

MANAGEMENT OF WASTE GENERATED BY HOSPITALS

IN MINNA

BY

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(2000/9556EH)

**DEPARTMENT OF CHEMICAL ENGINEERING,
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA**

OCTOBER 2006

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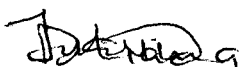
**A FINAL YEAR PROJECT WORK PRESENTED TO THE
DEPARTMENT OF CHEMICAL ENGINEERING IN PARTIAL
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ENGINEERING, FEDERAL UNIVERSITY OF TECHNOLOGY,
MINNA, NIGER STATE**

OCTOBER 2006

DECLARATION

I, David Juliana, (2000/9556EH), hereby declare that the project "Management of waste generated by hospitals in Minna, under the supervision of Eng. A.S Kovo was solely carried out by me and has not been submitted anywhere else as a research project for the award of Bachelor of engineering (B.Eng), in Chemical Engineering.

All literature cited have been duly acknowledged in the reference.



.....
David Juliana
(2000/9556EH)

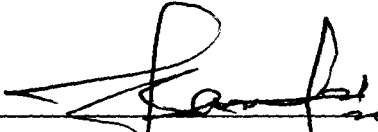
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DEDICATION

This project is dedicated to Almighty God, also to my parent late Mr. A. David and Mrs. Alice David.

CERTIFICATION

certify that the research work on management of wastes generated by hospitals (Minna as case study) has been actually carried out by David Juliana (2000/9556EH) under my supervision.



Engr. A. S. Kovo
Project Supervisor

20/10/06
DATE

Dr. M. O EDOGA
Head Of Department

DATE

External Examiner

DATE

ACKNOWLEDGEMENT

I ascribe all glory to almighty God for sustaining me throughout my academics pursuit, and has made it possible for me to complete my project work.

My appreciation goes to my supervisor Engr. A. S. Kovo for his patience and guidance, which has helped me to successfully carry out this project.

I am very grateful to my love Joseph Dada, for his moral support and understanding. God bless you.

My appreciation goes to my mummy Mrs. Alice A. for her moral and financial support. Also, to my brothers and sisters for their support, God bless you all.

Lastly, my special thanks to my friends, Elizabeth Rachael, Victoria, Omolayo for their love. May good God reward you all. (Amen).

ABSTRACT

Hospital management is an important subject that needs urgent attention, as a result of health hazard posed by medical wastes, which include transmission of Human Immuno-Deficiency Virus (HIV), and Hepatitis B or C viruses via sharps and blood.

The ways by which hospitals in Minna handle the wastes generated were evaluated using questionnaires. Twenty hospitals were studied. The wastes generated by these hospitals consist of isolation wastes, human blood and blood product, laboratory wastes, sharps objects, pathological wastes, cultures and stocks of infectious agents. Most of these wastes are potential hazards to the community. The group most at risk is medical care workers especially nurse, medical laboratory workers and wastes management operators outside the hospital. In places where scavenging or rag picking at disposal sites is common, the scavengers face a grave risk.

The study revealed that, thirty percent (30%) of the hospital dispose their wastes by burning in the open pits, fifteen percent (15%) by open dumping, twenty percent (20%) by land filling, while twenty-five percent (25%) employ the services of Niger State Urban Development Board (N.U.D.B). only two hospitals (10%) incinerates its waste. The key to satisfactory management of medical wastes is the development of appropriate and sustainable system; training of all staff, motivation of all concerned and supervision

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CHAPTER ONE

1.0 INTRODUCTION

Medical or hospital wastes are any solid, fluid or liquid wastes including the containers and any intermediate product, which are generated during the diagnosis, treatment or immunization of human beings or animals and are contaminated with patients' body fluids, in research pertaining thereto or in the production and/or testing of biological materials(WHO 1994). These include bandages, syringes, needles, disposable items such as tongue depressors, organs, body parts, placenta, blood, dressings, sanitary pads, plastics and stocks of infectious agents. Some medical wastes are potential hazards to millions of patients, health care workers, and visitors to medical establishment.

These wastes contain micro-organisms that are harmful to humans and animals. During handling of medical wastes diseases may be contacted. Collins and Kennedy (1987) reported that the groups most at risk are nurses, medical laboratory staff and waste management operators outside the hospitals. In addition, scavengers or pickers of improperly disposed medical wastes and the general public are at great risk from medical wastes and from direct contact with infected materials (Okoronkwo, 1998).

Wastes disposal problems are enormous in Nigeria. Attention has been focused on the disposal of industrial wastes while medical wastes management is neglected, proper disposal of hospital wastes is of paramount importance because of its infectious and hazardous characteristics. On the basis of this, a study on management of wastes generated from hospitals in Minna, Niger state, Nigeria, was initiated.

1.1 AIMS/OBJECTIVES

The aim of this research is to examine and analyse the problem of hospital waste management in Minna with the view of how to reduce the risk of the spread of disease and the occurrence of accidents associated with such wastes.

The following objective are considered

1. knowing the types of wastes being generated in the hospitals.
2. Classifying the wastes into solid, liquid and gaseous if possible.
3. Knowing how wastes generated are being managed and
4. How to improve the waste management particularly handling and disposal of the wastes.

1.2 JUSTIFICATION OF THE STUDY

The wastes under consideration may arise in hospitals, clinics, nursing homes, dentists and veterinary practices, laboratories and research establishments. Most of the medical wastes contain micro-organism that are harmful to humans and animals. The groups most at risk are the handlers of the waste, like nurses, medical laboratory staff, waste management operators and the scavengers or pickers.

