



Republic of Zambia
Ministry of Health

NATIONAL HEALTH-CARE WASTE MANAGEMENT PLAN

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Prepared

By

Directorate of Public Health and Research

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Foreword

This Plan has been developed to meet the recognized potential of health-care activities in creating waste that may itself be hazardous to human health and the environment. In this respect it is important to ensure that wherever waste is generated there must be safe and reliable methods for its handling to avoid any serious public health consequences and any significant impact on the environment. This therefore calls for sound health-care waste management system to be put in place.

This National Health-care Waste Management Plan provides an overview of health care facility waste generating processes in Zambia and presents options for minimizing health-care waste generation through source reduction. Reducing generation at the source, or recycling the wastes on or off site, will benefit health care facilities by reducing disposal costs and lowering the liabilities associated with hazardous waste disposal.

The hazardous wastes generated by health care facilities are small in volume as compared to those of industrial facilities. Some of the hazardous materials used by health care facilities that become part of their waste streams include chemotherapy and antineoplastic chemicals, radioactive sources, mercury and other toxic, corrosive and miscellaneous chemicals.

The introduction of improved management of segregating waste within health care facilities can result in reduction of the proportional amount of waste requiring special treatment and disposal costs. In addition, new technologies are available to treat and disinfect biomedical and health-care wastes so that the resultant can finally be disposed off with low risk to both human health and the environment.

The safe management of biomedical and health care waste is essential for community health. Thus in order to tackle solid waste management effectively, it has been found essential for the Ministry of Health to pay special attention to sources of waste generation, segregation by type, coding, storage, transportation, treatment including pre-treatment, disposal of residues including flue emissions from incinerators, occupational health safety, stakeholder and community awareness. These are some of the issues discussed in this plan.

The implementation of effective health-care waste management activities in Zambia calls for multisectoral cooperation and interaction at all levels. It is therefore essential to ensure that it becomes an integral feature of all health care services in the country. This plan is therefore intended for adoption into local plans towards practical management of health-care waste at all local health care facility levels where waste is being generated.

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Table of contents

Acknowledgement	i
Foreword Acknowledgement	ii
List of acronyms	v
Executive summary	vi
Chapter 1: Background information	1
1.1 Regional situation	1
1.2 Country profile	1
1.3 Health-care waste	4
1.4 Sources of health-care waste	5
Chapter 2: Description of the study	7
2.1 Study justification	7
2.2 Study goal and objective	8
2.3 Study hypotheses	9
2.4 Ethical consideration	9
Chapter 3: Data collection	10
3.1 Data collection techniques	10
Chapter 4: Findings and analysis	12
4.1 Desk literature review on legislative, regulatory and policy framework	12
4.2 Information gathering	18
4.3 Analysis of health-care waste management in Zambia	31
Chapter 5: Technologies for treatment and disposal of health-care waste	40
5.1 Incineration	41
5.2 Chemical disinfection	43
5.3 Wet thermal or steam treatment	43
5.4 Microwave irradiation	44
5.5 Land disposal	44
5.6 Inertization	45
5.7 Municipal landfills	47
5.8 Recommended treatment and disposal of health-care waste management	47
Chapter 6: Strategies for health-care waste management plan	61
6.1 Resources for implementing health-care waste management	61
6.2 Critical issues identified in health-care waste management	62
6.3 Priority service target areas	62
6.4 Priority areas of concern	63
Chapter 7: Monitoring and evaluation	68
7.1 Health-care waste performance monitoring plan	68
References	75
Appendices	77
1 Health-care waste management tools	77
2 List of districts per province and number of health care facilities	77
3 List of participants to consultative meeting	79
4 List of individuals consulted	79

LIST OF TABLES

1. Ten main causes of visitation to health facilities.....	3
2. Zambian legal limits for ambient air pollutants	14
3. Health care facilities in relation to population and bed capacity.....	18
4. Sites and levels of health care facilities visited	19
5. Analysis of waste composition at University Teaching Hospital.....	33
6. Handling of health-care waste	34
7. Estimate of daily health-care waste generation in institutions visited	35
8. Estimate of waste generation.....	38
9. Summary of technologies for health-care waste treatment and final disposal	45
10. Capacity and characteristics for technologies recommended at each level.....	52
11. Colour coding and type of containers for disposal of health-care waste.....	58
12. Health-care waste management plan	64
13. Monitoring plan: Logical framework matrix.....	68
14. Gantt chart for health-care waste management plan	72

LIST OF PICTURES

1. Unprotected incinerator at Kitwe central hospital.....	20
2. Receptacle for externally disposed waste at Arthur Davison hospital in Ndola	21
3. Refuse pit next to the road near the laundry at UTH in Lusaka	22
4. Scavengers attacking off loading refuse truck at Chingwere dumpsite in Lusaka.....	22
5. Scavengers including bare-foot kids from off loading refuse truck at Chingwere dumpsite in Lusaka	23
6. Refuse truck off loading waste onto burning waste at Chingwere dumpsite in Lusaka	23
7. Scavengers at Chingwere dumpsite in Lusaka	24
8. Refuse receptacle for off site disposal at UTH in Lusaka	24
9. Transit bay containing health-care waste at Solwezi main market	26
10. Open unprotected Chipemba dumpsite in Solwezi	27
11. Unprotected pit near public footpath in Livingstone.....	27
12. Unprotected incinerator at Livingstone general hospital	28
13. Protected incinerator at Kalomo district hospital	29
14. Unprotected waste disposal pit at Kalomo district hospital	29
15. Protected disposal pit at Yeta district hospital in Sesheke	30

List of acronyms

AIDS	Acquired Immune Deficiency Syndrome
Cap	Chapter
CBO	Community Based Organization
CBoH	Central Board of Health
DHB	District Health Board
ECZ	Environmental Council of Zambia
EIA	Environmental Impact Assessment
HIV	Human Immune Deficiency Virus
HMIS	Health Management Information System
IEC	Information, Education and Communication
LCC	Lusaka City Council
MoH	Ministry of Health
NAC	National AIDS Council
NGO	Non-Governmental Organization
PHA	Public Health Act
PHC	Primary Health Care
RHC	Rural Health Centre
STI	Sexually Transmitted Infection
TB	Tuberculosis
UHC	Urban Health Centre
UTH	University Teaching Hospital
WHO	World Health Organization
ZANARA	Zambia National Response to AIDS

Executive Summary

This document endeavors to assess management of health-care waste arising out of operations, at various levels of the health care delivery system in Zambia. This study undertook to critically examine management of waste in Zambia, which for purposes of this study is referred to as health-care waste, with special attention to suitability of current treatment and final disposal practices vis-à-vis available knowledge, information, technology and services provided.

The government is committed *“to provide Zambians with equity of access to cost effective, quality health care as close to the family as possible”*. In the provision of health care services, there is generation of various types of waste materials, which are loosely defined here as garbage, refuse, sludge and other discarded materials. This waste may be categorized as either hazardous or non-hazardous.

It is estimated globally that, about 10 - 25% (WHO. 1999) of the total waste generated in health care facilities is hazardous waste. This small component of waste is termed “special health-care waste.” Key among these is infectious waste contaminated with Human Immunodeficiency Virus (HIV), hepatitis B and C viruses. The direct impact of such waste on human beings or the environment poses occupational health safety risks and consequences of undesirable environmental pollution. However, because the current health-care waste being generated from health care facilities proceeds without observing operational procedures, the public and environment may be affected. This therefore calls for rigorous training and awareness raising activities.

The goal is to organize and put in place a technically, socially, economically, affordable and acceptable health-care waste management system which will reduce transmission of communicable diseases through indiscriminate disposal of health-care waste at health care facility and dump sites.

The overall objective of this plan is to develop a National Health-care Waste Management Plan that will reduce health problems and eliminate potential risks to human health and the environment. Specifically this plan has been developed to:

- Assess legal, regulatory, policy and administrative framework on health-care waste management and treatment facilities in the country by the year 2005
- Examine current health-care waste management practices in hospitals, clinics, other health care facilities and local authority disposal sites with regard to handling, inclusive of waste pre-treatment, collection, storage, transportation and final disposal by the year 2004.
- Assess types and quantities of health-care waste generation, availability of appropriate equipment and technologies to deal with, health-care waste treatment and final disposal by the year 2004

- Enhance access to use and support activities directed towards prevention of diseases with particular emphasis on those associated with handling health-care waste by the year 2005
- Assess levels of scavenging, recycling, knowledge and practical skills among those involved in health-care waste management and conduct training by the year 2005.
- Prepare a costed health-care waste management plan while taking in to consideration of public and private sector partnerships in relation to cost recovery based on the polluter pays principle by the year 2004.

The methodology for data collection included use of questionnaires; person-to-person interviews, direct observation of activities, focus group discussion, field visits and desk literature review.

The sample drawn in six provinces visited included the following: one University Teaching Hospital, one central hospital, three general hospitals, one specialist hospital, four district hospitals, one private hospital, two urban and three rural health centres.

The findings in this report are subject to certain limitations and some of them are:

- The distribution of study sites did not cover the whole country because of time limitation.
- The study did not start on time and as a result it was not possible to pre-test questionnaires.
- The study was unable to adequately assess health-care waste generation at private clinics because of uncooperative attitude from some administrators. It seems in spite of assurance of confidentiality, there was hidden fear that the findings might be reported to higher authorities for action.

The audit of health-care waste management undertaken in this study has shown that although the portfolio for solid waste management does not directly fall under the Ministry of Health (MoH) or Central Board of Health (CBoH), there is great need for MoH / CBoH to be fully involved because of the nature and quantities of waste generated at health care facilities. It is therefore necessary, that when legislating on health-care waste management MoH should work in consultation and collaboration with other stakeholders.

The running budget for effectively implementation of this plan is estimated at US \$3,580,000 (for details see table 13).

The final conclusions on health-care waste generation and state of health-care waste in Zambia have been made while taking into consideration findings from previous studies on the same subject. Additional information was also captured during the consultative meeting with stakeholders drawn from all provinces. This meeting widened coverage as it included institutions that hitherto were not physically audited. The findings in this report are therefore applicable to the entire country. The following are some of the main findings of concern:

- The existing legislation with an exception of Statutory Instrument (SI) No. 125 of 2001 does not adequately address issues of health-care waste management. In this

respect SI No.125 of 2001 can in the meantime be used while appropriate legislation is being developed.

- Health-care waste at the source of generation is not classified according to its type for easy treatment and final disposal.
- Many health care facilities do not take due responsibility for the waste they generate to the environment and the public to ensure safe, efficient, sustainable and culturally acceptable methods for collection, storage, transportation, pre-treatment and final disposal both within and outside their premises.
- Local authorities do not have sound managerial approaches for dumpsites and the use of appropriate technologies, which would minimise health risks that result from inadequate management of hazardous health-care waste. Scavenging is allowed to take place at all dumpsites without taking necessary measures to abate it. There is urgent need to develop technical guidelines under the National Waste Management Strategy being developed by ECZ.
- The level of theoretical and practical knowledge among those involved in handling hazardous health-care waste is low especially among those outside the health care facility who either finds them handling or exposed to such waste due to careless management practices.

The following recommendations require necessary immediate attention from the Ministries of Health, Local Government and Housing, and Tourism, Environment and Natural Resources as well as the Central Board of Health, private sector and other stakeholders in order to:

- Develop the National Environmental Health policy and strategies with necessary statutory instruments governing and regulating the management of health-care waste in Zambia, especially hazardous / special health-care waste
- Collaborate with Local Authority agencies to develop byelaws that will deal more strictly with health-care waste including infectious waste produced during home based care
- Ensure that all basic environmental permits and licenses be obtained, for large health care facilities that will help to deal with environmental impacts of health-care waste including among others the following; air pollution, land degradation / soil pollution, health impacts and water pollution
- Develop a health-care waste management code of conduct and technical guidelines
 - Revise and incorporate content for health-care waste management in curricula for Ministry of Education schools and institutions of higher learning
 - Facilitate research in health-care waste characterization related to waste quantities and composition and conduct research to determine the total inventory on the type of wastes generation at all levels of the health care system on human health and environmental impact due to technologies on health-care waste treatment
 - Incorporate health-care waste generation into existing Health Management Information Systems (HMIS) and establish health-care waste inventories for each health care facility using the same classification by type of waste
 - Integrate health-care waste management plans into existing National, District and all health care facility plans

- Develop a culture in all health care facilities that will inculcate appropriate behavioral change among health workers and all stakeholders to enhance success through in-service training, use of electronic and print media to enhance capacity to deal with risks associated with health-care waste
- Ensure that all health care facilities have in place appropriate, reliable and sustainable technologies for hazardous waste collection, storage, transport, pre-treatment, treatment and final disposal sites in close consultation with stakeholders
- Ensure that health-care waste is segregated at service level and accorded according to colour of the container
- Develop monitoring indicator on waste generation

• CHAPTER 1: BACKGROUND INFORMATION

1.1 Regional experiences

The level of health-care waste management in this region is not clear because of inadequate literature on the market. However, it is recognized in many countries that if infectious component of the waste from health care facility gets mixed with general noninfectious waste, the entire bulk of the health-care waste becomes potentially infectious. The following are some of the hazards that are identified as being associated with poor health-care waste management:

- Injuries from sharp waste material to all categories of health workers and waste handlers
- Risks of infections outside health care facility for waste handlers, scavengers and the general public, and spread of antibiotic resistance
- Risks associated with hazardous chemicals, drugs, being handled by persons handling wastes at all levels.

