste and bio-medical waste. The percentage of biomedical waste which is hazardous in nature is low about 1.0% with average generation rate of 0.13kg/day while that of non-hazardous, non-infectious general waste is 0.288kg/person/day. The average waste generation rate in term of mass is determined to be between 0.084 – 0.095kg/person/day which reveals the poor status and rural nature of these leper settlements. The waste components consist of bandages and swabs, paper, nylon and plastic, domestic waste, animal waste (mostly goat manure), wood ash and yard trimmings which are being disposed on open dump sites and sometimes by open burning which are unhygienic causing health hazards. Accumulation of these waste components without proper disposal initiates its putrefaction which produces offensive odour. In addition, absence of adequate sanitary facilities has promoted open defecation which is a source of infectious, diseases.
As an economical, appropriate and useful method of waste disposal, composting was proposed since it is found relevant and acceptable for the leprosarium and the settlements around as the waste generated is predominantly biodegradable and decomposable materials.
Key words: Solid waste, bio-medical waste, characterization, waste disposal, composting

1. Introduction

Solid waste is of two types: hazardous and non-hazardous both of which are generated from every facet of human activities. Mishandling and mismanagement of solid waste generated from every activity pose varieties of environmental and health hazards to the handlers and the general public. The transmission of diseases like leptospirosis, plague, flea-borne typhus, rat bite fever and salmonellosis are highly promoted by rats breeding around refuse dump sites (Cairncross and Feachem, 1983). Putrefied, toxic and soluble hazardous substances loaded with pathogens are mostly washed by rain out of piles of solid waste into surface water thereby polluting it.
Any open dump site for degradable refuse always generates offensive odour due to putrefaction and present unaesthetic sight to every onlooker. Open burning as primitive mode of waste disposal poses risk of cancers and fire outbreaks. Where the refuse contains biomedical waste as mix, there is high risk for scavengers visiting the dump site contacting infections like hepatitis, tetanus, etc through sharps injuries and contact. According to Pruss *et al,* (1999), the percentage risks of infections after exposure to biomedical waste are as follows: Human Immunodeficiency Virus (HIV): 0.3%, Viral Hepatitis B: 3% and Viral Hepatitis C: 3 - 5%.
Leprosy which was once thought to be hereditary has been identified as chronic and contagious disease caused by *Mycobacterium leprae* and transmitted by respiratory droplets when in contact with untreated persons. It was discovered by Dr Armauer Hansen and this makes leprosy to be alternatively known as Hansen's disease (Davison and Aladjemoff, 1963).
Cases of leprosy have reduced in the recent years due to prevailing efforts of World Health Organisation (WHO) in providing free Multidrug Therapy (MDT) medicines. Consequently, the number of global leprosy patients has reduced from 805,000 to 286,000 within the range of year 1995 to 2000 (WHO, 2006). This is so because the introduction of MDT shortens the duration of leprosy treatment from over five years to just 12months in the case

of Multi-bacillary (MB). As at the end of 2006 only six countries in the world (Brazil, Democratic Republic of the Congo, Madagascar, Mozambique, Nepal and United Republic of Tanzania) are yet to reach the elimination goal (Fine, 2006). In Nigeria according to Annual Report of Federal Ministry of Health (2009), the implementation of MDT has resulted in a rapid drawdown of the number of registered leprosy cases from nearly 200,000 cases at the end of year 1989 to 6,906 at the beginning of 2008. As a result, the rates of prevalence and case detection remained below 0.5 per 10,000, at both national and zonal levels and so Nigeria is still statistically categorised as low endemic for leprosy. However, there have been reports of the outbreak of leprosy again towards the end of 2008. A total of 4,899 new leprosy cases were detected in 2008 of which 87.7% were classified as the infectious MB cases, and 44.2% were females. The proportion of children was 10.8%. This made Nigeria to have grade 2 (GD2) disability rate of 14% at the end of 2008 as compared to the target of 5% stipulated by WHO and therefore shows that the disability rate of new cases was high and their detection occurred relatively late (Federal Ministry of Health, 2009). Most of the new occurrences detections are prevalent in the northern part of the country. Recently, two hundred and fifty four (254) leprosy cases have been found in Kebbi State in the first quarter of this year (www.nigeriannewspapersworld.com/2012/05/)

Leprosy patients are normally isolated from the community into special hospitals or colonies commonly known as Leprosaria due to its contagious nature. Although effective awareness has made many countries to change their orientation of abstinence and isolation policies, cured patients still choose to remain in the leprosarium because of the deep-seated stigma in the society (Coker et al, 2008)

Generally, hospital is one of the complex institutions which are frequented by people from every walk of life in the society without any distinction between age, sex, race and religion. All of them, patients and staff, produce waste which is increasing in its amount and type due to advances in scientific knowledge and is creating its impact (Rao and Garg, 1994). The clinic waste, in addition to the risk for patients and personnel who handle these wastes poses a threat to public health and environment (Singh and Sarma, 1996).