Based on the problems associated to the waste that are being generated in the hospitals, this study will focus on the identification of types of wastes generated in some of the hospitals in Minna, Niger state. Knowing different methods by which these hospitals are treating or handling and disposing their wastes, and how these methods can be improved upon in order to reduce hazards posed by the hospital waste to health and environment.

This study covers the various categories of hospital wastes, and its management. It will be limited to some of the hospitals and clinics in Minna (both private and government owned hospitals).

This study will be carried out using questionnaires and the major focus of the questionnaire is the type of waste generated by the hospitals, quantity of waste in relation to number of patients, frequency with which the waste are disposed, treatment and disposal method used. Other things include:

- Distribution of questionnaires to various hospitals and clinics in Minna.
- Collection of data from the hospitals.
- Analysing of data.
- Interpretation of results and
- Recommendation based on the result.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 HISTORICAL BACKGROUND

Waste management is a practice right from the inception of man. In the beginning, Adam and Eve who were the occupants of the earth were charged with the responsibility of taking care of the garden of Eden which includes, keeping the garden clean, this was done by hand picking and gathering of leaves and fruits that have fallen from its stalk which constitute the waste. As the day rolled by, they gave birth to children and fended for them by sourcing for food from the plants and animal around them. Since it is not all part of the plant and animal that can be consumed, others are thrown away, hence “waste”.

Waste management is the way of treating, handling and disposal of unwanted or unusable items, remains or by- products.

As the waste materials continue to increase, the mode and method of its collection and disposal increases/changes, with the new invention in technologies, waste is now wealth because it can now be treated and recycled to materials of great use thereby reducing the volume of the waste.

Nigeria is not left out in the struggle to improve waste management strategies. In recent years a number of waste management projects have been carried out in Nigeria, Minna not left out in collaboration with external support agencies. Some of the projects were successful producing lasting impact on the improvement of waste management in the country.

Waste management has been rocked with a lot of problems as a result major cities and towns are characterized by the mountains of refuse, indiscriminate dumping and burning of refuse due to negligence from the path of the waste managers as regards policies and allocation of funds.

In the spirit of deregulation and privatization policies, laws have been promulgated to involve the private sector (include private hospitals) in waste management and collection system which has been evident in major cities in Nigeria with clean streets and leveling of refuse mountains (Coinfreau, 1992).

2.1.1 WHY MANAGE WASTE

Due to the ever increasing rate of waste generation and the concern of individual. Proper research has been carried out into the components of the waste and has been affirmed wealth of the nation. For example solid waste has been identified as major raw materials for composting project in developing countries (Tehobanglous et al 1977).

In the case of domestic waste, the major constituents are dead animals and vegetable matter in form of kitchen waste and garden waste.

A city of 1 million would generate 500 ton/day of which at least 25%-75% of the weight comprises of vegetable and putresable matter (flunt off, 1976). It is then possible to convert this waste to substantial proportion of organic matter. The aim of composting is to convert a major proportion of the solid waste into a marketable product (flunt off, ibid).

Material recovery from waste is an efficient method to manage waste. Material recovery helps in successfully recovering substantial part of the material in a cost effective manner and also minimizes the quantity of waste to be disposed. In the case of medical wastes, for example sharp materials like syringes and needles can be taken to the plastic and metal reprocessing industries for recycling if properly disinfected and shredded.

About 25 million AD syringes (fixed needle) were used by the community medicine department of Ramaiah College Bangalore for mass measles campaign. (Safety of injections: WHO, UNICEF policy statement for mass immunization campaigns).

The 235kg of plastic generated from these syringes were converted into 8" 3" 3" rectangular boxes by the reprocessing industry. The metal needles were handed over to the Indian institute of science, Bangalore to melt into a small block.

Moreso, medical waste management is needed due to health, environmental, legal and ethical reasons (Thornton J, 1996). Therefore, if waste is properly managed, it is a source of wealth to a nation (Confreau, 1992).

2.1.2 CLASSIFICATION OF WASTE

Waste can be classified into different types depending on their source; they could be from household, industries, commercial centers, Agricultural materials, hospitals or clinics, and waste from construction and demolition.

The waste could be hazardous or non hazardous, infectious or non infectious waste.

a) Biomedical or Hospital waste: These are solid, fluid or liquid waste including the containers and any intermediate product, which is generated during the diagnosis treatment or immunization of human beings or animal. In other words, the rubbish containing human tissues, body fluids, excreta, unused drugs, swabs, disposable syringes and sticky bandages e.t.c constitutes biomedical waste. This waste is highly infectious and can be a serious threat to human health if not managed in a discriminate manner. (Management and handling rules, 1998).

b) Industrial waste: These are waste from industries or factories. In industrial sector, the major generators of hazardous waste are the metal, chemical, paper, pesticide, dye, refining and rubber goods industries. Some of these waste may contain toxic substances that are harmful to humans, animals and plants; are corrosive, highly inflammable or explosive, and react when exposed to certain things e.g gases.

c) Muncpal waste: consists of household waste, construction and demolition debris, sanitation residue, Agricultural waste, and waste from commercial complexes. Over the last few years, the consumer market has grown rapidly leading to products being packed in cans, aluminium foils, plastics and other such non biodegradable items that cause harm to the

environment. If these waste can be properly managed, they can be recycled into new product and this will reduce the quantity of waste that will be disposed.