Large variety of hazardous materials in relatively low quantities is produced in health care facilities. The lack of records on waste generation creates problems in tracking down hazardous waste in health care facilities. This result from hazardous wastes being mixed with infectious wastes, the diluted hazardous liquid waste has in some health care facilities been discharged into the sewer.

There has been increase awareness of late with regards to proper disposal of health-care waste. This has resulted in countries in the region including Zambia, to take necessary measures to tackle the problem to its logical conclusion.

1.2 Country profile

Zambia is a landlocked country-sharing boundary with eight neighbours; and these are Namibia, Angola, Democratic Republic of Congo, Tanzania, Malawi, Mozambique, Zimbabwe and Botswana. It covers an area of 752,617 sq. km, lying along latitude 15°S and longitude 30°E and has a population of 9.5 million people. Although Zambia is rated as one of the most urbanized countries in the sub-Saharan Africa, the majority (62%) of her people live in the rural areas (CSO, 2000). The country is divided into nine provinces, which are in turn sub-divided into seventy-two municipal districts.

a) *Socio-economic status*

Zambia has a mixed economy consisting of industries along the line of rail and agriculture in the rural areas. Copper has been the country's economy activity, accounting for 95% of export earnings and contributing 45% towards government revenue. Agriculture contributes 15% of Zambia's gross domestic product and it employs 75% of the labour force (CSO. 1996).

The low gross domestic product since the mid 1977 has been due to poor economic performance. The Movement for Multiparty Democracy government has since launched an economic recovery through the diversification of agriculture industry.

b) Health reforms

The Health Reforms promulgated by the Government in 1992 instituted a decentralized management system down to the district level from the Central Board of Health (CBoH). In this structure, the Ministry of Health (MoH) handles policy issues from where key aspects relating to development of legislation, resource mobilization, budgeting and finance as well as dealing with essential stakeholders such as bilateral and multilateral partners are undertaken.

A Memorandum of Understanding that was signed between the MoH and cooperating partners in November 1999 provides room for further collaboration, participation and assistance to ensure success of the reforms whose nerve centres are the district health management boards.

The pooling of GRZ and donor funds has created the necessary lifeline that has provided the much-needed support to the running costs of the district and hospital management boards through district basket funding.

The Zambian government established the National HIV/AIDS/STI/TB Council (NAC) under the Act No. 10 of 2002 with the following responsibilities:

- Support the development and coordination of policies, plans and strategies for the prevention and combating of HIV, AIDS, STI and TB for health and other institutions concerned with the prevention and combating of HIV, AIDS, STI and TB;
- Advise the Government, health institutions and other organizations on the policies, strategies and plans combating of HIV, AIDS, STI and TB;
- Ensure the provision and dissemination of information and education HIV, AIDS, STI and TB;
- Develop a national HIV, AIDS, STI and TB research agenda and strategic plan which shall include the quest for a cure for HIV, AIDS as one of the research priorities;
- Support programmes relating to prevention, cure, and treatment of HIV, AIDS, STI and TB:
- Mobilize resources to promote and support identified priority interventions including research in areas related to HIV, AIDS, STI and TB;
- Provide technical support and guidelines to health and other institutions involved in the-
 - i) Prevention and treatment of HIV, AIDS, STI and TB; and
 - ii) Care and support of persons infected with or affected by HIV, AIDS, STI and TB;
- Collaborate with other research institutions in relation to HIV, AIDS, STI and TB; and

- Undertake such other activities as are conducive or incidental to its functions under this Act.

c) Overview of health sector reforms

Health service delivery in Zambia is provided through Central Board of Health (CBoH), private sector such as the mines and missions. In addition to these, there are a number of national and international NGOs involved in programmes.

The CBoH is also charged with the responsibility to interpret policy, implement health programs countrywide, as well as build necessary capacity to drive the health care system in Zambia. The CBoH also collaborates with other government and private health care providers while the District Health Office (DHO) spearheads the execution of management system through District Health Boards (DHBs).

The levels stratified of health service provision throughout the country are classified under a five-tier system as follows:

- Health posts (community health-care)
 - Health centres (urban, rural and mobile out reach posts)
 - District hospitals (first referral – level I)
 - General hospitals (second referral – level II)
 - Central and specialized including University Teaching Hospital (national reference)

d) Some important health indicators

The top ten main causes of visitation to health care facilities according CBoH (2002) are as follows: Malaria, Respiratory infection (pneumonia and non-pneumonia), Diarrhoea (non-bloody), Trauma (accidents, injuries, wounds, burns), Skin infections, Ear / Nose/ Throat infections, Intestinal Worms and Digestive system (not infectious)

Table 1: Ten main causes of visitation to health facilities

Name of condition	Incidence Rate per 1000 population
Malaria	377.1
Respiratory infection: non-pneumonia	143.9
Diarrhoea: non-bloody	77.8
Respiratory infection: pneumonia	43.8
Trauma: accidents, injuries, wounds, burns	41.1

Skin infections	36.2
Ear / Nose/ Throat infections	23.9
Intestinal Worms	20.9
Digestive system (not infectious)	17.1

Source: CBoH (2002). Annual health statistical bulletin 2002

e) Description of health care facilities (CBoH, 2000)

1. Health posts (community health care)
 - First point of contact with the formal health care system
 - Responsible for population of 500 households (3,500 people) in rural areas and 1,000 households (7,000 people) in urban areas
 - Responsible for outreach activities in catchment area, within 5km. radius for sparsely populated areas
2. Health centres
 - The Urban Health Centres (UHC) have a catchment area of 30, 000 – 50,000 people and where as Rural Health Centre (RHC) cover a catchment area of 29km radius, or a population of 10,000 people
3. District and first referral institutions (first level hospital)
 - Designed to serve a population of 80,000 – 200,000 people
 - Provider of medical, surgical, obstetric and diagnostic services and with all clinical services to support health centre (and health post) referrals
4. General hospitals (second level referral hospital)
 - Catchment area of level II hospitals is composed of a population of 200,000 to 800,000 people
 - Providers of internal medicine, surgical, pediatrics, obstetrical, gynaecological, dental, psychiatric and intensive care services
 - Offer any other clinical services necessary to support level I referrals
 - Provide training services
 - Provide technical back up services and capacity building to level I facilities
5. Central hospitals (third level referral hospital)
 - Catchment population of 800,000 people and above
 - Providers of sub-specialization in internal medicine, surgery, pediatrics, obstetrics, gynaecology, intensive care, psychiatry, training and research

1.3 Health-care waste

Health-care waste in this study includes all waste generated by health care facilities, research facilities, laboratories and that produced during undertakings in the home e.g. dialysis, insulin injections and home based care (needles, syringes, soiled bandages, disposable sheets, medical gloves, dialysis machine filters, plastic catheters and dripset, glass waste, urinary bags, expired medicines, medicine containers, pesticide containers, sanitary napkins, condoms, liquid waste and placenta). In the case of waste it means; garbage, rubbish, refuse, unwanted matter / objects and anything not used to full advantage or rejected as useless products of metabolism.

It is estimated globally that about 10-25% (WHO. 1999) of the total waste generated in health care facilities is regarded as potentially hazardous waste. This small component of waste according to this study is termed as “special health-care waste”, which may create different types of health and environmental risks. The risks may result in acquisition of infectious diseases such as Human Immunodeficiency Virus / Acquired Immune Deficiency Syndrome (HIV/AIDS), hepatitis B and C viruses that may be as a result of recycling of used syringes.

The direct impact of such waste on human beings or the environment poses occupational health safety risks and consequences of undesirable environmental pollution. However, because the current health-care waste being generated from health care facilities proceeds without observing operational procedures, the public and environment may be affected. This therefore calls for rigorous training and awareness campaign activities.

Since the early recovery of patients and the health of health care providers directly depend on a clean hygienic environment, it is essential that waste from health care facilities is collected, stored and disposed of in a scientific and safe manner. It is equally vital that the health care facilities are kept clean and in a satisfactory state of hygiene.

The generation of waste depends on many factors such as types of health care facility, methods of managing waste, specialization of health care facility, proportion of reusable items and patient population treated on a day-care basis in the health care facility. It is important to take these factors into account when deciding on the choice of waste management technology.

- ***a) Types of health-care waste***
- *Chemical waste:* Waste containing chemical substances such as laboratory reagents, film developer, expired disinfectants or those, which are no longer needed
- *Clinical waste:* Waste coming out of medical care provided in hospitals or health care facilities such as medical plastic, soiled dressings, bandages, expired medicines, liquid waste containers, handling mercury, infected linen, and placenta
- *Genotoxic waste:* Waste containing properties of genotoxic chemicals and cytotoxic drugs (used in cancer therapy)

- *Hazardous waste*: Waste that has potential to threaten human health and life. In health care facilities it refers to chemicals, cytotoxic drugs, incinerator ash and radioactive elements constitute hazardous waste
- *Hospital waste*: Waste coming out of clinical care activities of hospitals (usually 80% non hazardous, 15-20% infectious waste and 5% non infectious but hazardous)
- *Infectious waste*: Waste suspected to contain pathogens such as laboratory cultures, waste from isolation wards, tissues/swabs, and equipment that have been in contact with infected patients (usually account for 15-20% hospital waste)
- *Non hazardous waste*: Waste containing domestic substances such as paper, leftover foodstuff and this usually account for 80% of hospital waste
- *Pathological waste*: Waste-containing human tissues or fluids such as body parts, blood and other body fluids, sharps (needles, infusion sets, scalpels, knives, blades and broken glass)
- *Pharmaceutical waste*: Waste-containing pharmaceuticals such as expired drugs and those in excess and items contaminated or containing pharmaceuticals (bottles and boxes)
- *Pressurized containers*: Gas cylinders, gas cartridges and aerosol cans
- *Radioactive waste*: Waste containing radioactive substances such as unused liquids from radiotherapy or laboratory research, contaminated glassware, packages, absorbent paper, saws, urine, vomit and excreta from patients treated with unsealed radionuclides and sealed sources
- *Sharps*: Sharp waste such as needles, infusion sets, scalpels, knives, blades and broken glass
- *Waste with high content of heavy metals*: Waste inclusive of batteries, broken thermometers and blood-pressure gauges

1.4 Sources of health-care waste

The potential sources of health-care waste generation are classified as following:

- Hospitals (University teaching hospital, central hospital, general hospital, specialist hospital e.g. leprosarium, district hospital and other health care facilities).
- Other health-care establishments (emergency medical care services, health centres (urban and rural) and clinics / dispensaries, obstetric and maternity clinics, outpatient clinics, long-term health care facilities and hospices, transfusion centres and military medical services.
- Related laboratories (clinical / microbiological) and research centres.
- Mortuary and autopsy centres
- Animal research, testing and treatment
- Blood banks and blood collection centres
- Nursing homes for the elderly
- Small health care facilities (physicians' office, dental clinic and home health care).

- Specialized health care establishments and institutions with low waste generation (psychiatric hospitals, institutions for disabled persons, immunization outreach posts, etc.)
- Non-health activities involving intravenous or subcutaneous interventions (illicit drug users, ear piercing and tattooing)
- Funeral services
- Ambulance services
- Home treatment

CHAPTER 2: DESCRIPTION OF THE STUDY

This study is part of the World Bank's multi-sectoral HIV/AIDS programme for African Region (MAP). In accordance with the main goal of MAP, the development objectives of the project in the Zambian government are as follows:

- Reduce the spread of HIV/AIDS.
- Mitigate socio-economic impact of HIV/AIDS.
- Increase access to care and support for people infected or affected by HIV/AIDS.