In Nigeria as well as other Africa countries, the prevalence of residual leprosy is of concern because, although most of the public and private colonies present are well equipped, poor maintenance and inadequate funding have rendered them abandoned and deteriorated with improper management of the solid waste being generated every day. Both Federal and the State Ministries of Health in any of the states where leprosarium is present in Nigeria could outline the waste management practices being practised (Coker et al, 2008).

1.1 Definition and Classification of Biomedical Waste

Biomedical Waste consists of all waste generated from healthcare facilities such as hospitals, clinics, veterinary hospitals, maternity centres, pharmaceutical stores and manufacturing companies, pathological laboratories, blood banks post-mortem homes etc. It consists of used gauze, cotton wool, bandage, hypodermic syringe, needles, scalpels and blades, discarded blood, fluid and blood transfusion bags, laboratory samples, amputated parts of human body, anatomical waste, left-over drugs and expired drugs, placentas, human remains etc. All these wastes are either infectious or potentially infectious. General refuse from hospitals is similar to generic wastes from residences and institutions and includes disposable linens, paper, flowers, food, cans, nappies and plastic cups (UNILAB, 2001). Also according to Medical Waste Management Act of California Department of Public Health (2007), Biomedical waste is defined as bio-hazardous waste or sharps waste and any waste generated or produced as a result of the diagnosis, treatment, immunization of human beings/animals, research pertaining to diagnosis, treatment or immunization of human being/animals, production/testing of biological, or the accumulation of properly contained home-generated sharps waste.

1.2 Disposal Methods of General Solid Waste (GSW)

The hazardous and infectious nature of biomedical waste makes its safe and environmentally friendly disposal is imperative. Since it is difficult to find a common denominator for defining hospital waste based on the estimation of the risks associated with it, it proves easier to find a common standpoint with respect to the waste disposal routes employed outside the hospitals (Lamidi, 2005). After treatment of the Biomedical waste, it becomes non infectious or non hazardous

In the hierarchy of Integrated Solid Waste Management, the various disposal methods available are:

a. Incineration without energy recovery
b. Incineration with energy recovery
c. Landfilling
d. Composting

The selection of disposal method fit for use among the available ones is a function of the following factors:

i) The material composition of the waste collected
ii) The water content of the waste
iii) The hazardousness of the waste and the presence of the pathogenic organisms
iv) Possibility of complete destruction of pathogens.
v) Highly reduced environmental impact

Therefore, this study seeks to characterize and quantify solid wastes generated in a leper colony, examine current management practices used for segregating, handling, treating and/or disposing solid wastes and propose a sustainable management strategy.

2. Methodology

2.1 Study location

This study was carried out in a Missionary operated leper colony in Oyo State of the South Western region of Nigeria between August to November 2006 after obtaining ethical consent of t its management. The colony was established in 1930 and consists of Healthcare centre or Leprosarium and three camps denoted as Camp 1, Camp 2 and Camp 3 respectively. The leprosarium has different units which include: Wards – Male ward and Female ward, Recreation unit, Rehabilitation centre/workshop, Laboratory, Kitchen, Store, Laundry unit, Consulting room, Milling unit, and Doctor's quarters. The colony is being managed under the employment of eight staffs: one doctor, one matron, three nurses and three waste handlers.

Each camp varied in size, population and site location but are all situated in the same colony. Camp 1 is made of four (4) dilapidated mud houses of a single room which can only accommodate two persons. This camp has both old men and women rehabilitated patients. Camp 2 consists of three blocks of houses with five (5) rooms per block and detached bathroom and pit toilet. Each room lodged a working class rehabilitated patient and his/her family. This camp occupied twenty rehabilitated patients as at the time of visitation. Camp 3, the most populated of them, has a set of four (4) blocks with five (5) rooms each, a set of two blocks with eight (8) rooms each and a block with four (4) rooms.