Managing municipal waste, industrial waste and hospital waste has traditionally consisted of collection, followed by disposal. Depending upon the type of waste and the area, a level of processing may follow collection. This processing may be to reduce the hazard of the waste, recover material for recycling, produce energy from the waste, or reduce it in volume for more efficient disposal.

2.2 HOSPITAL WASTE

Hospital waste are wastes generated during diagnosis, treatment or immunization of human beings or animals, in research activities in these fields or in the production or testing of biological materials (WHO, 1994). These include wastes like sharps, soiled waste, disposables, anatomical waste, cultures, discarded medicines, chemical wastes, etc. These are in the form of disposable syringes, swabs, bandages, body fluids, human excreta e.t.c. This waste is highly infectious and can be a serious threat to human health if not managed in a discriminate manner.

The management of waste poses to be a major problem in most of the countries, especially hospital waste. In recent years, medical waste disposal has posed even more difficulties with the appearance of disposable needles, syringes and other similar items. It has been roughly estimated that of the 4kg of waste generated in a hospital at least 1kg would be infected.

The quantity of waste generated from hospitals depends on numerous factors such as established waste management methods, type of health care establishment, hospital specializations, proportion of reusable items employed, and proportion of patients treated on a day-care basis. The data available from developed countries indicate a range from 1.5kg/bed/day, while data from developing countries indicates that the range is essentially similar but the figures are lower i.e 1-2kg/day/patient.

According to a WHO report, around 85% of the hospital wastes are actually non hazardous, 10% are infectious (hence hazardous), and the remaining 5% are non-infectious but hazardous (chemical, pharmaceutical and radioactive).

During handling of medical wastes diseases may be contacted. The main health hazard related to medical waste appears to be the transmission of Humano-Deficiency Virus (HIV) and Hepatitis B or C viruses via sharps and blood. The group most at risk are nurses, medical laboratory staff, waste management operators outside the hospitals. In addition, scavengers or pickers of improperly disposed medical waste and the general public are at great risk from medical wastes and from direct contact with infected materials. (Okoronkwo, 199

2.3 CLASSIFICATION OF HOSPITAL OR MEDICAL WASTES

Medical wastes vary in size, forms, physical, chemical and biological composition. WHO (1983) adopted the following classification of medical wastes:

- a) Isolation wastes: These are biological and discarded materials contaminated with blood, excretion, exudates or secretions from humans who are isolated to protect others from contacting certain highly communicable diseases, or isolated animals known to be infected with highly communicable diseases.

- b) Cultures and stocks of Infectious Agents: These include culture from medical and pathological laboratories, cultures and stocks of infectious agents from research and industrial laboratories, wastes from the production of biologicals; discarded live and attenuated vaccines, and culture dishes and devices used to transfer, inoculate and mix cultures.

- c) Sharp materials: Sharps that have been used in animal or patient care or treatment or in medical research, including hypodermic needles, syringes (with or without needles), Pasteur

pipettes, scalpel blades, blood vials, broken glass, needle with attached tubing and culture dishes, used slides and cover slips.

d) Human Blood and Blood Products: These include liquid waste from human, products of blood, items saturated and/or dripping with human blood, items that were saturated and/or dripping with human blood that are now caked with dried human blood; including serum, plasma and other blood components and their containers, and intravenous bags.

e) Animal Waste: These are contaminated animal carcasses, body parts, and bedding of animals that were known to have been exposed to infectious agents during research (including research in veterinary hospitals), production of biological, or testing of pharmaceuticals.

f) Cytotoxic wastes: These are wastes which in addition to being toxic are mutagenic and/or teratogenic when discarded or spilled.

g) Radioactive waste: These are wastes that comes from the use of radioactive substances in the treatment of chronic and communicable diseases e.g. unused liquids from radiotherapy or laboratory research, contaminated glassware, packages, or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides.

2.4 HOSPITAL WASTE MANAGEMENT

The management of medical wastes requires diligence and care from a chain of people, starting from the nurse to the doctor who use the equipment and supplies that become waste, through the labourer who provides clean sacks or containers and carries away waste on to the person responsible for ensuring that residues are disposed of in the correct way.

Potentially hazardous waste materials arising from hospitals requires special management and the use of costly handling and disposal arrangement to avoid causing infection or injury to those who come in contact with it, and to minimise negative impacts on the environment.

Training and motivation are both important. All staff need to know what is expected of them, and why it is important. This will require extra effort where there is a high turn over of manual workers. Training should not be solely to explain routine procedures, but should also cover emergency procedures, such as what action should be taken as a result of a spillage of particular types of waste, or an injury involving a needle.

Motivation is more difficult, but essential. It starts with the senior medical personnel, who must show by word and example that they believe in the importance of appropriate waste management procedures. Motivation can be assisted by a full discussion of the hazards posed by medical wastes, so that staff understand the significance of the steps that they are being asked to take. Supervision is essential to back up the words, to identify needs for further training, and bring to light carelessness and deception.

Management has a responsibility of gathering and using information relating to its sphere of operation. A knowledge of the quantities of the different types of waste is essential if sound management decisions are to be made. The incidences of accidents, injuries and infections should be carefully monitored. Information on disposal practices and facilities should be disseminated and used, for the guidance of others and where there is a possibility of co-ordination or sharing facilities. (Journal of Environmental Sciences, 1998, pg 85).