2.1 Study justification

This study aims at bringing safety, health and environment together as a basis for prioritizing national programme, through collection of data on types, quantities, sources handling procedures and basic understanding by those in charge. In addition it is also aimed at proposing ways of reducing levels of contact with hazardous health-care waste. It is assumed that generators might have to put in place measures that in their opinion were adequate to protect human health and the environment.

The management of hazardous health-care waste in health care facilities has not been assessed adequately to be able to provide decision makers with information on which to base their decision. The responsibility on the generator to ensure that waste generated is taken care of in a manner that ensures the protection of human health and the environment has not been fully emphasized. This equally applies to separating safety, health and environment into various categories in spite of their linkages.

This study also aims at sensitizing health-care generators as well as other stakeholders on the needs and basic techniques for proper management of health-care waste. This shall best be achieved by conducting training workshops for all stakeholder institutions and responsible persons. Other suggested activities include the development of a television and radio discussions plus production of pamphlets and brochures.

The health sector is fast growing industry, which is involved in the production of high quantities of domestic, and hazardous waste. The survival of pathogenic microorganisms from infectious waste largely depends on the resistance to various environmental conditions and presence of predators such as hepatitis B virus can survive in dry air for several weeks. The bacteria are less resistant than viruses and little is known about the survival of prions and agents of degenerative neurological diseases (Creutzfeldt-Jacob, Kuru, etc.), which seem to be very resistant.

Thus with an exception of waste containing pathogenic cultures or excreta from infected patients, the microbial load in the health-care waste is generally not very high. Various studies have shown that the concentration of microorganisms in health-care waste is not higher than in domestic waste and their survival rate is low.

In evaluating the survival and therefore potential infectivity of spread of pathogenic microorganisms in the environment, the role of vectors such as rodents and insects should be considered. This equally applies to health-care waste both within and outside health care facilities. Vectors such as rodents, flies, and cockroaches, which feed or breed on organic waste are well known passive carriers of microbial pathogens; their population may increase dramatically where there is mismanagement of waste.

The management of waste at various stages in the handling chain has not been well developed over the years thereby raising safety, health and environmental concerns. Thus with limited knowledge in the persons entrusted with the management of waste, coupled by inadequate facilities, the number of persons at risk becomes even larger.

Occupational health risk of acquiring HIV infection from patients in health care settings is low. Most cases of infection associated with needle stick injury from a patient with HIV infection. Patient to patient transmission is primarily from contaminated equipment that has been incorrectly disinfected or blood transfusion. Most patient care does not involve any risk of HIV transmission, therefore routine HIV testing for health care workers or patients is not recommended.

2.2 Study goal and objectives

a) Goal

To organize and put in place a technically, socially, economically, affordable and acceptable health-care waste management system which will reduce transmission of communicable diseases through indiscriminate disposal of health-care waste at health care facility and dumpsites.

b) Objectives

The overall objective of this plan is to develop a National Health-care Waste Management Plan that will reduce health problems and eliminate potential risks to human health and the environment by the year 2006.

c) Specific Objectives

Specific objectives include among others, to:

- Assess legal, regulatory, policy and administrative framework on health-care waste management and treatment facilities in the country by the year 2005
- Examine current health-care waste management practices in hospitals, clinics, other health care facilities and local authority disposal sites with regard to handling, inclusive of waste pre-treatment, collection, storage, transportation and final disposal by the year 2004.
- Assess types and quantities of health-care waste generation, availability of appropriate equipment and technologies to deal with, health-care waste treatment and final disposal by the year 2004
- Enhance access to use and support activities directed towards prevention of diseases with particular emphasis on those associated with handling health-care waste by the year 2005
- Assess levels of scavenging, recycling, knowledge and practical skills among those involved in health-care waste management and conduct training by the year 2005.
- Prepare a costed health-care waste management plan while taking in to consideration of public and private sector partnerships in relation to cost recovery based on the polluter pays principle by the year 2004.

2.3 Study hypotheses

The hypotheses behind this study are as follows:

- Many health care facilities in the country do not have sound health-care waste management systems for pre-treatment, collection, storage, transportation and safe final disposal.
- The legal framework to address health-care waste management is inadequate and not adequately enforced.
- Local authorities dumpsites do not have sound managerial systems that can safely deal with disposal of special component of waste from health care facilities. This is mainly because currently there are no dumpsites designated for hazardous waste where health-care waste can be dumped.
- The level of knowledge among those involved in handling hazardous health-care waste is low in relation to risk factors associated with either handling or being exposed to it as a result of careless management.

2.4 Ethical consideration

Written request to conduct the study were made to managements of health care facilities. The managements were assured of confidentiality and that data generated was not going to be used for other purposes apart from those specified in the study protocol.

CHAPTER 3: DATA COLLECTION

The examination of current practices with regard to handling of health-care waste has been verified for both the management of waste within health care facilities and local authorities once waste has left the source of generation. It has also looked into the level of knowledge among staff (hospital orderlies, nurses, patients and local authority workers) about practices to be adopted and availability of equipment such as incinerators to deal with this type of waste.

3.1 Data collection techniques

The study was conducted over a period running from 12TH August, to 30TH September 2002. A small sample of health care facilities in Zambia was targeted in order to establish the basic characteristics of the waste streams, types of waste disposal systems in place both on-site and off-site, technologies in use and disposal sites used. This was mainly because it was the desire of the client to ensure that this study covered all categories of health care facilities. However, this was not possible due to logistical problems. It was eventually decided to make field trips to the following selected provinces: Central, Copperbelt, Lusaka, North Western, Southern and Western.

Several methods were used to collect data. These included use of questionnaires; person-to-person interviews with representatives of identified officers, direct observation of activities, focus group discussion, desk literature review and field visits.

a) Selection criteria for study sites

The sample was drawn while bearing in the mind client's needs and the time available for the audit. Special care was taken to include areas that could provide information that would elucidate current practices in health-care waste management in various health care facilities. It was client's requirement that the sample should include at least one each of the following: University teaching hospital, central hospital, general hospital, specialist hospital, district hospital, private hospital, private clinic, urban and rural health centre. Six provinces were visited during auditing period, which covered sixteen health care

institutions. In case of Eastern, Luapula and Northern provinces, the analyses of health care facilities are based on literature review and interviews held with some representatives during and after consultative meeting.

b) Study limitations

The findings in this report are subject to certain limitations. Some of the major limitations are:

- The distribution of study sites did not cover the whole country because of time limitation
- The study did not start on time, as a result it was not possible to pre-test questionnaires.
- The study was unable to adequately assess health-care waste generation at private clinics because of uncooperative attitude from some administrators. It seems inspite of assurance of confidentiality, there was hidden fear that the findings might be reported to higher authorities for action.

CHAPTER 4: FINDINGS AND ANALYSIS

The study has identified levels of health-care waste management that are relevant in helping implement and enforcement of proper human health and environmentally sound, technically feasible, economically viable and socially acceptable systems for management of health-care waste management in Zambia.

In tackling this subject literature reviews was conducted on the legal and administrative frameworks that govern both local and global health-care waste management, and the following are the outcomes.

4.1 Desk literature review on legislative, regulatory and policy framework

The provisions of Zambian law regarding management of health-care waste are provided for through various legislations as listed below by sector of application and control.

a) Ministry of Health

The Ministry of Health is the custodian of various pieces of legislation related to health-care waste management and to cite a few: Public Health Act Cap 295, National Health Services Act Cap. 315, Ionisation Radiation Act Cap 311, Pharmacy and Poisons Act. Cap.299, and The Food and Drugs Act Cap 303. The Public Health Act does not mention, state measures or give procedures to be used when handling health-care waste. Although Section 67(h, q, r & s) defines what constitutes a nuisance, the Act falls short of addressing issues of health-care waste management.

The Ionisation Radiation Act Cap 311 establishes Radiation Protection Board, which is mandated with the responsibility to examine premises and issue licenses for the use of radiation and disposal of radioactive waste materials. This Act does not state the types of waste materials, disposal sites and methods of waste disposal.

The Pharmacy and Poisons Act. Cap.299 provides for licensing with the Registrar of Pharmacy and Poison Board in relation to the registration of Pharmacists, control of the

profession of pharmacy and trade in drugs and poisons. It however does not state procedures for disposal of expired drugs and health-care waste.

The National Health Services Act Cap. 315 provides for establishment of the CBoH, Hospital Management Boards and Health Boards. It makes provisions for local authorities to take necessary and reasonable measures to prevent occurrences of any outbreak or prevalence of any infection, communicable or preventable diseases. In the event of local authority's failure to deal with public health issues, the CBoH is empowered to take over its functions.

The Food and Drugs Act Cap. 303 prohibit the sale of poisonous food and drugs, and also set standards for the same. However, the Act does not address issues of genotoxic (cytostatic drugs) and pharmaceutical waste (expired and excess drugs plus items contaminated or containing pharmaceuticals) on how these can be treated and disposed of.

Under these pieces of legislation, a number of policies and strategies have been devised such as the National Environmental Health Policy (in draft form), National Health Policies and Strategies of 1992, National Health Strategic Plan for the period 2001-2005 whose thrust is on public health priorities including HIV/AIDS, and the National HIV/AIDS/STI/TB Council Strategic Framework 2001-2003. All these documents do provide an indication but with no definite procedure on how to address health-care waste management that assures the protection of human health and environment.

The National Environmental Health Policy has addressed issues centered on the quality of water, food, air and shelter. However, UNCED (1992) and Pretoria declaration (1997) were used as vehicles to develop the draft National Environmental Health Policy. This document does not address health-care waste management. It is hoped the final document is going to address health-care waste management in detail. The analysis also revealed that the national health policies and strategies (health reforms) of October 1992 placed more emphasis *“to provide Zambians with equity of access to cost effective, quality health care as close to the family as possible”* with little focus on health-care waste management.

b) Medical Council of Zambia

The main objective of the council is to efficiently discharge its registration, inspection and training functions for medical and allied professions. It is also responsible for registration of consulting rooms upon satisfying requirements of the Act. Cap. 297. This is done with regard to situation of premises, state of construction, accommodation for various services, state of equipment, qualification for medical / other staff, presence for suitable storage space of poisons, therapeutic, psychotropic and dangerous drugs. This Act does not adequately cover aspects of health-care waste management and yet it is the main institution charged with the responsibility for licensing consulting rooms.

c) Ministry of Local Government and Housing

The local administration (trade effluent regulations) Statutory Instrument (SI) No. 161 of 1985 provides for the control of medical, trade and industrial effluent disposal. The provisions under these regulations also do not adequately enforce health-care waste management. Similarly, a study carried out by the Lusaka City Council, in conjunction with ECZ (1997) does recognize that, the existing legislation although comprehensive on general solid waste, remains largely not being enforced. In addition according to ISWA (1996/7), guidelines and regulations on the management of special hospital and hazardous waste are not adequately covered.

d) Ministry of Tourism, Environment and Natural Resources

The National Environmental Policy is not in place. However, the Environmental Protection and Pollution Control Act cap 204 has provisions for development of various pieces of regulations such as Statutory Instrument No 125 of 2001 in which health-care waste is defines as ‘hazardous waste’. Thus prior to the promulgation of SI 125 of 2001, not much enforcement and monitoring with regard to hazardous waste was carried out. Thus, of particular concern are the hazardous waste management regulations for air standards, the water pollution control and solid waste management. The Act also contains regulations that apply to the control and monitoring of generation, collection, storage, transportation, pre-treatment, treatment, disposal, export, import and transboundary movement of hazardous waste. They do not include domestic and non-hazardous waste from health care facilities. These regulations deal in detail on waste containing metal and metallic bearing. Health-care waste is not adequately provided for under these legislations. However under schedule six of the hazardous categories, health-care waste is classified under waste streams as:

- Clinical wastes from medical care in hospitals, medical centers and clinics
- Wastes from the production and preparation of pharmaceutical products
- Waste pharmaceuticals, drugs and medicines
- Waste from the production, formulation and use of biocides and photo-pharmaceuticals

i) Permit requirements for licensing and to emit air pollutants

The ECZ is mandated to assess the quality of ambient air in order to safeguard the general health, safety or welfare of persons, animal life, plant life or projects affected by industrial or business activities undertaken by an operator. Emission limits are provided for in the Air Pollution Control (licensing and emissions standards) Regulations of 1996, Cap 204 of the laws of Zambia. It is responsible for issuing licenses and permits. Therefore, an individual or company who intends to erect or install a new industrial plant, undertaking or process that is likely to cause pollution shall:

- Register with the inspectorate during the planning stages
- Apply for a license
- Pay an appropriate fee set out in the regulations

It is noteworthy to emphasis that ECZ does not only issue licenses and permits, but it also offers conditions that govern the use of the licenses.

