

Assessment of Orthodox Healthcare Waste Management Practices in Katsina Metropolis, Nigeria

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Abstract

The management and treatment of healthcare wastes are of great concern due to their potential hazard to human health and the environment. The study assessed orthodox healthcare waste management practices among healthcare facilities in Katsina metropolis. A cross-sectional descriptive approach was employed to assess healthcare waste management practices of public and private healthcare facilities for four months. A total of 120 healthcare workers from 10 selected healthcare facilities were included in the study using simple random sampling techniques. A structured questionnaire and observational checklist were used to collect data. Results indicated that all kinds of healthcare wastes are generated and sharps represent 45% of the total waste volume. Healthcare wastes were disposed of using safety boxes, pit burial, open burning, pit burning, among others. Segregation of waste was not practised, few facilities used colour coded containers, none had a waste management plan, and funding was a major challenge to effective waste management. Personnel training, supervision of healthcare waste management, and funding by the relevant government agency are recommended. Waste management unit should be established in all health facilities in order to improve the problem of poor management of healthcare wastes in Katsina metropolis and Nigeria in general.

Keywords: Healthcare, Wastes, Questionnaire, Katsina Metropolis, Hospital

Introduction

The sustainable management of healthcare waste has continued to generate increasing public interest due to the health problems associated with exposure of human beings to potentially hazardous wastes arising from healthcare (Ferreira, 2003; Da Silver et al., 2005; Tudor et al., 2005). Waste generated in the process of healthcare delivery consists of a variety of waste components including hypodermic needles, scalpels, blades, surgical cottons, gloves, discarded medicines, body fluids, human tissues and organs, chemicals and others. These are the most environmentally sensitive healthcare by-products and they need greater attention and should be monitored (Remy, 2001). Disposal of healthcare waste is a growing environmental concern in the developing world. The problem is growing with an ever-increasing number of hospitals, clinics and diagnostic laboratories worldwide (Hassan et al., 2008). Presently, considerable gap exists with regard to the assessment of healthcare waste management practices in Nigeria and in several other countries in Sub-Saharan Africa (Oke, 2005). In developing countries like Nigeria where many health needs are competing for limited resources, it is not surprising that the management of healthcare wastes has received less attention and the priority it deserves.

The World Health Organization (WHO, 2004) has stated that, of the waste collected and sampled from health institutions, 85 percent is non-hazardous or general waste, about 10 percent is infectious and 5% is hazardous. WHO (1999) has also revealed that the vaccination of 17 million children annually during immunization campaigns in West Africa alone generates 300 metric tons of injection waste. There is an urgent need to ensure that the management of healthcare waste is based on the acceptable international strategies of waste segregation, storage, transportation and adoption of appropriate treatment and disposal, using best available and technologically affordable processes. Highly infectious human tissues are thrown into municipal dust bins, which are eventually disposed of at landfills. The incinerators used by some hospitals pollute the environment because of improper segregation of waste.

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In June 2000, six children were diagnosed to have a mild form of small pox (*Vaccinia Virus*) after playing with glass ampoules containing expired small pox vaccine at a garbage dump in Vladivostok in Russia (Blackman, 1996). Serious accidents, which result from radioactive waste have been documented in Goiania, Brazil in 1988 in which four people died from acute radiation syndrome and twenty-eight suffered serious radiation burns (Habibur et al., 1999). Day to day activities in health institutions generate a lot of waste. These are potential sources of infections, especially hepatitis B and C, human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) and tetanus. According to WHO(2000) it was estimated that injections with contaminated syringes caused 21 million hepatitis B virus (HBV) infections, two million hepatitis C virus infections and 260,000 HIV infections worldwide.

In developing countries such as Nigeria, healthcare waste has not received much attention and is usually disposed of together with domestic waste (Almuneef and Memish, 2003; Khitoliya, 2007). It is a common sight in Nigerian cities to see the destitute, waste scavengers and children collecting objects from dumpsites. They come in contact with waste such as syringe-needles, saline bags, blood bags, and even used condoms. The collection of used disposable hospital items such as syringes, their re-sale and potential re-use without proper sterilization could pose serious disease risk to people (Hassan et al., 2008). Healthcare wastes, if not properly managed, can pose an even greater threat than the diseases themselves (Path, 2009). The problem of how to manage healthcare waste has become one of the critical concerns in developing countries. There is lack of management, commitment, poor waste handling practices, inadequate training of healthcare waste handlers, and nonexistent segregation of waste and risky disposal practices. The overall practice of healthcare waste management is still problematic. In spite of the problem associated with improper disposal of healthcare wastes, no study seems to have been carried out on the current waste management methods as practised by the different healthcare facilities located within Katsina metropolis. It is therefore, within the context of this information gap that this study is situated. The aim of this research was to carry out an assessment of healthcare waste management practices adopted in Katsina metropolis.

Study Area

Katsina metropolis is the capital of Katsina State and the Headquarters of Katsina Local Government Area (LGA). Katsina state is located at the far northern end of Nigeria (figure1). Katsina, which also bears the name of the state, is also one of the Local Government Areas that make up Katsina State. The state is situated between latitudes 11° 07' N and 13°22'N and longitudes 6° 52' E and 9° 24'E. Katsina metropolis, which is our study area, occupies virtually the largest urban area of the LGA. It is structured into several wards (figure 2). Katsina city is located about 260km east of the city of Sokoto and 135 km northwest of Kano, close to the border with the Niger Republic.