2.4.1 HOSPITAL WASTE MANAGEMENT PROCESS

The hospital or medical waste management process include; General hygiene, Storage of hospital wastes, Handling of hospital wastes, Treatment of hospital wastes and Disposal of waste:

1) **General Hygiene:** General hospital hygiene is a prerequisite for good medical waste management. It will be useless in terms of prevention of nosocomial infections to start improving hospital waste management if the hospital does not have a reliable supply of safe water, and basic sanitation facilities accessible to hospital personnel, patients and visitors. It is vital that the whole hospital be kept clean and in a satisfactory state of hygiene. On the other hand, in terms of prevention of the spread of infection outside the hospital careful management of wastes from the point of generation is of paramount importance.

11) **Storage of Hospital Wastes:** In many ways, the storage of hospital wastes is the key to the whole management process, because it is at this stage that wastes are segregated into different streams and incorrect classification of wastes can lead to many problems at a later stage. It is also at this stage that all sharps should be put into containers, and failure to do this properly can lead to injury and potentially fatal infections

In United Kingdom for example, black bags are recommended for general non-hazardous wastes, yellow bags for infected wastes not containing sharps, and blue bags for clinical wastes that requires autoclaving prior to disposal in a yellow bag (Iwag,1992). These colour coding vary from nation to nation. So it is essential that the colour codings be standardized at the national level, and medical staff should be trained so that they do not confuse the colours and place wastes in the wrong receptacles.

111) **Handling of Hospital wastes:** Twice a day (more often for operating theatres and intensive care rooms) the waste bags and/or containers should be sealed and carried to a special waste storage room where they will be placed in separate piles according to the colours of the bags.

The general non-hazardous waste can be taken directly to an outside container to be either picked up by the municipal waste collection service or disposed of by the hospital itself. Porter carrying the waste should wear sensible protective clothing, both for hygiene reasons and to prevent skin puncture. Stout gloves are essential. If there is an agency dealing with

industrial, chemical or radio-wastes. It will be easy for the hospital to pass on to this agency the task of disposing of hospital chemical or radioactive wastes.

IV) Treatment of hospital waste: The term treatment refers to processes that modify the waste in some way before it is taken to its final resting place. Treatment may be required for a number of reasons:-

- a) To disinfect or sterilize the waste, so that it is no longer source of pathogenic organisms. Examples are chemical disinfection or thermal sterilization, irradiation, incineration. After such treatment the residues can be handled more safely and with fewer precautions.
- b) To reduce the bulk volume of the waste in order to reduce the requirement for storage and transportation. Examples are bailing and size reduction.
- c) To make surgical waste(body parts) unrecognizable, and therefore less aesthetically unacceptable. An example is shredding.
- d) To make recyclable items unusable for example syringes may be cut up or the needles cut or damaged so that they cannot be reused.

V) Disposal of hospital wastes:- Disposal is taken to mean the placing of the waste in its final resting place. Solid waste should not be disposed off to water because of risks of chemical, microbiological and gross pollution. It follows that the only disposal route is to land. There are many ways in which solid wastes can be disposed off to lands.

A well-run municipal land fill is recommended. In this method hazardous wastes should be covered immediately by a metre thickness of ordinary wastes and always be placed more than two meters from the edge of the deposited waste. Alternatively a specially constructed land filling cell for hazardous medical waste can be used. This arrangement

would allow close supervision of the operation and a 500mm thickness of cover could be placed over refuse to isolate it from vermin, and prevent land fill vehicles from disturbing it. (Journal of Environmental Sciences, 1998, Pg 83).

2.5 HAZARDS AND RISKS POSED BY HOSPITAL WASTE

There are many example and ample evidences that indiscriminate management of hospital waste could cause serious hazards to health and environment. There is strong epidemiological evidence from Canada, Japan and USA that the main concerns of infectious hospital waste is the transmission of HIV/AIDS virus and more often, of the hepatitis B or C virus (HBV) through injuries caused by syringe, needles contaminated by human blood. The group most at risk is medical care workers especially nurse, medical; laboratory staff, and waste management operators outside the hospital. (Collins and Kennedy, 1987).

It is estimated that no more than one infection by the AIDS virus will arise yearly in the united state of America among each professional risk group each, year other than nurses and housekeepers (WHO 1994). For each of those two groups the risk be 1.3. According to the theoretical calculation the annual number of Hepatitis B virus infections in non-hospital employees as a result of medical wastes related to injuries from sharps is betwe 162 and 321 in the United States of American compared to a total of 300,000 for all cases (WHO 1994).

In July 1987, two young Japanese residents in paediatrics, a 25year old woman and a 28-year-old man, were wounded on their fingers by syringes used. Both of them soon died from fulminant Hepatitis (shirato). Those syringes had previously been used on virus carrying patients. In total, shirato had documented in the Japanese scientific literature more than 500 cases of infections related to medical wastes, over 500 cases of injury or poisoning with chemical wastes from hospital and more than 400cases of biohazards from cytotoxic drugs improperly disposed.

Another hazard posed by hospital wastes is that of a poorly managed landfills which can create a number of adverse environmental impacts including wind-blown litter, attraction of vermin (harmful agents on the hospital waste) and pollutants such as leachate which can

leach into and pollute groundwater, river and food and cause alimentary infections like cholera, typhoid, dysentery, polio, ascariasis and hook worm diseases (Thornton J, 1996).

Wastes disposed indiscriminately for example open dumping breed vermin and pests like mosquitoes that transmit insect borne diseases like malaria., common houseflies which transmit infections mechanically, cockroaches, ants, mice and rats that causes nuisance. Dust may harbor tubercle bacilli and other germs, which cause disease if inhaled. Silage water, refuse and night soil , all create intolerable nuisance of sight and smell.