Table 2: Zambian legal limits for ambient air pollutants

Parameter	Reference time	Guideline limit	
1. Sulphur dioxide (SO ₂)	10 Minutes	500µg/m ³	
	1 hour	350µg/m ³	
2. Sulphur dioxide (SO ₂) in combination with Total Suspended Particles (TSP)* ¹ and PM ₁₀	SO ₂	24 hour	125µg/m ³
		6 Months	50µg/m ³
	TSP	24 hour	120µg/m ³
		6 Months	50µg/m ³
	PM ₁₀	24 hours	70µg/m ³
3. Respirable particulate matter PM ₁₀ * ²	PM ₁₀	24 hours	70µg/m ³
4. Oxides of nitrogen (NO _x) As nitrogen dioxide (NO ₂)	1 hour	400µg/m ³	
	24 hours	150µg/m ³	
5. Carbon monoxide (CO)	15 minutes	100mg/m ³	
	30 minutes	60mg/m ³	
	1 hour	30mg/m ³	
	8 hours	10mg/m ³	
6. Ambient Lead (Pb)	3 months	1.5µg/m ³	
	12 months	1.0µg/m ³	
7. Dust fall	30 days	7.5 tonnes/km ²	

Source: Air Pollution Control (licensing and emissions standards) Regulations of 1996, Cap 204

*¹) Total suspended particles (TSP) are particles with diameter less than 45 micrometers (µm).

*²) Respirable particles (PM₁₀) are particles with diameter less than 10 micrometers (µm).

NOTE: It is evident from the specifications given in table 2 above that many health care facilities with incinerators without flues to control emission of gas are operating contrary to the laws of Zambia.

ii) Permit to generate and store hazardous waste

A person generating and or storing hazardous waste is required to obtain a license from the competent authority. The application for a license to generate and store hazardous waste is to be accompanied by a fee prescribed by authorities from time to time.

iii) License to transport hazardous waste

A license from the competent authority will be required for the transportation of waste classified as hazardous or infectious. An application for this license will be made on prescribed forms and shall be accompanied by the fee set out within the regulations (third schedule). This license shall be subject to specific conditions such as routes to use, labels for the vehicle transporting the waste and the provision of security as well as emergency plans. A person may also take hazardous waste to a person who is licensed for pre-treatment under terms agreed for by the two.

In the event where the generator is not the one to transport the waste, he/she shall notify the competent authority in writing using the notification in the first schedule of the regulations about the proposed transportation, stating the licensed transporter or final licensed disposal facility. A further requirement may be to obtain a license to pre-treat or treat hazardous waste as and when the circumstances demand.

iv) License to pre-treat or treat hazardous waste

No hazardous waste should be disposed of without any form of pre-treatment or treatment.

v) Permit to own a hazardous waste disposal site

A license to operate a hazardous waste to final disposal site is a legal requirement and shall be obtained from competent authority. The application to operate a hazardous waste to final disposal shall be made to the competent authority in an appropriate form.

vi) Environmental Impact Assessment (EIA) process

Environmental Impact Assessment (EIA) is a statutory requirement in Zambia. An impact assessment is a systematic examination conducted to determine whether or not a proposed project will have an adverse or other significant impact on the environment. The assessment may also focus on health impacts arising out of the project activities in all stages of development process. The EIA process relies on a multi-sectoral and participatory approach to ensure that all affected and interested parties are involved in decision-making process. The view of the public is considered in the development of mitigation measures. These parties include project proponents, investors, government ministries and departments, private sector entrepreneurs, local communities, NGOs, traditional leaders and institutions, the general public and consultants.

Projects that would require an EIA include, among others, the following:

- Waste disposal for sites with a capacity of more than 1000 tonne/day.
- Sites for hazardous disposal of 100 tonne or more/year

There are three basic steps in the EIA process namely:

- Screening whether it qualifies for a full EIA process or not (brief)
- EIA preparation and review (full EIA Statement)
- Project implementation whose main focus is mitigation and post project assessment.

The EIA process may be required if the project proponents intend to operate their own hazardous waste final disposal site. The review process is a multi-stage one, as it requires submission of six copies of the project brief to the competent authority accompanied by a review fee. A decision may then be made for the project to either go ahead subject to conditions as the case may be or not to go ahead. It may also be required that a full impact assessment be conducted which would require a separate review.

During the preparation of the full EIA public participation is integral. Public participation through comments is also required during the final phase of the review process. The review process may take up to three months depending on the issues at hand. There are specific minimum periods within which to act by both parties.

vii) National waste management strategy

A draft national waste management strategy (ECZ, 2002) has been prepared in consultation with stakeholders and through working group activities (ECZ, 2000). The overall goal of the national waste management strategy is to control pollution and improve waste management to prevent environmental degradation by providing an efficient, effective and sustainable waste management system.

The objectives of the national waste management strategy are:

- To increase industries' responsibility for the waste arising from their manufacturing and production processes or end products. Therefore, industry is encouraged to develop waste management plans covering the whole life cycle of their starting materials, and to develop internal control measures.
- To implement a system of incentives which will discourage the use of non-biodegradable or non-recyclable materials?
- To establish and improve co-ordination by the relevant authorities and stakeholders in solid waste management.
- To promote the reuse and recycling of waste materials as a resource; hence encouraging the inculcation of the principle of "putting value to waste".
- To develop databases of various types on waste: hazardous and non-hazardous waste.
- To establish a classification and information management system for all types of waste.

Some elements of the national waste management strategy will definitely find use in the new national health environmental policy under development in the MoH. For example, the national waste management strategy proposes the following targets:

- *i. Short-term*
-
- That health care facilities will develop and implement waste management plans and practices
- Sensitize all medical health personnel on the procedures of handling waste, especially hazardous types, and incinerate all health-care hazardous waste.

- *ii. Medium-term*
-
- Implement accessible waste management plans and practices approved by the local authority in consultation with the ECZ
- Build treatment and disposal facilities such as incinerators; and
- Comply with relevant legislation and regulations

iii. Long-term

- Implement accessible waste management plans and practices approved by the local authority in consultation with the ECZ
- Commercialize the operation of incinerators; and
- Comply with relevant legislation and regulations

Note: In the absence of legal framework that lays down the role of government and stakeholders in environmental health services delivery it is necessary to have in place legal framework and policies, which spell out activities, deficiencies, gaps and varying responsibilities of individuals, families, communities, service providers, stakeholders and governmental agencies.

4.2 Information gathering during fieldwork

Face to face interviews were conducted with clinicians, environmental health staff, nurses and officials of health boards. Additional information was collected from the MoH and CBoH. Other approaches adopted for this study included, verbal interviews; literature searches on previous work, administration of questionnaires and impromptu techniques designed for in-situ evolution of appropriate data units.

a) Distribution of health care facilities

The full list of health care facilities that constitute the backbone of Zambia's health care delivery system is given in appendix 9.4. The list is not exhaustive as there may be many clinics that may not have been fully registered at the time of collecting this data.

Table 3: Health care facilities in relation to population and bed capacity

Province	Population size	Hospital			Health centre			Tool		
		No.	Beds	Pop / bed	No.	Beds	Pop / bed	No.	Beds	Pop / bed
Central	1,006,766	9	2093	481.1	106	853	1,180.5	115	2946	341.8
Copperbelt	1,657,646	16	3984	416.2	179	1646	1,007.3	195	5630	294.5
Eastern	1,300,973	9	587	819.8	139	1776	732.5	148	3363	386.9
Luapula	784,613	7	1095	716.9	105	859	913.8	112	1955	401.5
Lusaka	1,432,401	7	2738	523.0	94	810	1,767.9	101	3548	403.6
Northern	1,407,088	7	1285	1094.9	145	1770	794.9	152	3055	460.5

N. Western	610,975	10	1355	450.9	108	1182	516.9	118	2537	240.8
Southern	1,302,660	15	2814	463.0	200	1591	819.0	215	4405	295.8
Western	782,509	11	1047	747.8	111	1015	771.4	122	2062	379.7
Total	10,285,631	91	16988	599.7	1187	11502	833.1	1278	29501	348.7

Source: CSO, (2001). Preliminary report for the 2000 census of population and housing population count. Lusaka.

CBoH, (2001). Health statistics unit. Lusaka.

The above statistics reveal Zambia's health care facility coverage, which is as follows: Central (9%), Copperbelt (15.2%), Eastern (12%), Luapula (8.8%), Lusaka (7.9%), Northern (12%), North Western (9.2%), Southern (17%) and Western (9.5 %). It is clear from these statistics that Southern province has the largest proportion of health care facilities (17%) followed by Copperbelt with 15.2%. Lusaka province with second largest population has the least number of health care facilities, which accounts for only 7.9%. This is mainly due to it having the smallest surface area but densely populated.

There is a wide network of health care facilities in the country both in the public and private sectors. The largest number is made up of 1,187 health centres which mainly provide outpatient health care services in the peripheral rural areas. A total of 91 hospitals provide health care, which ranges from level one up to national reference (District, General, Central and University Teaching Hospital) in both public and private sector has strength of 50 to 1000 beds.

Table 4: Sites and levels of health care facilities visited

Name of institution visited	Level of institution	Province	Doctor	Nurse	CO	CDE	Total beds	O / rate %
University Teaching Hospital	National reference	Lusaka	277	320	50	437	1,905	80
Kitwe Central Hospital	Level III	Copperbelt	54	307	12	89	643	93
Arthur Davison General Hospital	Level III	Copperbelt	27	103	12	77	250	59
Solwezi General Hospital	Level II	North Western	13	67	6	86	303	29
Livingstone General Hospital	Level II	Southern	11	136	8	101	501	32
Liteta District Hospital	Level I	Central	1	32	7	30	147	71
Mazabuka District Hospital	Level I	Southern	4	100	9	15	196	16
Yeta District Hospital	Level I	Western	1	27	0	9	121	35
Mwandi Mission hospital	Level I	Western	2	11	3	11	86	26
Kalomo District Hospital	Level I	Southern	1	32	5	4	57	59
Chipata Clinic	UHC	Lusaka	2	52	5	24	57	19

Mutanda	RHC	N. Western	0	5	0	3	40	6
Mutanda Research	RHC	N. Western	0	2	0	1	1	50
Kazungula	RHC	Southern	0	1	0	1	4	50
Monze Clinic	UHC	Southern	0	11	4	11	0*	N/A
St. John's Medical Centre	Private Hospital	Lusaka	25	22	0	11	10	50

Source: a) CBoH (2001). Data Based on Statistics

b) Occupancy rates for only up to 3rd Quarter of 2001

* Provide out patient services only (OPD)

Note: Tables 4 above shows basic statistics of health care facilities visited during study.

i) Central Province

The study site was Liteta District Hospital with 100 bed capacity. This institution operates a quality assurance programme that ensures infection control measures are put in place. Pre-treatment measures are used to sanitize soiled beddings to remove infection risk to laundry workers.

Waste segregation is not effectively monitored as sharps and other special health-care waste could be seen around or near unprotected pit. There is also lack of capacity to quantify health-care waste generation. Disposal methods in place include open unprotected pits and a pit latrine. The existing incinerator has been abandoned and it is no longer in use.

ii) Copperbelt Province

Two level III hospitals (Arthur Davison Children's in Ndola and Kitwe Central Hospital) with a total bed capacity of 864 were visited. The assessment revealed that management of health-care waste on the Copperbelt seems to be in deplorable state. The incinerators were unfenced (picture 1) and were found in dilapidated state of repair that requires immediate replacement in order to raise their operational efficiency to desired levels. At Kitwe Central Hospital, the pits were found to contain all forms of waste and were unprotected from attack by both animal and human scavengers.

Arthur Davison Hospital external waste disposal the receptacle used possible through this health-care waste might way to communal 6, 7 and 10). Thus which are inadequately scavengers they pose health especially local scavenger authority workers who



has contracted an agent as indicated by (picture 2). It is arrangement that some inadvertently find its dumpsites (picture 4, 5, because of the sites, protected from extreme risk to public considering that it is the leadership not local control the sites.

Picture 1: Unprotected incinerator at Kitwe central hospital



Picture 2: Receptacle for externally disposed waste at Arthur Davison hospital in Ndola

Uchi dumpsite

Asset Holding Company Mining and Municipal Services operate the Uchi dumpsite under license from Kitwe City Council. The site is a potential health hazard because it is located near a dambo / swamp and Ndola / Kitwe highway. The site is also near Kafue River, which is the main source for domestic water supply for Kitwe residents. It is easily accessible but it lacks adequate soil for daily cover. The site operation interferes with natural and ground water systems because it provides a suitable conduit for leachates to percolate and thus pose a potential danger to both drinking water source and scavenging community.

iii) Lusaka Province

Three health care facilities with bed capacity of over 1,900 were visited of which two (Chipata Urban Health Centre and University Teaching Hospital – UTH) are government institutions and one (St John’s Medical Centre) is a private institution.