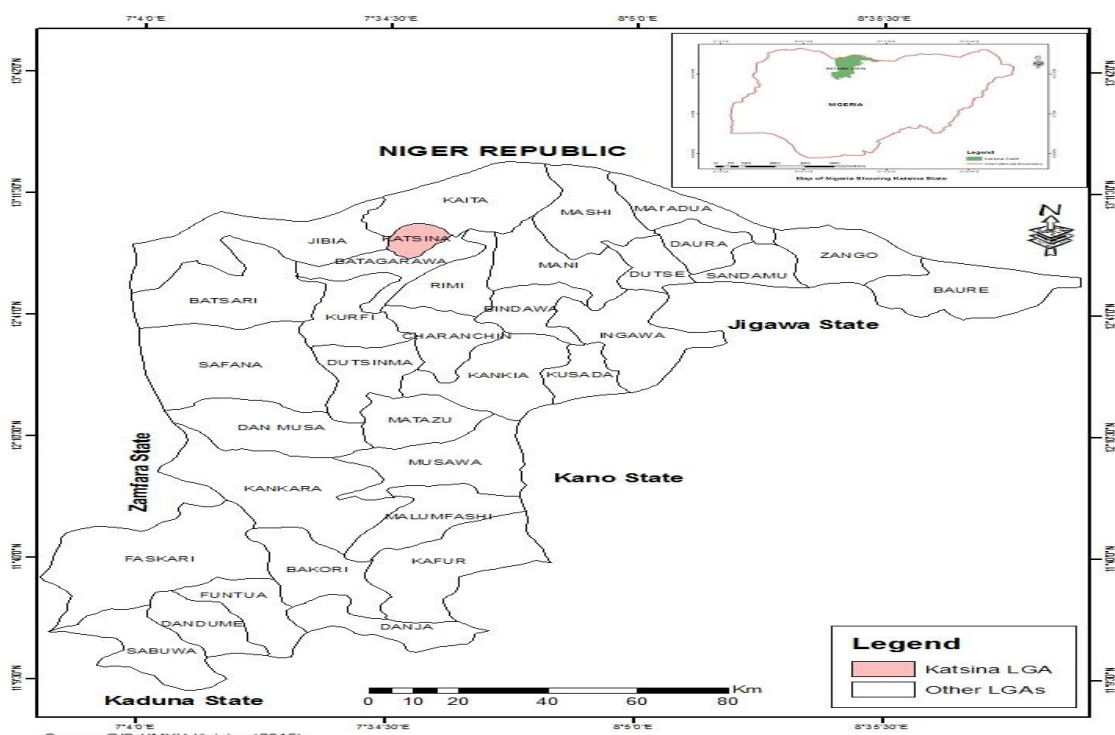


Figure 1: Katsina state showing Local Government Areas.
 Source: GIS unit, Umaru Musa Yar’adua University (UMYU), Katsina (2015).

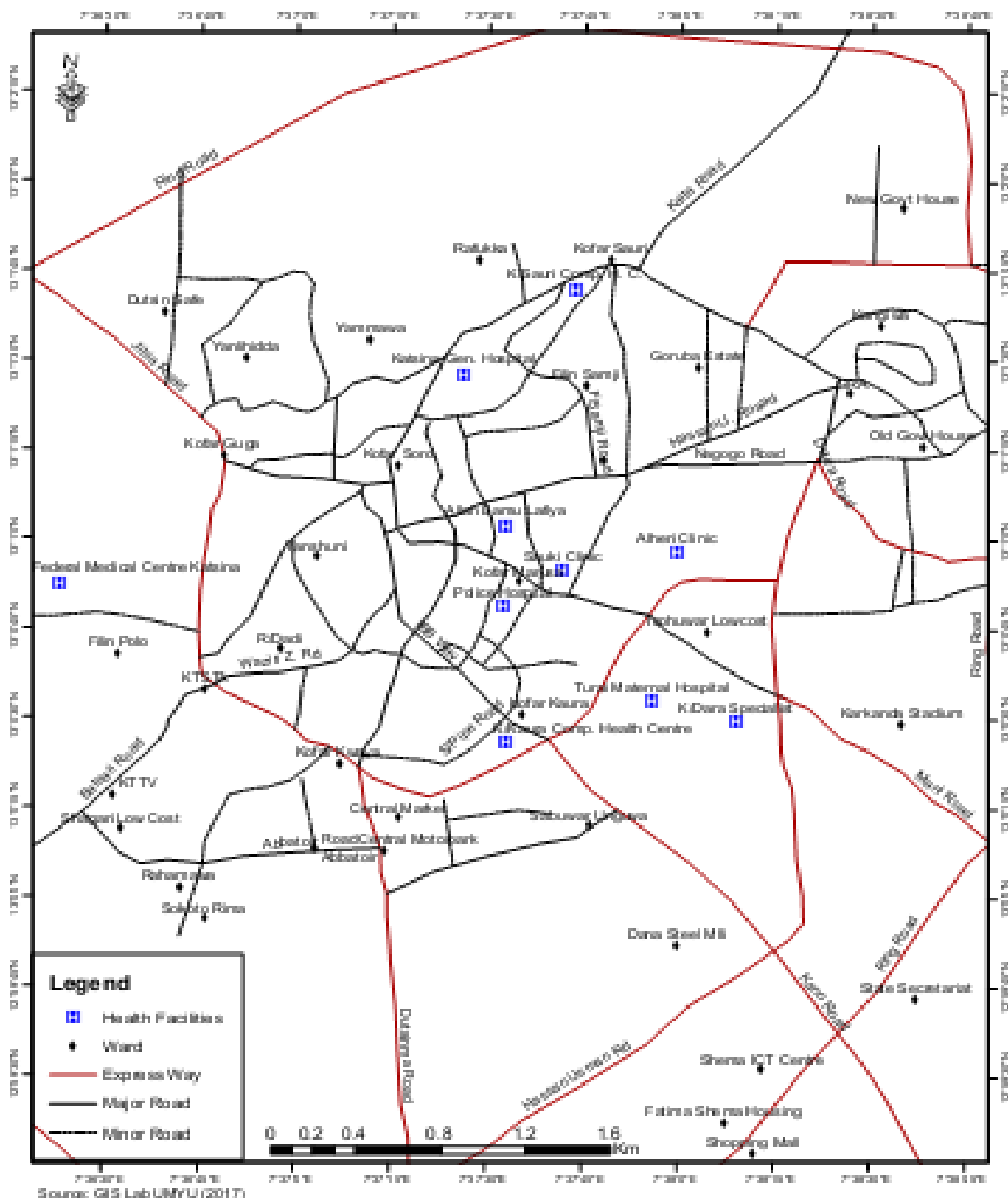


Figure 2: Katsina Metropolis Showing Selected Health Care Centers

Source: GIS Lab, UMYU (2017)

Methodology

Research design

A cross-descriptive survey, which is a type of descriptive observational study that involves measuring different variables in the population of interest at a single point in time, was used for this study. The common tool used for data gathering in this type of research is the Questionnaire.

Data collection

Primary and secondary data were used in this study. The primary data provided information relating to waste management by the different healthcare facilities in the study area.

The data elements that were considered included: locations of the healthcare facilities within Katsina metropolis, the types of waste generated, method of collection, waste storage facilities available, mode of transportation, treatment, and final disposal of waste outside the health facilities. Information from relevant agencies responsible for evacuation of waste at healthcare facilities as regards their waste disposal practices was also obtained. As such the information solicited for included frequency of supervision, enforcement procedure, sanctions if any, and identification of the specific government agencies responsible for enforcing compliance with their commended best practices by health institutions. Data were also collected on the level of awareness, hazardous nature of healthcare waste, staff training on waste management and other aspects of healthcare waste management practices. The secondary data, on the other hand, included information on the sampled healthcare service centers in the study area such as records of their management facilities, personnel in charge, type and level of training of the personnel, types and volumes of healthcare waste generated.