In Africa, some urban hospitals burn their wastes in the open air within the hospital premises; liquid wastes are sometimes treated but not disinfected (WHO, 1994). In Nigeria, Okoronkwo and Onwuliri (1997) reported that waste handlers in the city of Jos sold off their protective gadgets for economic gains and therefore became expose to infections with the hepatitis virus. The low degree of health education and hygiene awareness among the waste handlers were other factors that affected the risks posed by hospital wastes in Nigeria.

Cultural beliefs and degree of awareness of health issues, as well as the practices and technology are important elements of society which must be considered in deciding the risks posed by hospital wastes. For example, some people seem to believe that every cure requires an injection. Poor people, who have no access to qualified medical personnel, may seek anyone who can give them an injection; it may be administered by an unqualified practitioner using a discarded syringe. Scavengers or pickers are at risk from sharps, pharmaceuticals, and chemicals and from direct contact with infected materials, items such as containers that they salvage may spread contamination to society at large. If they are not properly cleaned and sterilized before they are sold.

2.6 TREATMENT OF HOSPITAL WASTE

Treatment of hospital waste means “any method technique or process for altering the biological, chemical or physical characteristics of waste to reduce the hazards . presents and facilitate. The basic treatment objectives of the hospital waste include volume reduction, disinfections, neutralization or other change of composition to reduce hazards to health and environment.

There are technology options available for the treatment of medical wastes, which are as follows:

(a) Chemical/Mechanical Treatment

This treatment system has an extensive and well-documented history in the medical setting in disinfecting and sterilizing environmental surfaces and medical devices (Jagger et al, 1989). Inherent in the operation of such system is the fact that the waste must first be shielded prior to exposure to such agents as sodium hypochlorite, chlorine dioxide, paracetic acid and so on, into direct contact with the chemicals.

This treatment system has the advantages of volume reduction of the waste; render the waste unrecognizable, rapid processing and waste deodorization. Some of the disadvantages associated to this treatment system are: high investment cost, not suitable for all waste type, possible air emission and need for chemical storage.

(b) Incineration

Incineration is a high-temperature dry oxidation process that reduces organic and combustible waste to inorganic, incombustible matter and results in a very significant reduction of waste volume and weight. This process is usually selected to treat wastes that cannot be recycled, reused or disposed off in a landfill site.

The combustion of organic compounds produces mainly gaseous emissions, including steam, carbon dioxide, and certain toxic substances (e.g. metals, halogenicacids) and particulate matter and ashes. If the conditions of combustion are not properly controlled, toxic carbon monoxide will also be produced, which have to be treated to avoid effects of health and the environment.

(c) Steam Autoclave

Autoclave have been used for the sterilization of surgical instruments, medical devices, heat stable liquids, as well as numerous applications in medical laboratories and private industry. Therefore, it was a natural progression to use autoclave to decrease or eliminate the potential bio-burden contained in medical waste. Some of the advantages associated to this process

are: low investment cost, ease of biological test and low hazard residue. The disadvantages are that, it is not suitable for all waste types and possible air emission.

(d) Pyrolysis and gasification

These methods involve the high temperature (545⁰C to 1000⁰C) treatment of waste in the absence of oxygen. In generating these high-temperatures, the systems treat, destroy and reduce the volume of medical waste. The process typically occurs in a sealed vessel under high pressure. Converting materials to energy, this way is more efficient than direct incineration, with more energy able to be recovered and used.

CHAPTER THREE

3.0 METHODOLOGY

In these study twenty (20) hospitals comprising both private and public (Government owned) hospitals in Minna, Niger State, were sampled. The number of patients attending these hospitals per day varied, ranging from four (4) to five hundred (500) patients per day. (Table 1)

The survey was carried out with the administration of a questionnaire to the medical personnel of the hospitals in Minna. The major focus of the questionnaire is the type of wastes generated by the hospital, number of patients per day, number of wastes unit used, the frequency with which the wastes are disposed, and disposal method used.

3.1 Table 1: Handling of Medical Wastes in Hospitals in Minna.

Name of Hospital	Number of Patient Per Day	Number of Waste Unit Used	Frequency of Disposal
Garkiya Children Specialist Hospital	15	8	Every day
Gilead Clinic	24	1	Twice /week
General Hospital	500	50	Every day
Kowa Maternity	10	4	Twice /week
Standard Hospital	30	15	Thrice /week
Faith Medical Clinic	6	6	Weekly
Mercy Maternity	4	2	Twice /week
Nasara Clinic	6	5	Twice /week
Taimako Clinic	50	7	Thrice /week
Maitumbi Clinic	6	6	Weekly
Top Medical Clinic	20	16	Thrice/week
Masol Hospital And Maternity	20	1	Daily
Bay Clinic	50	4	Twice /week
Imani Specialist Hospital	150	1	Monthly
Care Specialist Hospital	20	4	Twice/month
Freedom Clinic	7	1	Twice /week
Primary Health Centre	10	2	Twice /week
Mainasara	15	3	Twice /week
Royal Care Hospital	20	4	Thrice /week
Primary Health Centre	15	3	Twice /week

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 RESULTS

Table 2: Disposal of Medical Wastes by Hospitals in Minna

Waste management methods	Number of Hospitals Adopting the Method
Burning in open pit	6 (30%)
Open dumping	3 (15%)
Land filling (Burying)	4 (20%)
By Niger State Urban Development Board (N.U.D.B)	5 (25%)
Incineration	2 (10%)

Twenty hospitals were sampled; number in parenthesis represents the percentage of hospitals adopting the methods.