2.2 Material Sampling

Out of all the camps, Camp3 was used together with leprosarium as a case study in collecting solid waste being generated in the colony since it is the largest camp among the three camps present in the colony and it composes of all the age limits interested in the study, that is children, young and old people unlike Camp1 which comprises of old people alone and camp 2 which consists of predominantly younger people. This will ensure heterogeneous mixture of the solid waste generated. Sample collection was carried out using waste basket placed in each block present in the camp and the wastes generated were collected at the end of each day. Sorting method was used as a mean of sourcing and analysing the waste components under adequate protection to avoid contamination and infection.

2.3 Data collection

Physical observations with a checklist, interviewer administered questionnaire surveys and waste sampling and analysis were made during the site visitation to the colony. For both primary and secondary data collection on the type and nature of solid waste generated, quantities of solid waste generated, collection, disposal and management of solid waste, excreta disposal, number of people in each room per camp and periods of both public and personal environmental sanitation and other relevant areas requiring engineering management activities.

Oral interviews and assistance were provided for some of the lepers who cannot legibly fill in the information as required in the questionnaire to obtained vital information regarding general assessment of their up-keeping and environment.

The structured Questionnaires consisted of categories I - IV. Category I and Category II were administered to the Doctors and Nursing Staff to derive information on population of the patients, degree of their diseases, disposition to their condition, type of treatment being given, types of waste normally generated, degree of their contagiousness and mode of disposal. Category III was given to the members of the Board of Management of the leprosarium to have information on the assessment of the facilities, up-keeping of environment, degree of medical service being rendered and readiness for provision of needed waste disposal facilities. Category IV was administered to the waste handlers and some of the lepers to obtain information on the disposition of people in the environs present waste disposal system and management available and the problems confronting them. Visual observation was used to ascertain the correctness of the data obtained. The data were analysed manually.

3. Results

3.1 Population of Patients admitted to Leprosy

As at the time of visitation to the leprosarium, there are seven patients on admission as in-patients, but this normally varies as sometimes there may be admission of old patients due to recurrence as well as patients on transfer from other district or town as a result of being out of management. Apart from the admitted in-patients, there were about 132 cured patients residing in the colony under rehabilitation process; these ones have been cured of the diseases though some of them may visit the clinic occasionally as out-patients for treatment of ailments such as malaria, cough etc.

Figure 1 shows the variation of the population of admitted infected patients from year 2000 till 2006 when this

research was carried out. From the figure, it is apparent that there is no decrease in the population of the leprosarium as the graph is sinusoidal. This population figure is as a result of limited number of patients being rehabilitated. If there is no adequate strategic housing and sewage management plans to alleviate the spread of leprosy, it is possible that unaffected children, relatives or guardians may be exposed to infection through improper ventilation (Coker *et al.,* 2011).