The units covered in Lusaka were, perhaps, among the best in terms of internal controls on waste management at ward or unit level. However, effective waste segregation is hampered by lack of appropriate storage facilities. This was equally the same with collection and transportation of waste beyond ward or unit level up to final disposal site as expressed by many respondents. Many respondents failed to quantify amounts of wastes their wards or units were capable of generating per day /week/month/year. They equally failed to estimate costs for health-care waste management.

All three institutions operate at least one incinerator with an exception of UTH, which has two. UTH dispose some of its waste through a communal dumpsite under the operation of *Lusaka City Council (LCC)*. In addition, there is a proliferation of unprotected and unauthorized waste disposal pits within the premises especially the one (picture 3) located near the laundry. The loading bay at the UTH for off-site disposal facilities is located near the virology laboratory and second incinerator. This is another area that clearly reveals how health-care waste easily finds its way to unauthorized final disposal sites (picture 4, 5, 6 and 7) and most likely at the Lusaka City Council dumpsite at Chingwere.



Picture 3: Refuse pit next to the road near the laundry at UTH in Lusaka



Picture 4: Scavengers attacking off-loading refuse truck at Chingwere dumpsite in Lusaka



Picture 5: Scavengers including bare-foot kids picking from off loading refuse truck at Chingwere dumpsite in Lusaka



Picture 6: Refuse truck off load waste on to burning waste at Chingwere dumpsite in Lusaka



Picture 7: Scavengers at Chingwere dumpsite in Lusaka

There is apparent lack of capacity within the institution to ensure safety of health. There is evidence of public complaints over the operation of incinerators in relation to emission of noxious fumes, a situation that calls for relocating of the units. This equally applies to the loading bay (picture 8) for off-site disposal facilities, which is another area that reveals how health-care waste can easily find its way into unauthorized hands.



Picture 8: Refuse receptacle for off site disposal at UTH in Lusaka

Chingwere dumpsite

The LCC, through its public health department currently operates Chingwere dumpsite, which is approximately 8km north west of the City off Great North Road in close proximity with Chingwere cemetery and unplanned settlements. It is also near Chingwere stream raising possibilities of both surface and ground water pollution. The site is situated in an area with easy access to motor traffic and scavengers. Thus although there is adequate soil to provide daily cover for waste disposal, it takes many days before the waste is finally covered. In this respect waste is allowed to stay open for scavenging, a situation that exposes the community to potential risks from health-care waste.

iv) North Western Province

Three sites were visited (Mutanda Research, Mutanda Rural Health Centre (RHC) and Solwezi General Hospital) with a bed capacity of over 340.

Mutanda Research has the best means of waste disposal as they operate a ventilated disposal pit, which is covered with a concrete slab. The deposited waste is burnt on a daily basis. In the case of Mutanda RHC and Solwezi General Hospital, they use unfenced open pits and a dilapidated incinerator. At Mutanda RHC, a pit latrine is used for the disposal of placentas.

The technical personnel interviewed showed incapacity to give reliable descriptions of the waste streams and quantities of health-care waste generated. It also revealed that health workers have little knowledge on waste generation profile including safe handling and this is from collection, segregation, storage, and transportation up to final disposal.

Evidence of inappropriate health-care waste management was observed at the main Solwezi market (picture 9). Solwezi Municipal Council operates Chipemba dumpsite, which is situated 25km on the outskirts of the town. The dumpsite (picture 10) with large quantities of health-care waste is unprotected from scavengers and this exacerbates the potential risks to both human and the environment.



Picture 9: Waste transit bay containing health-care waste at Solwezi main market



Picture 10: Open unprotected Chipemba dumpsite at Solwezi

v) Southern Province

Although the target site in the province was Livingstone and Kazungula, other towns' enroute (Mazabuka, Monze and Kalomo) were included in the list of study institutions. Livingstone General Hospital according to health care workers indicates that they generate about 235kg of waste in a week. However this is a highly conservative figure. The hospital operates an wood fired (picture 11) unprotected (picture 12) premises.



unfenced incinerator and many open pits within the

Picture 11: Unprotected pit near public footpath at Livingstone general hospital



Picture 12: Unprotected incinerator at Livingstone general hospital

Kazungula RHC does not have an effective health-care waste system. All forms of waste are disposed of in an unfenced open pit. This is a situation that creates potential risk from hazardous health-care waste to both human health and the environment.

Kalomo District Hospital was observed to have a better waste management practices with a protected incinerator (picture 13), although communal waste was disposed of in an un-protected pit (picture 14).



Picture 13:
at Kalomo district

Protected incinerator
hospital



Picture 14: Unprotected waste disposal pit at Kalomo district hospital

The waste disposal site visited at Monze service's the hospital and the clinic in a beautiful symbiosis, which is more beneficial to the clinic. However, the situation on the ground was not very good, especially beyond ward level. Photographic material and other wastes were seen littering as a clear indication of unacceptable health-care waste management.

vi) Western Province

The study covered two (Mwandi mission and Yeta government) hospitals in Sesheke district. Waste segregation is placed under low priority at both hospitals. However, at both hospitals they practice better final disposal as evidenced by eagerness to fence off disposal pits (picture 15).



Picture 15: Protected disposal pit at Yeta district hospital in Sesheke

b) General observations during field visit

The audit of health-care waste management has clearly shown that although the portfolio for solid waste management does not directly fall under MoH / CBoH, there is great need for the MoH / CBoH to be fully involved because of health-care waste which inadvertently finds its way into communal municipal waste. It is therefore necessary for MoH when legislating on health-care waste to consult other stakeholders (Ministry of local Government and Housing, Ministry of Tourism, Environment and Natural Resources, ECZ, etc.).

Thus, the finalization of National Environmental Health Policy should provide the relevant framework to effectively address issues of health-care waste management at all levels of the health care system in Zambia. An analysis of current practices leads to the following conclusions:

- The practices in health-care waste management are not satisfactory
- Individuals handling health-care waste (health care workers, dumpsite workers and scavengers) are potentially at risk
- The content of health-care waste management at training institutions is inadequate, which urgently calls for a review of training curricula to include it.

There is need to mount awareness raising campaigns at all levels, which should aim at protecting health workers, visitors to health care facilities and communities living within the vicinity of health-care waste generation or final disposal sites.

4.3 Analysis of health-care waste management in Zambia

An analysis of the situation on the ground was made in terms of collection, separation, transportation, and final disposal. Current health-care waste including infectious wastes such as; swabs, syringes, blades, catheters, contaminated gloves and other medical care waste, which are either dumped in pits or simply thrown in to shallow open pits. Some of the wastes are burnt while others are simply buried. Due to the infectious nature of the waste, and the level of awareness of hazards associated with the materials by the handlers, especially maids / classified daily employees, the possibilities of occupational infections rank highly. Generally facilities for management and disposal of waste vary from one hospital to another ranging from:

- Incinerators built with primary and secondary burners, and in some cases, concrete constructed incinerators, which are basically, open air burning hearths as they do not have air pollution abatement facilities
- Placental pits, as well as mere open ditches
- Transportation of health-care waste to off-site disposal places
- Use of public sewer lines for infectious liquid disposal

In urban areas, the proliferation of private clinics, private hospitals and private waste management entrepreneurs has resulted in situations where infectious waste and sharps find there way to domestic waste dumping sites. Scavenging by street kids and unemployed youths at disposal sites is of serious public health concern. Possibilities of infections are

not a far-fetched idea given that most of the vulnerable do not wear any form of personal protection. Bare foot kids are not an uncommon sight at local authority dumpsites countrywide (picture 5).

a) Poverty issues

The scavengers (adult and kids) are driven by abject of poverty, which forces them to seek saleable objects from waste dumps. For kids, other underlying factors include the lack of leisure and recreational facilities, and also inability on the part of their parents to provide school requirements thus sending the kids to look for family sustenance money at an early age in their lives. Many kids may have been orphaned by the dreaded HIV/AIDS pandemic. Some of the most popular items for salvage are latex gloves and polyethylene carrier bags. The gloves are washed and sold to hair care salons where attendants unsuspectingly use the gloves to protect their hands from concentrated alkaline chemicals used in their trade. The carrier bags are sold to local market suppliers for vegetable and other edible household items, with obvious potential for diarrhoeal disease consequences.

The levels of risk to health of the desperate jobless who frequent dump sites are very high; therefore, there is need not only to sensitize these people, but also to find income generating activities for them. Schemes should, as a social safety measure, be created to help scavengers work at waste reclamation exercises in safer conditions.

Health care providers who generate waste, in collaboration with environmental protection control agencies; community development and youth wing of government should establish avenues that will minimize health risk to scavengers by instituting measures inclusive of:

- Providing secure packaging and storage for waste in transit
- Providing pilfer proof health-care waste transportation vessels both at the health care facility and waste disposal sites level
- Fencing off waste disposal sites to prevent both animal and human scavengers from accessing health-care waste
- Providing safer alternative income generation and recreation activities to scavengers, and
- Making waste reclamation into a hygienic and competitive business free of health-care waste

b) Obsolete equipment

Most health care facilities visited (especially 2nd and 3rd level hospitals) carry a large stock of obsolete equipment of all description which range from machinery in nuclear medicine and chemotherapy; X-ray machines and accessories; incubators; disused autoclaves; laboratory equipment; pressure and temperature gauges containing mercury; redundant compressed air cylinders; glass bottles of all description; defunct laundry equipment; electric cooking pots, hospital beds, through wheel-chairs, and motor vehicles that litter and take up valuable storage space. These also encourage vermin infestation.

Some equipment that was previously used for treatment contains toxic chemicals. This is equally applicable to motor vehicles which are a source of chemical agents that may harm workers. It is necessary that government develop plans that take care for best health care sector and other sectors. There is need to construct or provide secure bonded rooms at designated locations country-wide from where pre-treated items could be disposed of posing minimum risks from such equipment.

c) Composition of health-care waste

The average distribution on types of health-care waste for purposes of waste management planning according to Pruss, A. (1999) is approximately as follows:

- 80% General/communal waste, which can be dealt with using normal domestic waste management systems
- 15% Infectious and biological (or pathological) waste
- 3% Chemical or pharmaceutical waste
- 1% Sharps, and
- Less than 1% special waste, such as radioactive, cytostatic, photographic wastes, pressurized containers, broken thermometers, used batteries, etc.

The quantity of the above mentioned waste varies greatly from place to place and among health care facilities within a given sector of generation. Variations in the composition of waste raises serious issues at the local level which require different approaches with respect to necessary health-care waste management procedures to be applied in order to achieve sustainability. The variations may be due to several factors among which are differences in health care facility specialization, numbers of qualified health care personnel available, health-care waste management practices prevailing as well as recycling and reuse.

An attempt was made to assess composition and quantities of health-care waste generation in health care facilities. The exercise to determine composition and quantities of waste proved futile in most institutions visited with an exception of UTH. This was mainly because of failure by most staff to calculate waste generation in their institutions.

Table 5: Analysis of waste composition at University Teaching Hospital

Type of waste	Source of health-care waste generation per ward			
	Haematology	Virology	Surgical	Other wards
Biomedical				20%
Paper	4%	32.6%	5%	5%
Food			50%	55%
Sharps	20%		20%	20%
Blood	75%			
Stool containers		4.3%		
Bottles		43.5%		
Disposable pipettes		6.7%		
Gloves		10.9%	25%	

Others	1%	2%		
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Table 5 above gives a variety of waste compositions indicative of the situation on the ground determined during the study. Respondents in the study could not develop a more exhaustive list due to the non-systematic segregation of waste and non-uniform classification of waste by types.

d) Handling of health-care waste in health care facilities

The handling of health-care waste is critical in minimizing risks associated to human health and the environment. The potential risk occurs during transportation of waste on-site and off-site of production. This therefore, calls for regulations and control measures to be put in place to govern; packaging requirements for off-site transportation, labelling, labelling for radioactive waste, preparation for transportation, transportation vehicles or containers and routing.