Reconnaissance survey, questionnaire administration, general field observation, and personal interviews were used in collecting data. The reconnaissance survey was carried out prior to the period of data collection for the purpose of familiarization with health facilities and the existing situation of waste management. Two structured questionnaires were designed, one for both administrative and medical staff, as well as waste handlers, and the other for waste management agencies. Each of these two groups of respondents were interviewed on their role in healthcare waste management in the study area. The first structured questionnaire was used to collect data on the types of waste generated by health facilities in the study area, methods of waste management, availability of equipment and facilities for waste management, and other waste handling practices. Copies of the first questionnaire were administered in the different wards and units of the sampled health facilities. The second questionnaire on waste management agencies generated information on awareness of hazards of healthcare waste, existence of regulatory legislation on healthcare waste management, monitoring, disposal sites, and staff refresher programs, among others. General field observation enabled the researchers to collect first-hand information by observing the facilities available in the various healthcare service centers and existing disposal practice, while personal interviews were conducted to generate needed complementary information that would assist in meeting the objectives of the study. Secondary data related to healthcare waste disposal and management were obtained mainly from the State's Ministry of Health, healthcare facilities, and waste management agencies. There were 25 registered healthcare service centers located in Katsina metropolis as at December, 2015 (Table 1). These healthcare facilities form the sampling frame for the study.

Table 1: Healthcare Facilities in Katsina Metropolis

Name of Health facilities	Categories of healthcare services
Sauki Clinic	Private
Alheri Clinic	Private
K-Dara Specialist hospital	Private
A.J.S Clinic	Private
New Millennium clinic	Private
Allah Bamu-lafiya clinic	Private
Noor Clinic	Private
Okomos Clinic	Private
Sahel Medicare	Private
Ishara clinic	Private
Sura Clinic	Private
Rahusa Clinic	Private
Amana Clinic	Private
Steel Rolling Clinic	Private
Comprehensive Health Center KofarSauri	Primary
Comprehensive Health Center KofarKaura	Primary
Comprehensive Health Center KofarMarusa	Primary
Comprehensive Health Center KofarGuga	Primary
Primary Health Center Rafindadi	Primary
Primary Health Center, Abbatoir	Primary
Health Centre Tudun Yanlihidida	Primary
General Hospital Katsina	Secondary
Turai Yar'adua Specialist hospital	Secondary
Modern Police Hospital	Secondary
Federal Medical Centre	Tertiary

Source: Katsina State Ministry of Health

The researchers, using a Purposive Sampling Technique, selected 10 out of the healthcare centers in the study area for detailed investigation (**Table 2**). The health facilities were selected from both public and private sectors.

Table 2: Healthcare Facilities Selected for the Study

S/N	Health Facility	Categories of healthcare facilities	No of Wards/units	No of Questionnaire Administered
1.	Sauki Clinic and Maternity	Private	12	08
2.	Alheri Clinic	Private	14	10
3.	K-dara Specialist Hospital	Private	10	10
4.	Allah BamuLafiya Clinic	Private	7	08
5.	Comprehensive Health Centre KofarSauri	Primary	8	07
6.	Comprehensive Health Centre KofarKaura	Primary	5	07
7.	General Hospital	Secondary	24	22
8.	TuraiYar'adua Specialist Hospital	Secondary	12	15
9.	Modern Police Hospital	Secondary	9	08
10.	Federal Medical Centre	Tertiary	20	25
	Total		121	120

Source: Authors' Field Survey (2016)

A purposive sampling technique was used to select health facilities because it enabled the researchers to generate the relevant data that would reflect all aspects of the research problem. Health facilities from all the three categories of healthcare services (primary, secondary and tertiary) were selected. At the second stage of data collection based at the healthcare facilities, a stratified (proportional), simple random sampling approach was applied to administer questionnaires to personnel of health institutions selected for the study. These included administrative and medical staff, waste handlers, and waste management agencies. The random sampling approach was considered most appropriate as it would not be possible to capture all relevant staff of the healthcare facilities and agencies at any one point in time due to the 'shift' nature of their schedules of duty.

One Hundred and Twenty(120) copies of the appropriate questionnaire were proportionally administered to selected staff of the 10 health facilities sampled in the study area, including doctors, nurses, laboratory technicians, and waste handlers. As earlier alluded to, the second questionnaire was used to collect information from the relevant agencies responsible for evacuation of waste at health facilities. The waste disposal performance of the sampled healthcare facilities was assessed using a checklist consisting of six characteristics that describe waste disposal and 20 indicators of healthcare waste disposal and management (**Table 3**). These performance characteristics or measures included: waste generation, waste collection, waste segregation, waste treatment, waste storage, and off-site disposal.

Table 3: Healthcare Waste Management Description and the Indicators Used in the Assessment of Waste Management Performance at Healthcare Facilities.

S/N	HCW Management Criteria	Indicators
1.	Waste generation	Types of Waste generated include sharps, pathological, chemicals, pharmaceutical etc.
2.	Waste Collection	Types of receptacles/storage containers (uniform or specific, varying types, sizes etc.), color coding of receptacles, number/adequacy of waste receptacles.
3.	Waste segregation	Are sharps or infectious materials collected separately? Is segregation regulated or controlled?
4.	Waste storage	Presence or absence of purpose-built waste handling facility, are waste dumped outside the hospital building? Is there open waste disposal?
5.	Waste treatment	Autoclaving of lab wastes, crude incineration outside, encapsulation e.g. of sharps, waste burial within healthcare facility, chemical disinfection of body fluids, other advanced technology.
6.	Offsite disposal	Is waste disposal contracted out? How are wastes transported? Open vehicle or Enclosed compacted vehicle? What is the final destination of the waste (open dump, level 1 landfill, hazardous waste engineered landfill, shredded plus some other technology?)

Source: Modified Townsend and Cheeseman (2005)

Data Analysis

Statistical Package of Social Sciences (SPSS) was used in processing and presentation of data in frequency counts, Tables, graphs and charts. The modified checklist guideline by Townend and Cheeseman(2005) was used to assess the performance of each of the healthcare facilities investigated, to determine if they were operating at a sustainable level.

3.0 Results and Discussion

The present study assessed the types of waste generated and collected, as well as its segregation, storage, treatment, and disposal.