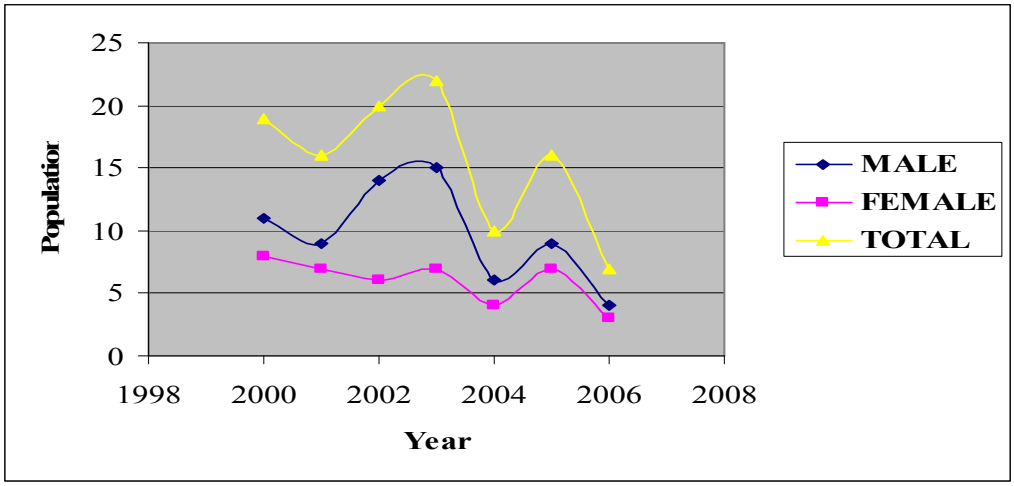

Figure 1 Variation in Population of Leprosarium over Five Years

3.2 General Assessment of Leprosarium

The general assessment of the leprosarium as shown in Table 2 with regards to waste management and facilities shows lack of waste management culture and the assessment is very poor. This might be due to lack of solid waste disposal facilities like lavatories, incinerator etc., and inadequate management of the available facilities coupled with lack of funding. This indicates their vulnerability to various infective diseases. This present state of the leprosarium may also promote the easy spreading of leprosy if good medical attention is not given.

Table 2 Environmental, Structural and Health Assessment of Leprosarium

Facilities	Leprosarium	Camp 1	Camp 2	Camp 3
Total Number of people[+]	24-25	24-25	40-45	70-75
Present Number of people per room or Ward (including children)	1-5	1-2	1-4	1-3
Housing	Concrete Block Ward*	Mud walled Single Apartment***	Concrete block Single Apartment**	Concrete block Single Apartment**
Ventilation	Cross*	Single (Small)***	Single (Small)**	Single (Small)**
Excretal disposal	Pit Toilet	None	None	None
Solid waste disposal	Pit Open Dump***	Open Dump***	Open Dump***	Open Dump***
Medical service	Out and In Patient Treatment**	Out Patient Treatment**	Out Patient Treatment**	Out Patient Treatment**
Rehabilitation programme	Obsolete Availability ***	Obsolete Availability***	Obsolete Availability***	Obsolete Availability***
Water Supply	Well** Borehole**	Well*** Borehole**	Well*** Borehole**	Well*** Borehole**

[+] *Assuming a maximum of two people per room, excluding children.*

Degree of Usefulness

* = *Adequate in serviceability*

** = *Average in serviceability*

*** = *Inadequate in serviceability*

3.3 General Waste from the Colony

Solid waste from both the leprosarium and leper settlement generally is a heterogeneous mixture of both non-hazardous general waste and hazardous bio-medical waste which are normally collected together without segregation. The non-hazardous is a general waste from agricultural and household activities like farming, cooking and serving of food and the hazardous wastes from the clinic centre located within the leprosarium.

The characterization of the waste for both leprosarium and the camps is shown in the Table 3, which shows that the waste consists of the following material composition: swabs and absorbents from the clinic, domestic waste, animal waste, wood ash, nylon and plastic, paper, and yard trimmings.

Table 3a Characterization of Waste from Leprosarium and the Camps

	Weekly Waste Generated (kg)			
Waste Components	Leprosarium	Camp1	Camp2	Camp3
Paper	0.37	0.08	0.10	0.19
Bandages and Absorbent	0.46	0.12	0.13	0.22
Nylon and Plastics	0.55	0.15	0.14	0.26
Yard Trimmings	6.73	1.74	1.52	1.48
Domestics Waste	9.90	2.62	2.82	4.47
Wood Ash	15.60	4.18	4.49	6.93
Animal Waste (Goats)	17.10	5.32	5.58	6.20
Total Weekly Waste Generated (kg/day)	50.72	14.23	14.78	19.74

Table 3b Waste Generation Rate of Leprosarium and Camps

	Waste Generated (kg/day)			
Waste Components	Leprosarium	Camp1	Camp2	Camp3
Paper	0.05	0.01	0.01	0.03
Bandages and Absorbents	0.07	0.02	0.02	0.03
Nylon and Plastics	0.08	0.02	0.02	0.04
Yard Trimmings	0.96	0.25	0.22	0.21
Domestics Waste	1.41	0.37	0.40	0.64
Wood Ash	2.23	0.60	0.64	0.99
Animal Waste (Goats)	2.44	0.76	0.80	0.89
Total Daily Waste Generated (kg/day)	7.25	2.03	2.11	2.82