This study has investigated some activities related to handling of health-care waste in health care facilities and the following are the outcome:

Table 6: Handling of health-care waste

<i>Category</i>	<i>Percentage</i>	
	Yes	No
Segregation of waste by type	37	63
Re-use of health-care waste	31	69
Disposal facilities (incinerator, open pit, placenta pit, pit latrine, etc.)	75	25
Scavenging health-care waste	25	75
Functional infection control committee	50	50
Health-care waste awareness programmes	44	56

Table 6 above shows that the majority (63%) of the health care facilities do not segregate waste by type, 25% of the local community scavenge health-care waste within health care facilities, 44% have health-care waste awareness programmes in their plans, and 31% re-use health-care waste, this is in agreement with Mazick, A. (2001) who states that 20% of facilities reuse disposal syringes or needles. However 75% of respondents indicated that they have disposal facilities within their premises and common ones being incinerators, open pits, placenta pits, and pit latrines. The study also revealed that many health care facilities do not have in place functional infection control committees. This finding reveals that many health workers and especially those handling health-care wastes are exposed to risks of infection.

i) Segregation of health-care waste

Segregation of health-care waste is the responsibility of waste generators and should take place at the source of generation. It is an effective system as it reduces costs and protects public health. It also facilitates appropriate handling, treatment and disposal of waste.

Segregation of waste helps in identifying the categories of health-care waste being produced in the facility. The waste should therefore be sorted into colour coded plastic bags or containers for easy identification during handling process.

ii) Injection safety

The disposal of sharps is a big issue as it is generally unsatisfactory in many public health care facilities of Zambia. The levels of safety and risks to the injection recipients, health workers and the community pose serious problems in disposing used injection equipment. According to Mazick, A (2001), 20% of the health care facilities reuses disposable syringes or needles. This finding is in agreement with this study, which found 31% to be reusing disposables.

The safety and risks to health workers is an issue of great concern in the advent of HIV/AIDS pandemic as 95% of the sharp waste is collected in an unsafe manner. Mazick, A (2001) further states that 74% of the final disposal dumpsites are unsecured as they are easily accessible to the general public creating high levels of risks to the community. This finding is also in agreement with this study, which observed indiscriminate disposal of health-care waste in all sites visited. This shortcoming constitutes a major risk to communities and the general public at large where such activities are allowed to exist unabated.

iii) Waste collection

Generally, the handling of infectious waste at source by doctors, nurses and para-medical staff is relatively very good, partly because generators are trained personnel who understand potential risks involved. It is the collection beyond ward level that has a relatively higher possibility of causing injury or infection. While very good handling procedures for sharps are being advocated by adopting the Kaputa version, chances of pricks are not completely diminished because the model needs to go through further modification.

iv) Waste transportation

In most situations final disposal sites are situated very far from the point of generation. With minimal use of reliable technology during transportation, spills and fly-offs sometimes occur. This is yet another potential source of infection transfer. In most cases the waste generators were not the ones who transport the waste; as a result the necessary due care to potential health risk along the route are compromised. General transporters are hired to ferry waste by open truckload that do not have adequate facilities on their vehicles for containing hazardous waste, as is the case for ordinary municipal waste. The personnel operating at the final disposal site are not warned at all of the cargo being offloaded.

v) Waste disposal

Current disposal practices in waste management among medical institutions are varied, depending on the type and nature of disposal facilities available. In places where incinerators (which are basically open air burning hearths because they do not have any form of emission abatement technologies) are used, some form of indiscriminate burning of waste is conducted. The primary objective of special health-care waste / hospital incineration is the destruction of pathogens in infectious waste which include-microbiological laboratory wastes; blood and blood products e.g. serum and plasma; sharps, including needles, laboratory glass wastes and glass pipettes; surgical, autopsy and obstetrical wastes which have been in contact with patient blood or body fluids; wastes which have had contact with communicable disease isolation wastes; human tissue containing pathogens with sufficient virulence and in quantities such that exposure to the waste by susceptible human hosts could result in infectious disease; and, dialysis unit wastes i.e. wastes that were in contact with blood of patients undergoing haemodialysis. Combustion is not controlled and so are emissions. Most incinerators are poorly managed resulting in the emission of such air polluting agents as particulate matter, toxic metals, noxious and toxic gases as carbon monoxide, and the acid gases such as hydrochloric acid. Some units are not fenced-off thereby exposing them to scavenging by birds, dogs and in rare incidences mental patients.

There are no warning signs at places where hazardous waste is stored or incinerated, and colour coding is not widely practiced.

vi) Responsibility of health-care waste management

The responsibility for the management of waste is loose because in some health care facilities there are no adequately trained and competent persons specifically assigned to deal with management of waste. Some institutions do not have an Environmental Health staff on their establishment. Placentas are disposed of in placental pits. Topical environmental protection concerns and issues such as the possibility of leachates percolating into ground water arise out of these disposal arrangements. Generally no assessments on impacts of the waste disposal facilities on other environmental components are conducted during the design, siting and construction of such facilities.

vii) Amount of waste generated

The amounts of waste generated in health care facilities are normally allocated to the number of patient days or bed days. The typical figures for health risk waste (infectious, biological and sharps) and household waste in European countries according to WHO (1999) is as follows:

- Big and specialized hospitals : 0.5 – 0.6 kg/patient day
- Small or medium size clinics : 0.2 – 0.3 kg/patient day
- General / communal waste : 2 – 3.5 kg/patient day

The above formula for waste generation has been used to calculate waste generation. It has been found appropriate to use this formula because of good medical records, which are maintained, at all levels of health care delivery in Europe.

Table 7: Estimate of daily health-care waste generation in institutions visited

Name of site visited	Level of the institution	Number of beds	Total waste generated in kg / patient day		
			Health-care waste	General / communal waste	Total waste
University Teaching Hospital	National reference	1,905	952.5	3,810	4,762.5
Kitwe Central Hospital	Level III	643	321.5	1,286	1,607.5
Arthur Davison Central Hospital	Level III	250	125	500	625
Solwezi General Hospital	Level II	303	151.5	606	757.5
Livingstone General Hospital	Level II	501	250.5	1,002	1,252.5
Liteta District Hospital	Level I	147	73.5	294	367.5
Mazabuka District Hospital	Level I	196	98	392	490
Yeta District Hospital	Level I	121	60.5	242	302.5
Mwandi Mission hospital	Level I	86	43	172	2150
Kalomo District Hospital	Level I	57	28.5	114	142.5
Chipata Clinic	UHC	57	11.4	114	125.4
Mutanda	RHC	40	8	80	88
Mutanda Research	RHC	1	0.2	2	2.2
Kazungula	RHC	4	0.8	8	8.8
Monze Clinic	UHC	0	N/A	N/A	N/A
St. John's Medical Centre	Private Hospital	10	2	20	22
Total		4,321	2,126.9	8,642	10,768.9

Note: The following formula has been used in the calculation of waste with 100% occupancy rate: Big and specialized hospitals 0.5 kg/patient day, small or medium size clinics 0.2 kg/patient day and general / communal waste 2 kg/patient day.

Table 7 shows estimate of waste generation rate in health care facilities visited during study. The total waste generated by UTH alone accounts for almost 50% on daily basis of all wastes from institutions visited. Although one institution is recorded as not among those producing waste, this is mainly because of the outpatient services it offers with waste regarded as minimal but worth taking note.

e) National estimate of waste generation

The failure by many health workers to give accurate estimate of health-care waste generation resulted in the usage of an international formula to calculate the same. The following formula has been used where occupancy rate is 100%:

- Big and specialized hospitals 0.5 kg/patient day, small or medium size clinics 0.2-kg/patient day and general waste 2-kg/patient day.

Table 8: Estimate of waste generation

Type of health care facility	Number health care facilities	Number of beds per each type of health care facility	National estimated waste generation in kg/patient day		
			Health-care waste	General waste	Total estimated waste
Big and specialized hospitals	9	16,988	8,494	33,976	42,470
Small or medium size clinics	1187	11,502	237.4	23,004	23,241.4
Total	1196	28,490	8,731.4	56,980	65,711.4

Table 8 shows an estimate of daily national waste generation by all health care facilities. A total of approximately 66,000 tons of both health-care and general / communal waste is generated daily countrywide. The bulk of this waste is disposed of indiscriminately. This therefore clearly indicates the magnitude of the health-care waste disposal system in the country.

The factors listed above place heaviest strain on rural based health care facilities where the bulk of Zambia’s population lives, but where the people have the least capacity to afford to pay for services and also lack necessary technically qualified staff strength. Rural health care facilities have no access to centralized health-care waste treatment and disposal facilities as has been elaborated. It is therefore evident that the best option for final disposal for rural health care facilities is burial under controlled conditions elaborated by technical specifications such as:

- Careful siting of burial grounds in secluded areas approved by the local authority.
- Observe landfill principles (i.e. provide liners in pits that are technically designed to specification).

The urban health centres are better off because they carry lower population sizes that are more affluent and capable to pay for services. The shorter distances between settlements make them amenable to provision of centralized health-care waste facilities that offer off-site treatment and disposal for both enhanced, safety and economic reasons.

The final conclusions on waste generation and the general state of health-care waste in Zambia have been made while taking into consideration findings from previous studies on the same subject. Additional information was also captured during the debriefing meeting of stakeholders, which drew participants from all provinces. This has widened coverage as it has included institutions that hitherto were not physically audited. The findings in this report are therefore applicable to the entire country.

f) Scavenging and reuse

Ordinary solid waste containing health-care waste is rendered hazardous. Therefore reuse or recycling could be feasible only if segregation is implemented. The Zambian rural health care facilities have higher potential to generate health-care waste, with low capacity to manage it. However, the urban health care facilities have the advantage of the availability of the information media, which may be used to quickly expose them to the dangers of their situation and suggest appropriate protective options against the adverse effects of health-care waste. Therefore, possible impacts of infection risk on the vulnerable groups in rural areas will for a long time remain a seething time bomb.

Scavenging by both human beings and animals on health-care waste is prevalent especially at dumpsites with the attendant health risks, along the whole chain of management. The problem of scavenging is normally veiled and hidden at the health care facility level because personnel are conscious of the risk of being caught with items that could be regarded as institutional property e.g. plastic liquid and/or solid medicine containers. Effects on more vulnerable elements of our society occur especially on premises where there are persons of unsound mind on hospital grounds whose level of risk is heightened by their ignorance. In cases where health-care waste is transported to external sites for disposal, the greatest danger lies with the innocents who include women and small kids.

CHAPTER 5: TECHNOLOGIES FOR TREATMENT AND DISPOSAL OF HEALTH-CARE WASTE

There are various forms of technologies to effectively reduce infectious hazardous health-care waste and at the same time prevent scavenging. This therefore calls for careful consideration when selecting the technology.

5.1 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 of in a landfill site.

The combustion of organic compounds produces mainly gaseous emissions, including steam, carbon dioxide, nitrogen oxides, and certain toxic substances (e.g. metals, halogenic acids), and particulate matter, plus solid residues in the form of ashes. If the conditions of combustion are not properly controlled, toxic carbon monoxide will also be produced. The ash and wastewater produced by the process also contain toxic compounds, which have to be treated to avoid adverse effects on health and the environment.

Most large, modern incinerators include energy-recovery facilities. In cold climates, steam or hot water from incinerators can be used to feed urban district-heating systems. However in warmer climates like Zambia, steam from incinerators could be used to generate electricity. The heat recovered from small hospital incinerators can be used for preheating waste to be burnt.

a. *Characteristics of waste suitable for incineration*

- Content of combustible matter above 60%
- Content of non-combustible solids below 5%
- Content of non-combustible fines below 20%
- Moisture content below 30%

• *b. Waste types not to be incinerated*

- Pressurized gas containers
- Large amounts of reactive chemical waste
- Silver salts and photographic or radiographic wastes
- Halogenated plastics such as polyvinyl chloride (PVC)
- Waste with high mercury or cadmium content, such as broken thermometers, used batteries and lead-lined wooden panels
- Sealed ampoules or ampoules containing heavy metals

c. Types of incinerator

Incinerators range from extremely sophisticated, high-temperature operating plants to very basic combustion units that operate at much lower temperatures. All types of incinerator, if operated properly, eliminate pathogens from waste and reduce the waste to ashes. However, certain types of health-care wastes, e.g. pharmaceutical or chemical wastes require higher temperatures for complete destruction. Higher operating temperatures and cleaning of exhaust gases limit the atmospheric pollution and odors produced by the incineration process. Therefore type of incineration should be carefully chosen on the basis of the available resources and local situation. The basic kinds of incineration technology for treating health-care waste are as follows:

a) Rotary kiln

A rotary kiln, which comprises a rotating oven and a post-combustion chamber, may be specifically used to burn chemical wastes, and is also suited for use as a regional health-care waste incinerator. Ashes are evacuated at the bottom end of the kiln. The gases produced in the kiln are heated to high temperatures to burn off gaseous organic compounds in the post-combustion chamber.