4.2 DISCUSSION OF RESULTS

4.2.1 Composition of Medical Wastes Generated

The composition of medical wastes generated in various hospitals in Minna is in many respects similar (liquid and solid wastes) though there are differences in quantities generated by each of these hospitals as a result of number of patients visiting these hospitals per day. The wastes comprise isolation wastes, human blood and blood products, radioactive medical wastes, laboratory wastes, unused and used sharp objects, cultures and stocks of infectious agent, discarded medical equipment and cytotoxic wastes.

4.2.2 Treatment and Disposal of method of Medical wastes

From the data collected, thirty percent (30%) of the hospitals in Minna dispose their wastes by burning in open pit. Burning of wastes in open pits contributes to air pollution and some of the gases emitted can cause disease if inhaled. Fifteen percent (15%) dispose their wastes by open dumping. Okoronkwo (1998) reported that open dumping of wastes encourages

spread of infectious disease within the community because some scavengers are at risk from sharp objects, pharmaceutical and chemical wastes and from direct contact with infected materials. Item such as containers, that they salvage may spread disease to community at large if not properly cleaned and sterilized before they are sold. Similarly, this may cause death in free-range livestock that may feed on some of those infectious wastes. The presence of dump encourages the growth of disease transmission insect such as flies, cockroaches, mosquitoes and rodents. Twenty percent (20%) dispose their wastes by land filling or burying (Table 2). Poorly managed land fills can create number of adverse environmental impacts, including wind-blown litter, attraction of vermin and pollutants which can pollutes ground water and rivers.

Also, twenty-five percent (25%) of the hospital and clinics engage the services of Niger State Urban Development Board (N.U.D.B) to dispose their wastes (Table 2). It has also been observed that agencies, which handle the disposal of medical wastes and other wastes in Minna, do not treat the wastes before disposal but dump them in the open air in the outskirts of the city, thereby exposing the people in that area to danger.

Improper treatment and disposal of medical wastes causes the spread of the disease in the environment (Tsado 19989). Among the twenty (20) hospitals sampled, only two (10%) hospital treats its wastes by incineration. Incineration of wastes, as reported by Cross and Robinson (1989) and Holmes et al (1993) is the most effective method of treatment of medical wastes because it involves the application of combustion process under controlled condition to converts wastes containing infectious and pathological materials to inert mineral residues and gases.

There is no hospitals among the twenty sampled that dispose waste by chemical method. Chemical method is the treatment of wastes with chemical such as sodium hypochlorite, chlorine dioxide, peracetic acid to disinfect waste before disposal.

CHAPTER FIVE

5.1 CONCLUSION

The fundamental purpose of this study was to examine the types of wastes generated by hospitals in Minna and how they are managed. Hospital wastes management is an important subject that needs urgent attention because of the hazards and risk associated with medical wastes. The main hazard related to medical wastes appears to be the transmission of HIV and Hepatitis B or C viruses via sharps and blood.

Large quantities of medical wastes are being generated in Minna, and these may contain some infectious agents that can lead to outbreak of diseases in the environment. The wastes are not treated and disposed properly in the environment. Therefore indiscriminate dumping of medical wastes abounds in Minna.

5.2 RECOMMENDATION

Improper treatments and disposal of medical wastes causes the spread of diseases in the environment. It is therefore necessary to recommend that:

- (i) Workers' safety through education, training and proper personal protective equipments should be ensured.
- (ii) There is need to separate medical wastes from domestic wastes to enhance treatment and disposal.
- (iii) Medical waste that can be recycled should be disinfected or cleaned properly before recycling. Example, needle and syringe can be taken to metals and plastics factory for reprocessing.
- (iv) Public should be enlightened on the dangers associated with medical wastes.
- (v) The sanitation agencies should monitor hospitals closely and compel them to comply with the guidelines for the treatment and disposal of medical wastes.

REFERENCES

- Collins, C.H and Kennedy, D.A. (1987)
Microbiological Hazards of Occupational Needlesticks and Sharps.
Journal of Applied Bacteriology, 62, 385 – 402
- Okoronkwo, M.O and Onwuliri, C.O.E. (1997).
Some Health Associated with Waste Management in Jos, Plateau State of Nigeria.
Udoh, S.U and Akpan, G.O (eds)
Environmental Education for Sustainable Development, Focus on Nigeria
Fab Education Books, Jos, Nigeria. Pp. 305 – 315
- Tsado, M.L. (1998). Transport Treatment and Disposal of Medical Wastes.
A paper presented at the first national Conference of School of Environmental Technology,
Bauchi, Nigeria.
- Cross, F.L and Robinson, R. (1989).
Infectious Wastes in Standard Handbook of Hazardous Wastes Treatment and Disposal.
McGraw Hill Book Company, New York.
- Okoronkwo, M.O (1998).
Major Issues in the management of Medical Wastes.
Journal of Environmental Sciences 1(2): 80 – 86.
- WHO (1983). Management of Wastes from Hospitals.
World health organization, Regional Office for Europe
Copenhagen. Pp. 35 – 43.
Types of solid waste waste, <http://www.epa.gov/epaoswer/non-hw/muncpl/index.htm>.
Treatment and Disposal Technology for Health-care waste, <http://www.telmedpak.com/htm>,
June, 2006.
Waste reduction activities for hospitals, <http://www.civmb.ca.gov/BizWaste> ©1995, 2005.
Hospital waste reduction, <http://www.stopwaste.org/home/index.asp?page=249>

Hospital waste disposal issue, <http://www.telmedpak.com/homes.asp?a=374>, 2006

Hospital waste management,

<http://www.greenpeace.org/lebanon/en/hospitalwastemanagement>.