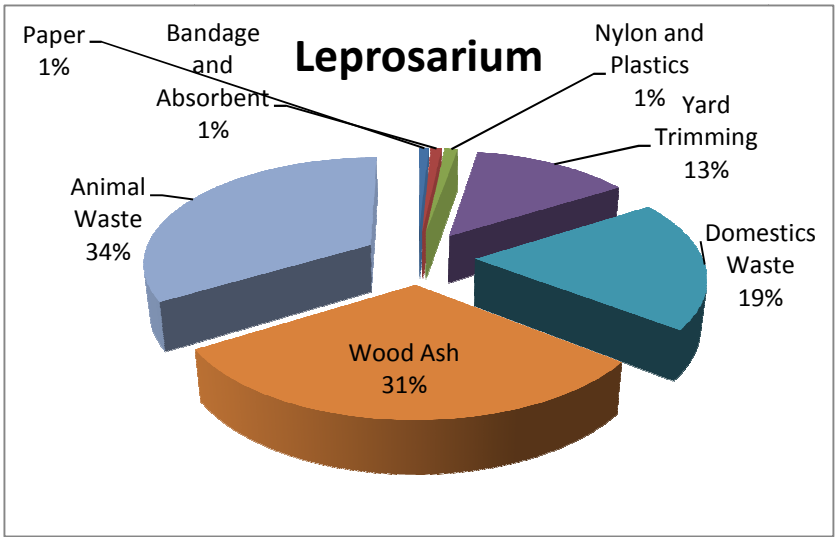

Figure 2: Mass Percentages of Waste Material Components from Leprosarium (%)

The percentage of biomedical waste which is mainly absorbents and swabs is approximately 1.0% (see figure 2) with average daily generation rate of 0.13kg/day which is too low comparing to biomedical waste generation rate of township hospitals. The remaining 99% is a general non-hazardous or domestic waste with waste generation rate of 14.21kg/day minus the generation rate of biomedical waste consisting of both combustible and decomposable waste materials. The average waste generation rate in term of mass for this colony is between 0.084 – 0.094kg/person/day. Absorbents and swabs generated as biomedical waste is shown in plate 1.

4. Discussion

There is sporadic increment in the population of the patients admitted into the leprosarium as seen in Figure 1. This might be due to the admission of new patients into the clinic or relapse of the infection in the old patient which may necessitate admission. However, there may be increase in the number of patients in the camp as a result of congestion and poor ventilation the patients and their relatives who are taking care of them are being subjected to. Also, the level of treatment given to them is not as adequate as compared to leprosaria in developed countries due to lack of funding and government intervention. Plate 2 is one of the dilapidated buildings in the colony.

The amount of biomedical waste generated was low. This really corresponds to the following though they are often interwoven:

(i) the population of admitted patients in the leprosarium,
(ii) the nature of prescribed drugs and
(iii) the functional status of the hospital in rendering its medical services.