3.1 Types of Healthcare Waste Generated

The data obtained revealed that the types of waste generated by all the health facilities included: sharps, pathological, chemical, pharmaceutical, genotoxic, pressurized containers, and other general wastes (Figure 3). Most of the Units and Wards in all the health facilities used sharps, thus it was the major category of healthcare waste that was generated.

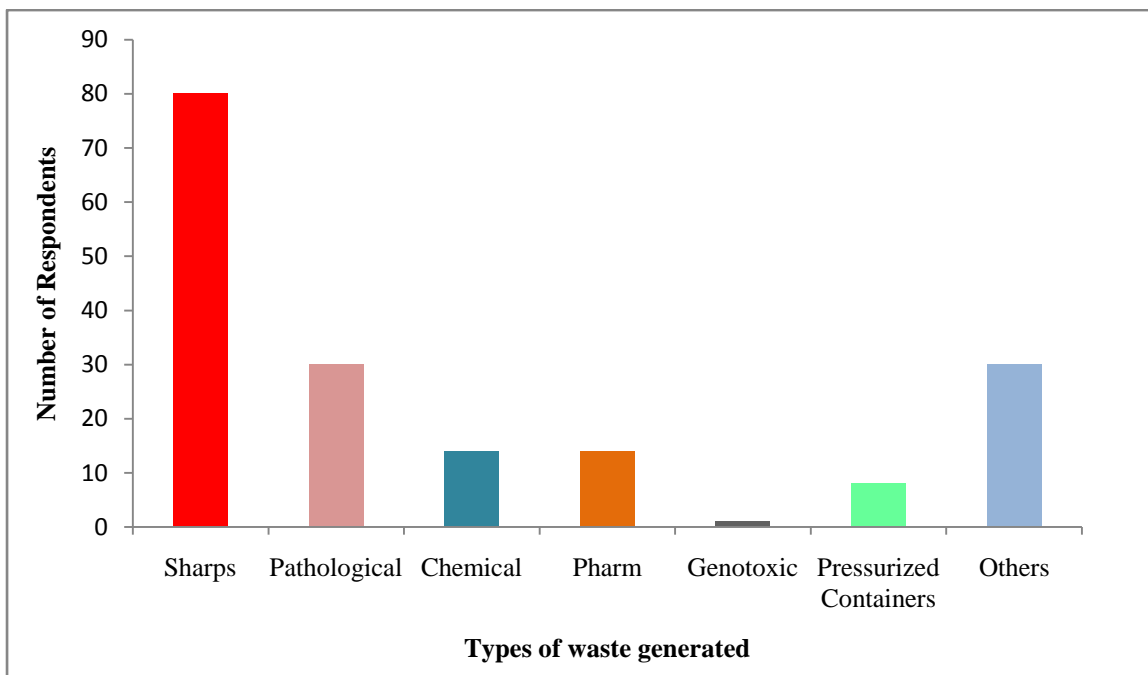


Figure 3: Types of Waste Generated by Health Facilities

Source: Authors' Field Survey (2016)

In the various health facilities sharps were used in almost all the units/wards. It therefore accounted for 45% of healthcare waste generated. Magnitudes of other waste components were: pathological -17%, chemical and pharmaceutical – 8.5% each, general and non-hazardous wastes – 17%, pressurized containers – 3.5%, and genotoxic waste – 0.5%. Waste generated during healthcare activities presents a high risk to doctors, technicians, cleaners, hospital visitors, and patients due to inadequate management (Lichtnecker, 2002). It poses threats to the environment and requires specific treatment and management prior to its final disposal (Hassan et al., 2008).

3.2 Waste disposal

Findings from the study revealed that all the health facilities sampled in the study area adopted open dumping, open burning, waste collectors, burial and incineration methods in the management of their waste.

3.2.1 Disposal of Sharp Wastes

Health facilities adopted different approaches and methods in the disposal of sharps used in the course of treating patients. It was observed that sharps, including syringes and needles, were usually collected using safety boxes that were puncture-proof. These safety boxes were marked 'Biohazard', which meets the WHO standard.

The safety boxes were then disposed of when filled. They were not re-used but disposed of together with the contents. Findings from the study revealed that methods used in the disposal of these safety boxes included waste collectors, open burning, pit burning, and incineration (Figure 4).

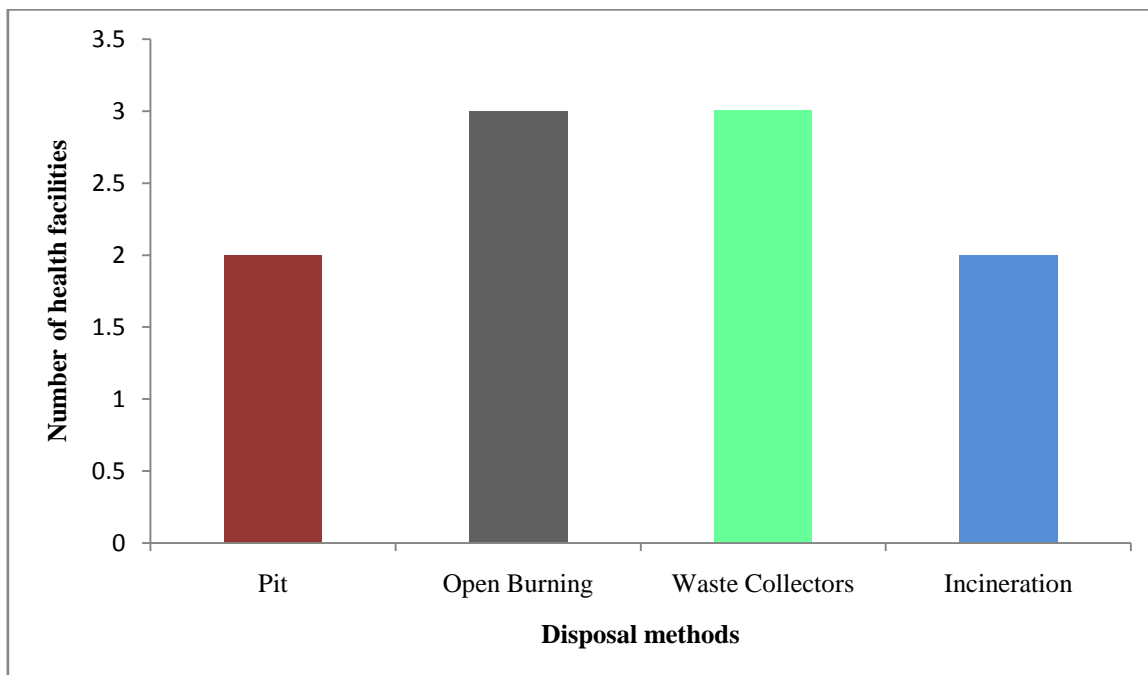


Figure 4: Methods of Sharps Waste Disposal

Source: Authors' Field Survey (2016)

Results of field investigation revealed that 20% of health facilities utilized the pit burning system for the disposal of sharps, 30% used the open burning methods, another 30% of the health facilities used waste collectors from the State Environmental Protection Agency (SEPA), while 20% used incineration and open burning. As observed by the researchers, open burning of waste usually took place in the premises of the health facilities involved.