Rotary kilns may operate continuously and are adaptable to a wide range of loading devices. Those designed to treat toxic wastes should preferably be operated by specialist waste disposal agencies and should be located in industrial areas.

b) Pyrolytic (double-chamber) incinerator

Pyrolytic incineration is also called controlled air incineration or double-chamber incineration. This is the most reliable and commonly used treatment process for health-care waste. It may be designed especially for a health care facility.

Ash from a chamber of incinerators contains less than 1% of un-burnt material, which can be disposed of in landfills. However, to avoid dioxin production, no chlorinated plastic bags should be introduced into the incinerator and should therefore not be used for packaging waste before its incineration.

c) Single-chamber incinerator

Health-care waste may be incinerated in a single-chamber incinerator. This type of incinerator treats waste in batches while loading. Removal of ash is done manually. The combustion is initiated by addition of fuel and should then continue unaided.

Atmospheric emissions usually include acid gases such as sulfur dioxide, hydrogen chloride, and hydrogen fluoride, black smoke, fly ash (particulates), carbon monoxide, nitrogen oxide, heavy metals, and volatile organic chemicals. To limit these emissions, the incinerator should be properly operated and carefully maintained.

d) Drum / brick incinerator

This type is the simplest form of single-chamber incinerator. It should be used only as a last resort. It is difficult to burn the waste completely without generating potentially harmful smoke. The option is appropriate only in emergency situations during out-breaks of communicable diseases and should be used only for infectious waste.

The drum incinerator should be designed to allow the intake of sufficient air and the addition of adequate quantities of fuel is essential to keep the temperature as high as possible. Wood should be added to the fire until the waste is completely burned. After burning the ashes from both fire and waste should be collected and buried safely inside the premises of health-care facilities.

This process may cause 99% destruction of microorganisms and result in a dramatic in reduction the volume and weight of waste. However, many chemical and pharmaceutical residues will persist and therefore eventually cause massive emission of black smoke, fly ash and toxic gases.

e) Incineration in municipal incinerators

It is economical to dispose of infectious health-care waste in municipal incinerators if the facility is located close to health care facilities. As the heating value of health-care waste is significantly higher than that of domestic refuse, the introduction of small quantities of health-care waste will not affect the operation of a municipal incinerator. Municipal

incinerators are usually of a double-chamber design, with operating temperatures ranging between 800°C and 1200°C.

A number of rules and recommendations apply to the disposal of health-care wastes in municipal facilities:

- When health-care waste is delivered to the incineration plant, the packaging should be checked to ensure that it is undamaged
- Health-care waste should not be packed in cylindrical containers because these could roll on the grids where they are placed for combustion
- Facilities should be available at the incineration site for cleaning and disinfections of transportation equipment, including vehicles
- Deposit of health-care waste in the normal reception bunker is not recommended because there is a risk of waste bags being damaged during transfer to the furnace by the overhead crane. Health-care waste should therefore be loaded directly into the furnace
- Use of an automatic loading device for bags and containers of health-care waste, rather than manual loading, would protect the safety of workers
- Health-care waste should not be stored for more than 24 hours at an incineration plant; longer storage would require cooling facilities to prevent the growth of certain pathogens and the development of odors
- The combustion efficiency should be checked. It should be at least 97% during incineration of health-care waste
- Health-care waste should be introduced into the furnace only when the normal conditions of combustion have been established; never during start-up or shutdown of the combustion process
- The process should be designed to prevent contamination of ashes or wastewater by the health-care waste

f) Operation value of incineration

This technology reduces organic and combustible waste into inorganic and incombustible matter. The process is capable of causing significant reduction in weight and volume of waste. This is usually applied to waste that cannot be recycled, reused or disposed of in landfill sites. The combustion process produces gaseous emissions (carbon dioxide, nitrogen dioxide, metals, halogenic acids etc.), steam and solids (ash).

Incineration is the proposed technology, which has been recommended for all health care facilities as a technology for final disposal of health-care waste. To break into the advantages offered by economies of scale, it is proposed to establish centralized regional facilities with high capacity incinerators. Local authority or private waste disposal contractors should manage these and the proposed sites are:

- Ndola; to cater for the major copperbelt cities/towns
- Chilanga or Kafue; to cater for Kafue, Chilanga and Lusaka.

It is proposed to use a multi-tier system that recognizes the differentials in budgetary provisions and financial constraints with respect to location and catchment population for the health care facilities.

- Small health care facility (bed capacity less than 50)
- Large health care facilities (> 50 bed capacity)
- Regional / centralized waste disposal sites (cover several health care facilities of all sizes within the catchment zone).

5.2 Chemical disinfection

This technology is used in health care to kill microorganisms found on medical equipment, floors, walls and in health-care waste. The process is most suitable for treating liquid waste (blood, urine, stools or hospital sewage) although even solids (microbiological cultures, sharps, etc.) can also be disinfected chemically. It is important to ensure that health-care waste undergoes a preparative process of segregation, shredding and milling prior to application of chemical reagents.

5.3 Wet thermal or steam treatment

Wet thermal disinfection is similar to autoclave sterilization process. It involves exposing shredded infectious waste at high temperature and pressure. It inactivates most microorganisms and biological spores if exposed at an appropriate time (60 minutes) and a minimum of 121°C.

All health-care waste for autoclaving should be segregated to remove unsuitable material. The waste is then shredded to reduce it to an acceptable size. The output from this process is safe for landfill in a municipal waste-dumping site. There is need to exercise maximum care and control when handling wastewater from steam.

Wet thermal or steam treatment is a non-destructive technology, in spite of this it is not recommended for treating special health-care waste (organs, tissues or amputated human body parts)

5.4 Microwave irradiation

Microwave and radio wave irradiation uses high-energy electromagnetic field. Thus water contained within the wastes is rapidly heated by microwaves resulting in the destruction of infectious components of waste through the process of heat conduction. The treatment takes place in an enclosed container at atmospheric pressure and temperatures below normal boiling point, resulting in minimal generation of wastewater. The output from this process is non-hazardous and can be disposed of into landfill at municipal waste dumping sites.

5.5 Land disposal

In situations where there are no means to treat waste before disposal should use SI No. 125 of 2000 which states that “Where a person is generating hazardous waste under these Regulations without a license to treat or pre-treat hazardous waste, that person shall take the hazardous waste to a person licensed to treat hazardous waste on such terms and conditions as the two shall agree”. Allowing health-care waste to accumulate at hospitals or elsewhere constitutes higher risk of transmitting infection than careful disposal in a municipal landfill after pre-treatment.

The primary objections to landfill disposal of untreated hazardous health-care waste, may be based on cultural, religious or on perceived risk of the release of pathogens to air, water or risk of access by scavengers.

Open dumps are often associated with uncontrolled tipping which usually leads to higher risk of disease transmission and free access to scavengers. In the case of sanitary landfills, they are designed to achieve the following:

- Geological isolation of wastes from the environment
- Appropriate engineering preparations before the site is ready to accept wastes
- Staff present on site to control operations
- Organized deposit and daily coverage of waste

a) Encapsulation

Encapsulation is used as an option for disposal of pretreated waste. It uses containers filled with waste such as sharps, chemicals and pharmaceutical residues. The medium (plastic foam, bituminous sand and cement mortar or clay material) is then added to the container together with the waste. Sealed containers are finally disposed of in landfill sites immediately the medium has dried. This technology on its own is not recommended unless it is used in combination with burning of the waste.

b) Safe burial within the premises

The safe burial of waste in health care facility ground is commonly used in institutions that use minimal programs for health-care waste management such as RHCs, refugee camps and in places experiencing exceptional hardship. However, health care facility management should establish basic rules such as:

- Access to the disposal site should be restricted to authorized personnel only
- Burial site should be lined with a material of low permeability to prevent pollution of groundwater.
- Ashes after incineration should receive proper and sound management practice of land disposal because they are still hazardous.

Land disposal may result in ground water pollution if the landfill site is inadequately designed. In choosing a treatment or disposal method for health-care waste, particularly if there is a risk of toxic emissions or other hazardous consequences, the relative risk, as well as the integration into the overall framework of comprehensive waste strategy, should therefore be carefully evaluated in the light of local circumstances.

5.6 Inertization

This process involves mixing waste with a mixture containing lime, cement and water. The mixture helps to minimize risk of contaminating both surface and ground water by toxic substances that are present in the wastes. The mixture can be transported in liquid state to landfill or poured into municipal sewerage system. It is a suitable technology for disposing pharmaceuticals and incineration ashes.

Table 9: Summary of technologies for health-care waste treatment and final disposal

No.	Type of treatment / disposal methods	Advantages	Disadvantages
1.	<p>Incineration: Rotary kiln</p> <p>Pyrolytic incinerator or double-chamber incinerator</p> <p>Single-chamber incinerator</p> <p>Drum and brick incinerator</p>	<ul style="list-style-type: none"> • Adequate for all infectious waste, most chemical waste and pharmaceutical waste. • Very high disinfection efficiency. • Good disinfection efficiency. • Drastic reduction of weight and volume of waste. • The residues may be disposed of in landfills. • No need for highly trained operators. • Relatively low investment and operating cost. • Drastic reduction of weight and volume of the waste. • Very low investment and operation cost. 	<ul style="list-style-type: none"> • High investment and operating cost. • Incomplete destruction of cytotoxics. • Relatively high investment and operating cost. • Significant emissions of atmospheric pollutants. • Need for periodic removal of slag and soot. • Inefficiency in destroying thermally resistant chemicals and drugs such as cytotoxics. • Destroys only 99% of microorganisms. • No destruction of many chemicals and pharmaceuticals. • Massive emission of black smoke, fly ash, toxic flue gas and odours.
2.	Chemical disinfection	<ul style="list-style-type: none"> • Highly efficient disinfection under good operating conditions. • Some chemical disinfectants are relatively inexpensive. • Drastic reduction of weight and volume of 	<ul style="list-style-type: none"> • Requires highly qualified technicians for operation of the process. • Uses hazardous substances that require comprehensive safety measures.

		<ul style="list-style-type: none"> the waste. Environmentally sound. Drastic reduction of weight and volume of the waste. Relatively low investment and operating costs. 	<ul style="list-style-type: none"> Inadequate for pharmaceutical, chemical and some types of infectious waste.
3.	Wet thermal or steam treatment	<ul style="list-style-type: none"> Environmentally sound. Drastic reduction of weight and volume of the waste. Relatively low investment and operating costs. 	<ul style="list-style-type: none"> Shredders are subject to frequent breakdowns and poor functioning. Operation requires qualified technicians Inadequate for anatomical, pharmaceutical and chemical waste and waste that is not readily steam-permeable.
4.	Microwave irradiation	<ul style="list-style-type: none"> Good disinfection efficiency under appropriate operating conditions. Drastic reduction in waste volume. Environmentally sound. 	<ul style="list-style-type: none"> Relatively expensive and operating costs. Potential operation and maintenance problems.
5.	Land disposal: Encapsulation Safe burying	<ul style="list-style-type: none"> Simple, low-cost and safe. May also be applied to pharmaceuticals. Low cost. Relatively safe if access to site is restricted and where natural infiltration is limited. 	<ul style="list-style-type: none"> Not recommended for non-sharp infectious waste. Safe only if access to site is limited and certain precautions are taken.
6.	Inertization	<ul style="list-style-type: none"> Relatively inexpensive. 	<ul style="list-style-type: none"> Not applicable to infectious waste.

Source: WHO, (1999). Safe management of wastes from health-care activities

5.7 Municipal landfills

The disposal of untreated hazardous health-care waste into municipal landfills is not advisable unless it has been found that they genuinely lack means of treating waste before disposal. There are two main types of waste disposal on land and these are open dumps and sanitary landfills.

Landfill technology is the cheapest and most convenient method of waste disposal. It is estimated that over 90% of waste generated in South Africa is deposited in landfills while the figure for the whole world is 80%. Landfill is environmentally acceptable if properly carried out (RSA, 1998). Thus the recommended technology should lead to the selection of an option that is economically and environmentally sound for treatment and final disposal of health-care waste.

NOTE: Health-care waste should not be deposited on or around open dumps.