Plate 1: Absorbent and Swab as Bio-medical Waste from Leprosarium

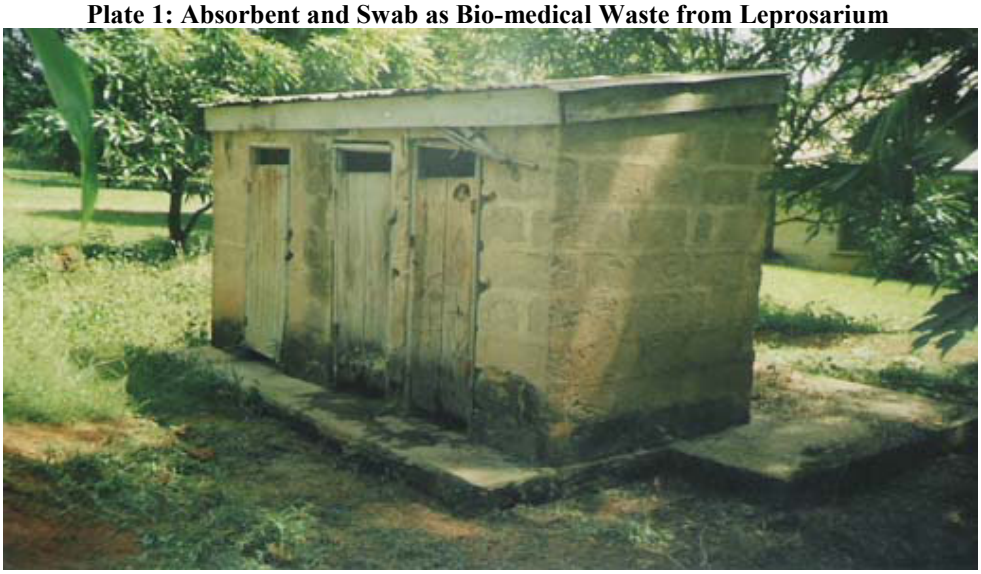

Plate 2: Pit Latrine in the camps provided for the patients

Intravenous drugs are really prescribed for them due to the callousness of their skin, instead orally administered are mostly common in their drug while the swab and cotton wool are being used in cleaning their opened wound. The analysis of the whole waste from the camps shows that it a general municipal waste which when segregated consists of paper, nylon and plastic, domestic waste or vegetable remains, wood ash, animal or goat manure, rag and yard trimming. There is no presence of any biomedical waste such as bandage in the collection. This might result from the fact that rehabilitated patients quickly resort to the leprosarium once there is breaking out of fresh wounds and they do not return to the camp until the wounds are completely healed up. In addition, it is only the rehabilitated patients that are allowed to live in the camps; no patient with leprosy wounds is allowed as out-patient. The proportion of each of the components is a direct or indirect relation of the numerical population and area size o the camps. It is a direct relation in the sense that the larger the population of the camp the more waste generated; however, where the percentage of elderly people highly exceed the children and young people then less waste will be generated and this an indirect proportion. The major vegetative component of the leprosarium is grass; this makes yard trimmings to be the major component of their solid waste. The segregation of the whole from the camps shows that the wastes consist of mainly garbage and refuse which are heterogeneous mixtures of both combustible and non-combustible waste. The combustible part is mainly nylon and plastic and if this is properly segregated, the remaining part of the waste is a good composting material as it contains wood ash, yard trimming animal remains and other decomposable material. These waste materials are mainly dumped at designated spots as open dump sites. One of these is shown in Plate 3.

In conjunction with this, most of the residents in the colony are defecating in the open bush near the colony as a result of absence of good or functional latrine which as well suitable for the lepers. The available toilet is pit latrine which facilitates easy breeding of mosquitoes and houseflies and hence easy spreading of diseases such as malaria, dysentery and cholera since they are diseases vectors. Similarly, open bush defecation promotes offensive odour round about the whole environment and as well serves as breeding place for black rat and other diseases causing organisms. The pit toilet, though available, is not sufficient for the whole population of the colony. This has generated worry and anxiety on the imminent of outbreak of cholera and other diseases which may result from open defecation.

As at the time of this work, there was no treatment of waste before disposal and the current waste disposal practices used are open dumping and open burning. The practice of waste disposal without treatment is very dangerous to the waste handlers and the patients alike since they have first contact with the waste which contains medical wastes however small it is. The combustible materials are burnt inside a pit of about one metre deep shown in plate 4 near the male ward with open fires, which definitely affects the patient health and as well contribute environmental air pollution.

The waste had the mean moisture content of 45.9% which is low as a result of high content of dry waste material it contained, for example wood ash [13.3%] and yard trimmings [30.8%], in addition, the study was done during the dry season.

Plate 3: Open Dump Site in the Colony

Plate 4: Dump Pit for open burning of waste in the leprosarium

5. Conclusion

It is apparent that irrespective of the amount of waste generated from the leprosarium, it is usually mixture of both biomedical waste and general municipal waste which need segregation no matter how small the quantity biomedical waste is, and proper handling and disposal to curtail the hazardousness and infectiousness of this waste. However, these procedures are completely absence which makes the residents, waste handlers and even the staff of leprosarium (Medical doctors, Nurses, etc.) vulnerable to infections if care is not taken.

Also various diseases and infections cannot but occur where mishandling and mismanagement of waste generated is prevailing, environmental sanitation is lacking and indiscriminate disposal of excreta is rampant as it is case of the case study. The residents are living below standard as most of the amenities needed for their sustainability are not available.

As a result of these, the waste handlers as well as the residents in the colony should be educated on the risk and need to sort and segregate the waste before disposal. They should be informed of the proper method of disposing waste from medical institution such as leprosarium. This is the social function of the management concerned for this leprosarium.

Nigeria Government at federal, state and local levels should intervene in the management of both private and public leprosarium and develop appropriate and workable policies on solid waste and medical waste management with the intent of achieving World Health Organisation policy of eliminating leprosy and integrating intensive care for those already affected. In the same vein, both National and International Organisations should rise up to assist this set of people in the community in building social amenities which are necessary for them to feel that they are really living and not abandoned part of the community.

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