3.2.2 Disposal of Pathological and Pharmaceutical Wastes

Pathological wastes, by their nature may contain pathogens (bacteria, viruses and parasites) which can cause diseases to humans. They are, therefore, infectious. The disposal methods for pathological and pharmaceutical wastes by the various health facilities, according to their waste handlers and nurses, included pit burial, open burning, and through waste collectors (Figure 5). Exposure to hazardous medical wastes has been associated with disease and injury. Potential hazards may include infectious diseases, as well as microbial resistance due to discharge of pathological wastes into the environment (Sharma et al., 2010).

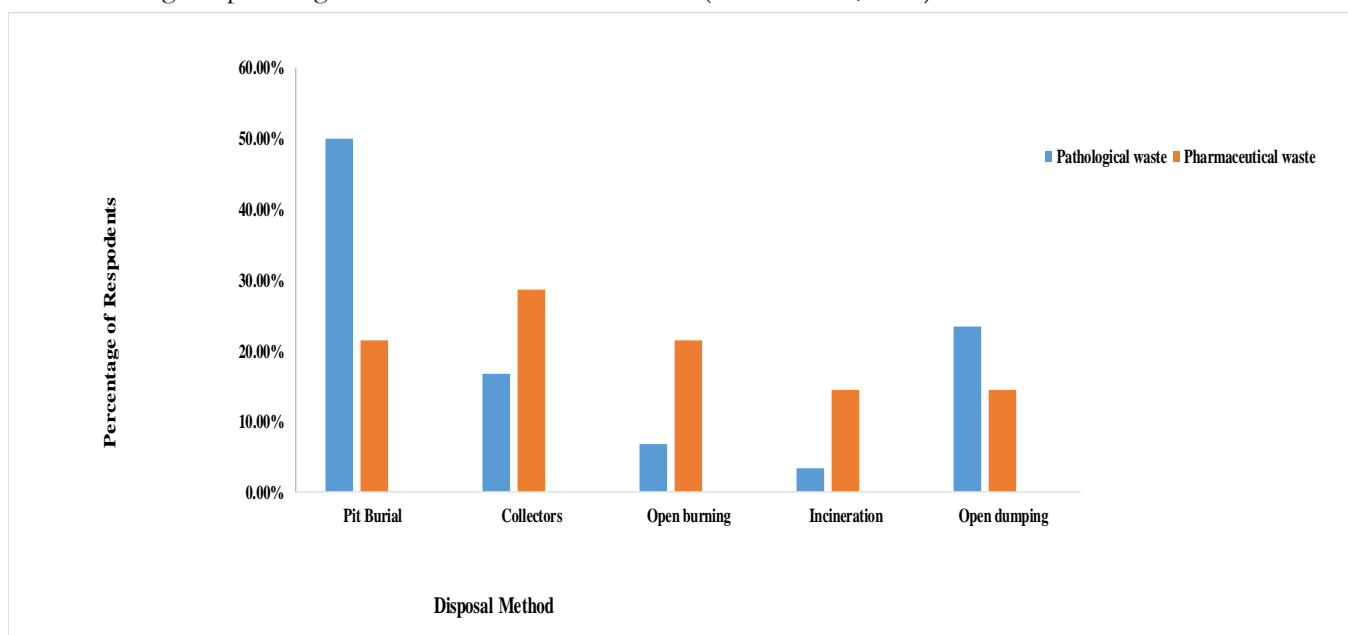


Figure 5: Pharmaceutical and Pathological Wastes Disposal Methods

3.2.3 Disposal of Chemical wastes

Chemical wastes comprise soluble and non-soluble waste materials and their disposal is through various methods. The commonly used methods for the disposal of chemicals, as revealed by field investigation of the 10 healthcare centers, in Katsina metropolis are as shown in Table 4.

Table 4: Methods of Chemical Wastes Disposal

Disposal Methods	Number of Respondents	Percentage
Sewer and open dumping	5	50%
Incineration and sewer	1	10%
Waste collectors and sewer	2	20%
Waste collectors and incineration	2	20%
Total	10	100%

Source: Authors' Field Survey (2016).

3.2.4 Pressurized Containers Disposal

The waste materials under this group are pressurized cylinders, cartridges and aerosol cans. Many of these cans are re-usable, while others such as aerosols must be properly disposed of. Observations from the field study conducted and analysis of data showed that 50% of health facilities sampled in the study area used both open dumping and waste collectors for pressurized containers as reflected in figure 6.

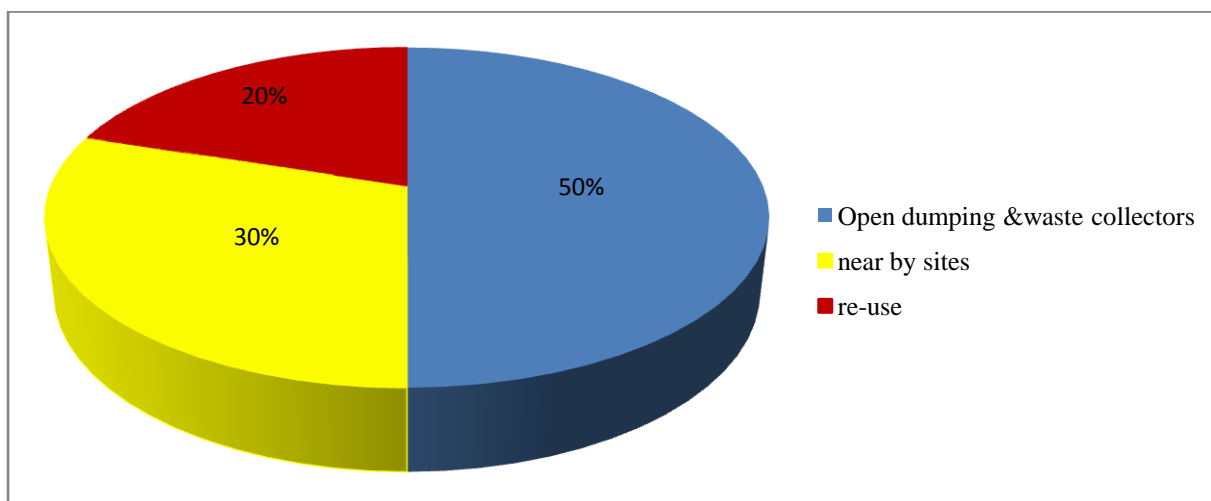


Figure 6: Methods of Disposal of Pressurized Containers

Source: Authors' Field Study (2016).