Medical Waste <http://www.epa.gov/medicalwaste>.

APPENDIX 1

Statistical Analysis

Mean of number of patients

$$\bar{x} = \frac{15+24+500+10+30+6+4+6+50+6+20+20+50+150+20+7+10+15+20+15}{20}$$

$$= \frac{978}{20} = 48.9$$

$$\approx 49$$

Therefore, the mean of the number of patients per day is approximately 49 patients.

Mean of Waste Unit Used

$$\bar{x} = \frac{8+1+50+4+15+6+2+5+7+6+16+1+4+1+4+1+2+3+4+3}{20}$$

$$= \frac{143}{20} = 7.15$$

Therefore the mean of the waste unit used per day is approximately 7 units. Comprises of Bulk bin, Drum and plastic containers.

Standard Deviation of the Number of Patients

$$\delta = \sqrt{\sum_{i=1}^m \frac{(x_i - \bar{x})^2}{N - 1}}$$

$x_i - \bar{x}$	$(x_i - \bar{x})^2$
$15 - 49 = -34$	1156
$24 - 49 = -25$	625
$500 - 49 = 457$	203401
$10 - 49 = -39$	1521
$30 - 49 = -19$	361

$(x_i - \bar{x})$	$(x_i - \bar{x})^2$
$20 - 49 = -29$	841
$50 - 49 = 1$	1
$150 - 49 = 101$	10201
$20 - 49 = -29$	841
$7 - 49 = -42$	1764

$6 - 49 = -43$	1849		$10 - 49 = -39$	1521
$4 - 49 = -45$	2025		$15 - 49 = -34$	1156
$6 - 49 = -43$	1849		$20 - 49 = -29$	841
$50 - 49 = 1$	1		$15 - 49 = -34$	1156
$6 - 49 = -43$	1849			$\Sigma = 233,800$
$20 - 49 = -29$	841			

$$\delta = \sqrt{\frac{233800}{20 - 1}}$$

$$= \sqrt{12305.26}$$

$$\delta = 110.9$$

$x_i - \bar{x}$	$(x_i - \bar{x})^2$
$8 - 7 = 1$	1
$1 - 7 = -6$	36
$50 - 7 = 43$	1849
$4 - 7 = -3$	9
$15 - 7 = 8$	64
$6 - 7 = -1$	1
$2 - 7 = -5$	25
$5 - 7 = -2$	4
$7 - 7 = 0$	0
$6 - 7 = -1$	1
$16 - 7 = 9$	81

$$\delta \approx 111$$

$(x_i - \bar{x})$	$(x_i - \bar{x})^2$
$1 - 7 = -6$	36
$4 - 7 = -3$	9
$1 - 7 = -6$	36
$4 - 7 = -3$	9
$1 - 7 = -6$	36
$3 - 7 = -4$	16
$3 - 7 = -4$	16
$4 - 7 = -3$	9
$3 - 7 = -4$	16
	$\Sigma = 233,800$

Therefore, the standard deviation of the number of patient is approximately 111 patients.

Standard Deviation of Waste Units Used

$$\delta = \sqrt{\sum_{i=1}^m \frac{(X_i - \bar{X})^2}{N-1}}$$

$$\delta = \sqrt{\frac{2263}{20-1}}$$

$$\delta = \sqrt{119.10}$$

$$\delta = 10.9$$

$$\delta \approx 11$$

Therefore, the standard deviation of waste unit is approximately 11 waste units.

APPENDIX II

QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE

Hospital: Garkiya Children Specialist, Bosso Minna.

1. Types of waste generated.

Solid E.g. syringe, ivf bag, bld bag needle, liquid – iv fluid

2. Number of patients per day

15

3. Number of waste units used

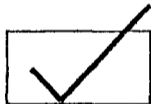
8

4. Frequency of disposal of waste

Every day

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Open air dumping

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Gilead Clinic, Ketare Gwari.

- 1. Types of waste generated.**

Hospital Wastes

- 2. Number of patients per day**

24

- 3. Number of waste units used**

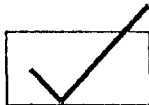
One

- 4. Frequency of disposal of waste**

Twice/week

- 5. Method used in disposing your waste**

Physical



Chemical



If physical, what type of physical method

Disposal + Burning

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: General Hospital

1. Types of waste generated.

Dry and Wet

2. Number of patients per day

500

3. Number of waste units used

Many (50)

4. Frequency of disposal of waste

Daily

Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Burning

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Kowa Clinic, Bosso.

1. Types of waste generated.

Solid waste product e.g. Bottle for specimen, Syringe, Bandage, Cottonwood.

2. Number of patients per day

10

3. Number of waste units used

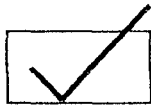
4

4. Frequency of disposal of waste

Twice in a week

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Burning

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Standard Hospital

1. Types of waste generated.

Solid/ Liquid

2. Number of patients per day

30

3. Number of waste units used

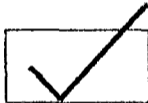
15/20

4. Frequency of disposal of waste

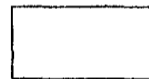
3 times a day

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Burning & Boring/Soak away

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Faith Medical Clinic, Tunga Locost.