3.2.5 Radioactive Wastes Disposal

This healthcare waste category is made up of solid, liquid, and gaseous materials contaminated with radionuclides, produced as a result of procedures such as in vitro analysis of body tissues and fluid in organs, imaging and tumor localization, as well as various investigative and therapeutic practices. Among the 10 sampled healthcare facilities, only 1 produced radioactive wastes while disposal was through waste collectors.

3.3 Waste Handling (Processing) Practices

The waste processing practices of the different health facilities were assessed and the results summarized in figure 7. These include waste segregation, use of protective equipment, colour coding, waste collection, evacuation and treatment.

Collection of waste in all of the health facilities was through containers. These containers included waste basket, plastic bucket, and polythene bags. The waste was usually collected from point of generation on a daily basis, which were then placed in available storage facilities at the entrances of wards or units. The collection of wastes was carried out by the cleaning staff, usually twice a day. The wastes were usually collected on a daily basis to avoid decomposition during storage.

Waste segregation was usually carried out at the point of waste generation. Hazardous and infectious wastes were segregated from all other general wastes. It was observed that waste segregation was being practised

in only some units of the health facilities visited. In most cases, there was no form of waste segregation at the stages of collection, storage, and transportation up to the point of final disposal.

Most of the healthcare centers were also found to have no segregation plan even though the facilities that could be used to segregate healthcare waste were not available. When hazardous and non-hazardous wastes are collected together, all the waste becomes hazardous. Although the healthcare wastes that were being disposed of are restricted for unauthorized personnel, it was observed that, the requisite staff that handled such wastes lacked adequate protection, which exposed them to the risk of infection. Even though the study observed that some waste handlers had access to hand gloves and boots, other critical protective equipment such as face mask and special clothing were not provided.

The convention has always been that healthcare wastes should be segregated at the point of generation after which they are collected in different colour coded containers. The colour coding ensures easy identification of the different waste streams. Results of field study revealed that the use of colour coding for different waste type was not being practised, as wastes were collected together. Only 3 out of the 10 healthcare facilities were observed to practice some form of colour coding, but not fully implemented. Some of the respondents (waste handlers) complained of non-availability of materials to effectively carry out the use of colour coding.

General field observation further revealed that 3 of the healthcare facilities had dumpsite in their premises, while 5 others stored their waste in waste bins provided by the Katsina State Environmental Protection Agency (SEPA). Findings of the study also revealed that evacuation of waste depended on the arrangement made with SEPA, which charged certain fees for its services. Most of the private health facilities depended on SEPA for regular evacuation of their waste while public health facilities engaged in open burning and incineration. The findings revealed that non-evacuation of waste was mostly due to lack of provision of funds for that purpose. Some of the health facilities resorted to open burning, which did not completely burn the wastes.

Findings from the study indicated that most of the waste generated, especially hazardous waste, were not subjected to any form of treatment before disposal. This implies a high risk of infection of waste handlers (Figure 7).

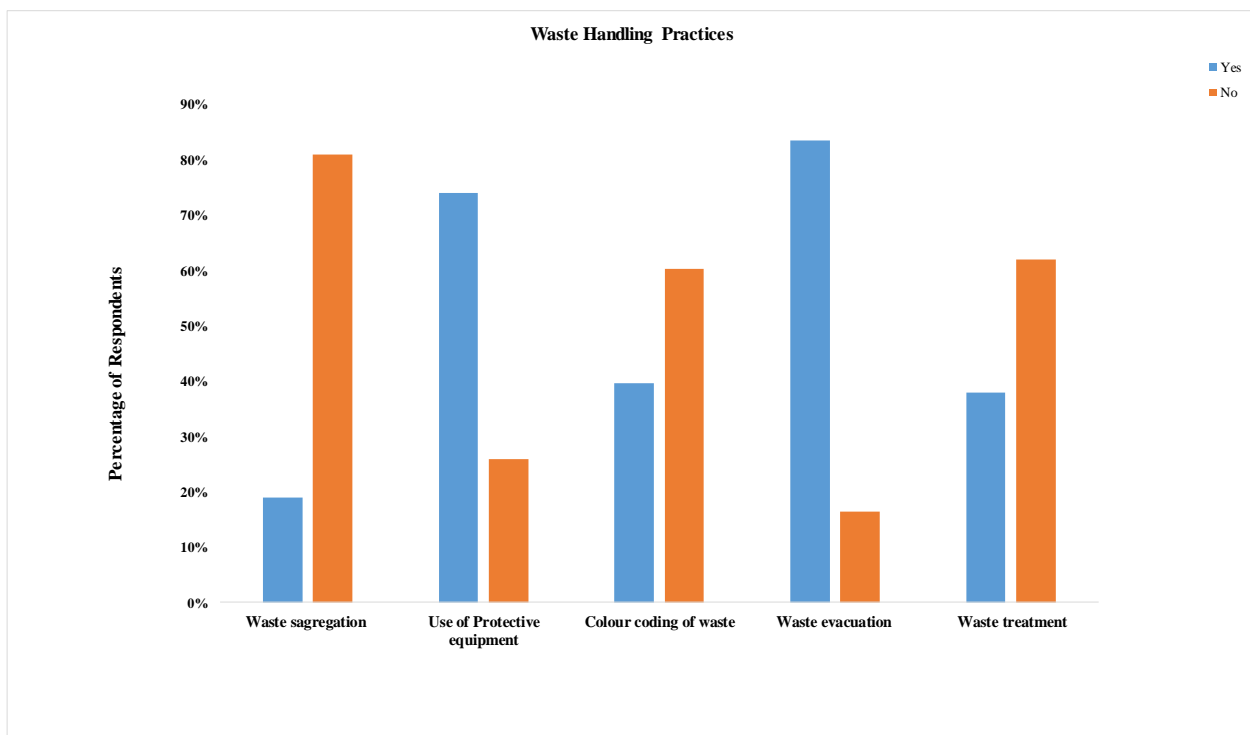


Figure 7: Waste Handling Practices

3.4 Associated Factors Influencing Waste Handling Practices

The study sought for information on factors that were likely to influence healthcare waste handling practices by waste handlers and health personnel.

Table 5: Factors Influencing Healthcare Waste Management Practice

S/NO	Variables	Frequency	Percentage
i.	Awareness of hazardous nature of Healthcare waste.	116	100%
ii.	Vehicle for waste transportation	1	0.86%
iii.	Presence of waste management unit	60	51.7%
iv.	Training on Health care waste management	62	53.4%
v.	Availability of special budget for waste management.	1	0.86%
vi.	Efficiency of waste management unit.	12	10.3%
vii.	Perception on the need for proper waste management.	112	96.6%

Source: Field Survey, (2016)

The findings of the study revealed that healthcare facilities in the study area recognized the hazardous nature of healthcare wastes. All of the respondents showed awareness of the threat posed by improper disposal of healthcare waste. Four of the health facilities, all of which were private, engaged in partial segregation by disposing of sharps and syringes along with general wastes. More than 50% of the health facilities relied on the State Environmental Protection Agency (SEPA) for the evacuation of their waste at regular intervals (Table 5). It was also observed in the study that 6 of the health facilities investigated did not have waste management units. Only 3 of the health facilities employed environmental health officers to supervise waste disposal activities. None of the private health facilities employed environmental health officers to monitor waste disposal activities. As a result of the absence of waste management units, waste disposal activities were left in the hands of cleaners and other casual workers employed to do the work.

As regards staff training on hospital waste handling, 53.4% indicated that they had received one form of training or the other on waste management. However, such training was limited to only lectures and seminars organized periodically by Heads of Units/Wards. As Table 5 further reveals, 46.6% had not received any form of training for waste management. Findings from the study also shows that only about 10% of the respondents agreed that waste management unit in their health facilities were efficient. From the study, it was discovered that most often than not, they were not provided with adequate materials to work with, and non-availability of funds also affected their operations. The study also shows that environmental officers employed in most of the public hospitals were relatively new. As such they were still trying to make their presence felt. The majority of respondents agreed that safe management of hospital is a serious public health issue that requires urgent attention. The study reveals that management commitment is the major hindrance to the effectiveness in dealing with the issue.

3.5 Assessment of Waste Management Performance

The study, similarly, sought to assess the performance of the sampled healthcare facilities on the basis of waste management in the study area using Townend and Cheesman's (2005) checklist guide (Table 6).

Table 6: *Checklist Assessment of Waste Management Performance at Healthcare Facilities

Indicators	Frequency	Percentage
Special budget for waste management	0	0%
Training of staff on waste management	4	40%
Use of personal protective equipment	6	60%
Availability of receptacles of varying size and types.	7	70%
Colour coding of receptacle.	4	40%
Adequacy of waste receptacle	7	70%
Are sharps collected separately?	8	80%
Is there segregation of other waste?	2	20%
Presence of purpose-built waste handling facility	1	10%
Dumping of waste out side	2	20%
Open waste disposal	4	40%
Autoclaving of lab waste	2	20%
Crude incineration out side	2	20%
Encapsulation of sharps	1	10%
Waste burial within healthcare facilities	2	20%
Chemical disinfection of body fluid	1	10%
Is waste contracted out	6	60%
Waste transported in enclosed vehicle	1	10%
Final destination of waste (open dump)	8	80%

Source: Field Survey (2016); *Checklist adopted from Townend and Cheesman (2005)

This study has revealed significant problems with healthcare waste management at the sampled health facilities in the study area. These include lack of management commitment, poor waste handling practices, inadequate training on HCW, mainly non-existent segregation of HCW, and risky disposal practices. The study revealed that healthcare centers such as the tertiary and secondary health facilities in the study area employ the services of environmental health officers. As such they have waste management units. The implication of this is that more personnel are recruited in waste management activities. On the other hand, the private and primary healthcare facilities perform poorly. This can be attributed to absence of both waste management units and appropriate personnel in waste management under their employ.

Findings from the study (Table 6) revealed that only 1 health facility has any form of waste management policy in place. This indicates the low level of Hospital Management commitment towards waste management. It was revealed that none of the health facilities in the study area provided any form of budget for waste management. The study conducted showed that funding was a major challenge to effective healthcare waste management, in the study area. It was also shown that only about 40% of the health facilities provide some form of training for their staff on hospital waste management.

These findings clearly show the critical need for Managements to provide institutional support and guidance aimed at ensuring that health workers follow standard procedure in the management of HCW. The absence of any clear policy in Hospital Management ensures that there is very little attempt at training of staff on waste handling. Table 6 also shows that 60% of the sampled health facilities made available PPE for their waste handlers. The findings revealed that where this equipment is provided, it is limited to hand gloves, boots, and surgical masks. Waste handlers are thus not well protected from the risk of infection.

In Nigeria, healthcare wastes such as used syringes, discarded blood vials, and needles, which are improperly disposed of and left untreated, exist (Coker et al., 1998). Findings of this study further confirm the United States Agency for International Development's (USAID, 2009) assertion that Nigeria did not have any plan or policy on healthcare waste management as medical waste is being mixed with municipal solid waste and this may subject the populace to the risk of HIV and other related diseases.

WHO has recommended colour coding of waste receptacles to facilitate the segregation of HCW at the source of generation: red for highly infectious waste, yellow for other infectious waste, yellow marked SHARPS for sharp waste, brown for pharmaceutical waste, lead box labeled with radioactive symbols for radioactive waste, and black for general or non-infectious waste (Prussand Townend, 1998). However, as earlier alluded to, only 40% of the sampled health facilities made use of adequate colour coding for waste. The use of colour coded bins is important to achieve effective segregation of waste. Segregation of waste in all the health facilities was limited to sharps. About 80% of the facilities segregated their sharp wastes, while segregation of other waste was not practised. All the other types of waste were mostly collected together. Only 20% of the sampled health facilities carried out complete segregation of their waste to some extent. Segregation of HCW serves many important public health functions. Segregation reduces medical waste thus reducing the health impacts on the general public. WHO recommends segregation of HCW preferably at the source of generation and provides guidelines for the safe management of medical waste in developing countries (WHO, 1994). From this study, it is obvious that the WHO guidelines have not been adequately followed in the segregation of waste. The current disposal methods adopted by health facilities in the study area, such as dumping and open burning at the health facilities premises, poses health risks to patients and people residing close to healthcare facilities. A study conducted on the effect of burnt hospital wastes on the soil around farm settlement near Obafemi Awolowo University Teaching Hospital Complex Ile-Ife, south - west Nigeria, detected elevated levels of eleven elements including lead and chlorine that were of serious health concern due to agricultural practices in the area (Iyanget al, 2013). Only 1 of the health facilities had a purpose-built waste handling facility - an incinerator. During open burning, air pollutants are released in to the atmosphere causing respiratory illness to nearby populations.