1. Types of waste generated.

Hospital Wastes form wound dressing, needle & syringes, remnant food etc.

2. Number of patients per day

6

3. Number of waste units used

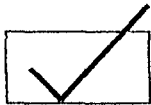
6

4. Frequency of disposal of waste

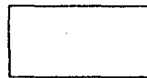
Weekly

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

In collaboration with Niger State Urban Development Board

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Mercy Maternity, Tudun-Fulani.

1. Types of waste generated.

Syringe & Needle, Cottonwood, Plaster, Hand gloves, Blood products.

2. Number of patients per day

4

3. Number of waste units used

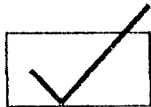
2

4. Frequency of disposal of waste

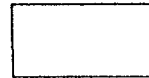
Twice

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Burying

If chemical, name the chemical method used.

QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS

IN MINNA, NIGER STATE

Hospital: Nasara Clinic, Maikunkele.

1. Types of waste generated.

Syringe, glove, Ampoules

2. Number of patients per day

6

3. Number of waste units used

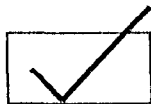
5

4. Frequency of disposal of waste

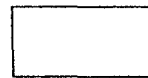
Twice a day

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Burying

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Taimako Clinic, Sabo Gari.

1. Types of waste generated.

Solid

2. Number of patients per day

50

3. Number of waste units used

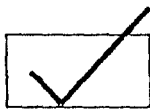
7

4. Frequency of disposal of waste

Every three days

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Collection by NUDA/Labour

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Maitumbi Maternity Clinic.

- 1. Types of waste generated.**

Hospital wastes from Wound dressing, Needles & Syringes, Food remnants etc.

- 2. Number of patients per day**

6

- 3. Number of waste units used**

6

- 4. Frequency of disposal of waste**

Weekly

- 5. Method used in disposing your waste**

Physical

Chemical

If physical, what type of physical method

In collaboration with Niger State Urban Development Board

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Top Medical Hospital, Tunga.

1. Types of waste generated.

Solid and Liquid wastes

2. Number of patients per day

20

3. Number of waste units used

16

4. Frequency of disposal of waste

Every 2 days

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

In collaboration with Government Agency

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Masol Hospital & Maternity, Niteco

1. Types of waste generated.

Used Needles/Syringe/Cotton/Gloves/Food items

2. Number of patients per day

20 – 30

3. Number of waste units used

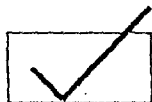
One

4. Frequency of disposal of waste

Daily

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Incineration (Burning)

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Bay Clinic, Tunga.

- 1. Types of waste generated.**

Medical Disposable Waste/Food Waste/Stationery Waste

- 2. Number of patients per day**

50

- 3. Number of waste units used**

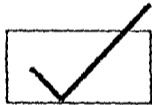
4

- 4. Frequency of disposal of waste**

Twice in a week

- 5. Method used in disposing your waste**

Physical



Chemical



If physical, what type of physical method

Convey to Government Incinerator

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: IMANI SPECIALIST HOSPITAL.

1. Types of waste generated.

Solid & Liquid

2. Number of patients per day

150

3. Number of waste units used

1

4. Frequency of disposal of waste

Monthly

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

In collaboration with NSUDB

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Care Specialist Hospital, Shiroro

1. Types of waste generated.

Liquid & Solid

2. Number of patients per day

20

3. Number of waste units used

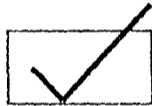
4

4. Frequency of disposal of waste

Twice in a month

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Burning and land filling

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Freedom Clinic, Barkin Sale.

1. Types of waste generated.

Solid & Liquid Wastes like syringe, needle, gloves, blood, etc.

2. Number of patients per day

7

3. Number of waste units used

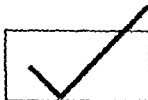
1

4. Frequency of disposal of waste

Twice/week

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Burning

If chemical, name the chemical method used.

QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS

IN MINNA, NIGER STATE

Hospital: Primary health care, Maikunkele

1. Types of waste generated.

Liquid and Solid Wastes.

2. Number of patients per day

10

3. Number of waste units used

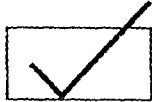
2

4. Frequency of disposal of waste

Twice per week

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Burning

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Mainasara Clinic, Kpakungu

1. Types of waste generated.

Liquid and Solid Waste

2. Number of patients per day

15

3. Number of waste units used

3

4. Frequency of disposal of waste

Twice

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Open dumping

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Royal care Hospital, Dutsen Kura.

1. Types of waste generated.

Liquid and Solid Waste

2. Number of patients per day

20

3. Number of waste units used

4

4. Frequency of disposal of waste

Thrice

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Burning

If chemical, name the chemical method used.

**QUESTIONNAIRE ON MANAGEMENT OF WASTES GENERATED IN HOSPITALS
IN MINNA, NIGER STATE**

Hospital: Primary Health Care Centre, Rafin Yashi.

1. Types of waste generated.

Solid and Liquid Waste

2. Number of patients per day

15

3. Number of waste units used

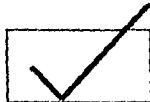
3

4. Frequency of disposal of waste

Twice per week

5. Method used in disposing your waste

Physical



Chemical



If physical, what type of physical method

Open dumping

If chemical, name the chemical method used.