A study carried out on characterization and management of solid medical wastes in the Federal Capital Territory, Abuja, revealed non practice of waste segregation by all the health facilities surveyed, no formal training of waste management officers in waste management techniques, and hospital administrators paid little attention to appropriate management of medical waste (Bassey et al, 2006). This is quite similar to the situation revealed by the present study carried out in Katsina metropolis. Results of our study also confirm the findings of Olubukola's (2009) comparative analysis of HCW management in two General Hospitals in Lagos, Nigeria where results revealed similarity in waste data and HCW management practices in the two general hospitals.

This was characterized by lack of waste minimization or waste reduction strategies, poor waste segregation practice, lack of instructive posters, and disposal of HCW along with general waste (Olubukola, 2009). Waste management practices in six major hospitals in Jos metropolis was assessed and compared with international standards (Ngwuluka et al., 2009). Findings indicated that these hospitals fell below standard as prescribed by WHO and other regulatory authorities. Wastes were not only not segregated but also inappropriately disposed of, health workers were unaware of relevant regulations and the existence of a hospital waste management policy. Another study carried out in a teaching hospital in Nigeria, where practices and commitment to sustainable HCW management were assessed, revealed that health workers were aware of the hazards associated with poor HCW management (Abah and Ohimain, 2010). However, level of compliance with recommended best practices was found to be unsustainable. From the foregoing discussion, it is clear that the findings of all earlier works, as cited here, have basically been confirmed by the present study.

Conclusion

Healthcare facilities in Katsina metropolis recognize the hazardous nature of medical waste as they are by-products of materials used in the treatment of diseases. However, little or no arrangements are put in place for proper handling of such waste which pose serious risk to health care workers, waste collectors, and community at large. This calls the attention of relevant authorities to the need to provide appropriate level of commitment of HCW management through adequate funding, personnel training, provision of badly needed equipment including PPE, and sustained general awareness programmes.

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APPENDIX I RESEARCH QUESTIONNAIRE

The Researcher is a postgraduate student of the Department of Geography, Nigerian Defence Academy Kaduna. He is conducting a research on “Assessment of Orthodox Healthcare Waste Management Practices in Katsina Metropolis”.

In this regard, he wishes to solicit for your cooperation and honest response to these questions. All information provided will be used only for the purpose of this study and shall be treated with strict confidentiality.

Thanks

Researcher

SECTION A

1. Name of Unit /Ward _____
2. What are the types of waste generated?
 - a) Sharps (needles, syringes, scalpels)
 - b) Pathological (blood, body parts etc.)
 - c) Chemical
 - d) Radioactive (through X-ray activities)
 - e) Pharmaceutical (Expired drugs etc.)
 - f) Genotoxic
 - g) Pressurized containers
 - h) Others specify

Please tick as appropriate

S/N	Disposal methods	Burial	Open dumping	Waste collectors	Open burning	Incineration	Sewer	Others
1.	How do you dispose pathological waste?							
2.	What method is used for the disposal of sharps?							
3.	What is used for radioactive waste disposal?							
4.	What are the chemical waste disposal techniques in your hospital?							
5.	How do you dispose of pharmaceutical waste?							
6.	What method, is used for the disposal of pressurized containers							

7. How do you collect your waste?

- a) Wheel trolley b). Container c)Cart d) Other specify

SECTION B

Please tick as appropriate

S/N	Waste Handling Practices	Yes	No
1.	Is there any waste segregation at the health facility?		
2.	Is there protective clothing for people handling the waste?		
3.	Are you aware of the hazardous nature of healthcare waste?		
4.	Do you subject waste to any form of treatment before disposal?		
5.	Do you use colour coding for waste collection?		
6.	Has the hospital any vehicle for waste transportation		
7.	Do you dumpsite in the health facility premises?		
8.	Is there a waste management unit in the hospital?		
9.	If Yes, is the unit efficient in waste management activities?		
10.	Do you maintain a register for waste disposal?		
11.	Have you undergone any training programme on healthcare waste handling?		
12.	Is there any form of evacuation of waste by relevant government agencies?		
13.	Are you aware of any special budget for waste management in the facility?		

14. What form of treatment are waste subjected to before disposal?
a) Autoclaving b). Incineration c) Thermal process d). Chemical process e). Other Specify
15. How often do relevant government agencies check your disposal activities?
a) Weekly b). Monthly c). Quarterly d). Others specify
16. Do you agree that adequate funding will promote efficient waste disposal activities?
a) Agree b). Disagree c) No Comment
17. Safe management and disposal of hospital waste, is not an issue at all
a) Agree b). Disagree c) No Comment

APPENDIX II

**DEPARTMENT OF GEOGRAPHY, FACULTY OF ARTS AND SOCIAL SCIENCES
SCHOOL OF POST GRADUATE STUDIES
NIGERIAN DEFENCE ACADEMY (NDA) KADUNA
A STRUCTURED INTERVIEW SCHEDULE FOR WASTE MANAGEMENT AGENCIES.**

1. What is the name of your Agency or department?

2. Are you aware of the environmental and health hazard of hospital waste?
Yes () No ()
3. Who do think should be responsible for enforcing compliance to recommended best practice by hospitals?

4. Are you aware of any legislation applicable for regulating hospital waste in Nigeria? Yes () No ()
5. If Yes, please State the legislative Act

6. Do your Agency Monitor and Evacuate hospital waste within Katsina Metropolis?
Yes () No ()
7. If Yes, how often do you go-around to evacuate waste at the various health facilities?
Weekly () Quarterly () Monthly () other specify ()
8. Is there any sanction for non-compliance of healthcare centers to recommended best practice? Yes ()
No ()
9. What are the variables that are consider during inspection of hospital?

10. Do you organize any seminar or workshop for hospital staffs and waste handlers? Yes () No ()
11. Is there any designated site for the disposal of healthcare waste within Katsina Metropolis? Yes () No ()

12. What steps do you take to ensure compliance by health facilities to safe disposal practice?

13. Do you agree that Environmental health officer should be employed by hospitals? Yes ()

No ()

14. What categories of hospitals do you carry out your operations?

15. Do you agree that effective monitoring and supervision by relevant Agency will promote safe disposal practice by healthcare centers?

Yes () No ()