5.8 Recommended treatment and disposal of health-care waste management

The need for proper handling and final disposal of infectious and other medical waste has become inevitable; and, as a result, several strategies need to be clearly explored. Ownership and responsibility for the waste need to be clearly defined. The involvement of the private sector with strict supervision may also be investigated and explored. In Zambia, the non-availability of well engineered and managed disposal sites poses serious public health concerns and community trust in the safety of methods and technologies to be adopted. In the management of health-care waste, it is critical to ensure that the choice of waste treatment technology and methodologies pose minimal risks to both public health and the environment. The key environmental components that are directly affected by most methods of disposal are air, ground water, surface water and soil. The fact that there is little or no specific data at the national level on health-care waste generation and management, available information clearly indicates an urgent need to conduct a situation and gap analysis.

a) Training needs for health-care waste

The following deficiencies and risk levels were identified during the study:

- Legislation and national health policy to address issues related to health-care waste
- Responsibility for health-care waste planning, implementation, day-to-day operation, information, training, education of staff and contact person towards authority.
- Definitions for health-care waste management which is relevant to health institution in relation to departments and wards
- Definitions of other types of hazardous waste relevant to the health care institution
- Assessment of waste generated in each department / ward according to category in kg per day
- Guidelines on collection, separation and transportation of health-care waste
- Guidelines for registration and reporting the amounts of health-care waste

At the local authority level, the following actors in the health-care waste management require to under go further training in this area in order to effectively prepare them for new responsibilities. These include incinerator operators, road haulage contractors, landfill operators, and refuse collectors and transporters, managers for waste dumpsites and casual workers at dumpsites.

The training should make health-care waste generators aware of potential implications of mismanagement of waste for the health of handlers and patients. Those at risk should be provided with the overall view of the fate of waste after collection and removal from the ward. They should also be taught the importance of proper segregation of different categories of waste. The training programme should be designed in such a way as to

include employees in management, staff in the waste generation sites, waste handlers and all those at risk. The course content should include information on health-care policy, role and responsibility of each health care facility staff and relevant technical instructions on the practices of health-care waste management.

i) Target groups

All individuals or organizations that produce health-care waste should be responsible for its segregation and should therefore receive training in the basic principles and practical applications of segregation. On the job training and sensitization activities should therefore be designed for separate categories of target groups such as:

- Hospital administrators
- Medical, nursing and paramedical staff
- Auxiliary staff and health-care waste handlers
- Local authority workers, dump site managers and incinerator operators
- Scavengers and street kids
- Relatives and friends of those looking after patients

b) Safety matters

Workers who handle health-care wastes are at greatest risk from exposure to the potentially infectious wastes and chemical hazardous wastes. This process starts with persons most at risk such as:

- Doctors, pathologists and dentists
- Nurses, midwives, maids and porters
- Laboratory technicians and pharmacists
- Patients and relatives
- House keeping staff
- Caretakers, drivers and gardeners
- Incinerator operators and dump site workers
- Scavengers, especially women and children at open/unprotected disposal sites both on and off site
- Biophysical environment, especially those near inferior incinerator operating sites and dumps sites.

i) Protection of workers

The process of production, segregation, transportation, treatment and disposal of health-care waste involve handling of potentially hazardous waste. Workers should be protected against injury and all risks associated with hazardous waste.

ii) Cytotoxic safety

An officer should be designated to ensure the safe use of cytotoxic drugs and radioactive materials at all health care facilities handling cytotoxic substances. It is also advisable to ensure that specific guidelines on their safe handling are given.

c) Waste generation

As expanded further in the treatise on study data collection methodology, there is an urgent need to inculcate appropriate behavioural change in health workers at health care facility level. This should be done before developing capacity to collect reliable data on waste stream inventories.

This study has also revealed that many health care facilities require reliable waste disposal facilities. In institutions where incinerators are in use, they should be installed with appropriate emission control devices that will ensure protection of both human health and the environment. It has also been established that dumpsites in many local authorities are operating in deplorable states that require immediate attention. There is urgent need to open up and develop new sites. The selection and designing of new sites should be done in consultation with ECZ and other stakeholders.

d) Proposed technologies for treating health-care waste

Incineration is a method of choice for most hazardous health-care wastes. However, recently developed alternative treatment methods are becoming increasingly popular. The final choice of treatment system should be made carefully, on the basis of various factors, many of which depend on local conditions such as:

- Disinfection efficiency
- Health and environmental considerations
- Volume and mass reduction
- Occupational health and safety considerations
- Quantity of wastes for treatment and disposal/capacity of the system
- Types of waste for treatment and disposal
- Infrastructure requirements
- Locally available treatment options and technologies
- Options available for final disposal
- Training requirements for operation of the method
- Operation and maintenance considerations
- Available space
- Location and surroundings of the treatment site and disposal facility
- Investment and operating costs
- Public acceptability
- Regulatory requirements

Certain treatment options may effectively reduce the infectious hazards of health-care waste but may simultaneously; give rise to other health and environmental hazards.

Land disposal may result in groundwater pollution if the landfill site is inadequately designed. In choosing a treatment or disposal method for health-care waste, particularly if there is a risk of toxic emissions or other hazardous consequences, the relative risks, as

well as the integration into the overall framework of comprehensive waste strategy, should therefore be carefully evaluated in the light of local circumstances.

Most available technologies for destruction, elimination or reduction of infectious and other types of waste will inevitably produce secondary waste streams. When selecting the most appropriate technology for a particular special health-care waste, a review of secondary waste streams and potentially affected population must be conducted. Striking a balance between technology and secondary waste streams while assessing cost benefit and available technologies is a key step in decision making. Successful health-care waste management involves using several technologies at the same site. It is important however, to take note of cultural perceptions regarding health-care waste. At trained traditional birth attendant level, placentas are taken care of using culturally and ethically accepted burial methods of disposal. There are different cultural views and perceptions regarding the handling, transportation, treatment and disposal of health-care waste especially items such as stillborn fetuses, placentas and body parts. It is also important to note that rural health-care waste management practices will be different from urban health care facility waste management practices.

Among technologies available for treatment and disposal of special health-care waste are landfill, incineration, sterilization (including autoclaving and microwave) as well as chemical disinfection. Chemical disinfection, although not highly amenable to hazardous waste, is mostly used for blood, urine, stool as well as hospital sewage in Zambian health care facilities. Autoclaving is used largely as a pre-treatment technology to reduce risk levels in laboratory samples prior to disposal. Placental pits have been largely established as disposal technology exclusively to cater for maternity units for those health care facilities without sophisticated facilities. However, the critical issues of availability of funding, technical competence, non availability of realistic aspects relating to ease of operation and lack of established standard operation procedures have resulted in short cuts being taken. This may lead to increased risk elements. The fact that standards and guidelines on effective use of reliable but complex land filling systems with appropriate lining to prevent leachates have not yet been established shows how far local systems are from the norms as prescribed in modern practice.

The advantages and disadvantages of various treatment and disposal technologies have been discussed above. The following recommendations are made on the type of technologies required at each level of health care.

<i>Type of health institution</i>	<i>Recommended technology at various levels</i>
<ul style="list-style-type: none">• Private health care facilities	<ul style="list-style-type: none">• This will depend on the level and location of the institution i.e. clinic/health centre/ hospital and rural/urban setting
<ul style="list-style-type: none">• Health Post	<ul style="list-style-type: none">• Land disposal with safe burying with provision and use of liners to prevent ground water contamination

- Health Centre (Rural)
 - Land disposal with safe burying with provision and use of liners to prevent ground water contamination
 - Brick incinerator
- Health Centre (Urban)
 - Land disposal with safe burying with provision and use of liners to prevent ground water contamination
 - Chemical disinfection
 - Rotary kiln incinerator
- First Level (District Hospital)
 - As for Urban Health Centre
- Second Level (General Hospital)
 - Land disposal with safe burying with provision and use of liners to prevent ground water contamination
 - Pyrolytic incinerator
 - Chemical disinfection
 - Wet thermal or steam treatment
- Third Level (Central Hospital)
 - Land disposal with safe burying with provision and use of liners to prevent ground water contamination
 - Pyrolytic incinerator
 - Chemical disinfection
 - Wet thermal or steam treatment disinfector
 - Microwave irradiation for teaching hospital
 - One waste collection vehicle per institution
- National Reference (University Teaching Hospital)
 - As for third level, except the number of units will be twice those at level three
 - Two waste collection vehicles
- Regional (centralized) waste disposal sites (Lusaka and Copperbelt provinces)
 - Three at each station of either Pyrolytic incinerator or incinerator 350 to 1000 LA wood / coal fired.
 - Four waste collection and two utility vehicles per station

Note: Health-care waste is a burning problem in Zambia, which can only be addressed by segregation and selecting the right technology.

Table 10: Capacity and characteristics for technologies recommended at each level

Level of institution	Capacity	Technology	Characteristic and maintenance
Health Centre (Rural and Urban)	2 m. deep & filled to a depth of 1-1.5m.	<ul style="list-style-type: none"> Land disposal with safe burying 	<p>Burial site lined with low permeability</p> <p>Suitable for hazardous and quantities of chemical waste</p>
	<p>One bag at a time.</p> <p>100-200 kg/day at 300-400°C</p>	<ul style="list-style-type: none"> Brick incinerator 	<p>Appropriate for infectious and general health-care waste</p> <p>Not suitable for chemical residues, pharmaceutical, genotoxic, radioactive, inorganic compounds, thermal resistant waste, pressurized containers, halogenated plastics and heavy metals</p> <p>Easy to operate but not suitable where air pollution is a problem</p>
First Level (District Hospital)	As above	<ul style="list-style-type: none"> Land disposal with safe burying 	As for health centre
	80°C for 45 mins. 7-73% concentration	<ul style="list-style-type: none"> Chemical disinfection Formaldehyde (HCHO) 	<p>Inactivate microorganisms, used on dry and solid waste with steam</p> <p>Corrosive to metals with exception of stainless steel and aluminium</p> <p>Suitable where safety is guaranteed</p>
	37-55% at 60-80% humidity for 4-12 hrs.	<ul style="list-style-type: none"> Ethylene oxide (CH₂OCH₂) 	<p>As for formaldehyde except it is corrosive to rubber and plastics</p> <p>Not recommended because it irritates the skin, eyes and it is carcinogenic (health hazards)</p>
	2% for 5min. & 10hrs. on spores	<ul style="list-style-type: none"> Glutaraldehyde (CHO-(CH₂)₃CHO) 	<p>As for formaldehyde</p> <p>Not to discharge into sewers</p>

	2-12% active chlorine	<ul style="list-style-type: none"> Sodium hypochlorite (NaOCl) 	<p>Active on bacteria, viruses, & spores but ineffective on blood and stool</p> <p>Corrosive to metal & safe to plastic</p> <p>Mild health hazards</p>
	0.5 to 3 tones/hr. at 1200 – 1600 °C	<ul style="list-style-type: none"> Rotary kiln incinerator 	<p>Appropriate for infectious, chemical and pharmaceutical waste</p> <p>Not suitable for non-risk, radioactive, pressurized containers and heavy metals</p> <p>Require trained personnel</p>
Second Level (General Hospital))	25 (50LA)	<ul style="list-style-type: none"> Land disposal with safe burying 	As for health centre
	200 kg to 10 tons / day at 800-900 °C	<ul style="list-style-type: none"> Pyrolytic incinerator 	<p>Appropriate for infectious, pathological, pharmaceutical and chemical residue waste</p> <p>Not suitable for non-risk, genotoxic, radioactive, pressurized containers and heavy metals</p> <p>Expensive and requires trained personnel to operate and maintain</p> <p>Suitable for larger facilities</p>
	As above	<ul style="list-style-type: none"> Chemical disinfection 	As for First Level
	5-8kg requires 60 mins. At 121°C	<ul style="list-style-type: none"> Wet thermal or steam treatment (autoclaving) 	<p>Inactivate microorganisms. Sterilize reusable medical equipment</p> <p>Suitable for infectious waste & sharps & not pathological, cytotoxic or radioactive wastes</p>
Third Level (Central Hospital) including National Reference (University Teaching Hospital)	As above	<ul style="list-style-type: none"> Land disposal with safe burying 	As for health centre
	As above	<ul style="list-style-type: none"> Pyrolytic incinerator 	As for general hospital
	As above	<ul style="list-style-type: none"> Chemical disinfection 	As for district hospital
	As above	<ul style="list-style-type: none"> Wet thermal or steam treatment 	As for general hospital

	250kg/hr	<ul style="list-style-type: none"> • Microwave irradiation disinfector (teaching hospital) 	Potential operation and maintenance problems
Regional waste disposal site (two centralized incinerators stationed in Lusaka and Copperbelt provinces)	As above	<ul style="list-style-type: none"> • Land disposal with safe burying 	As for health centre
	As above	<ul style="list-style-type: none"> • Chemical disinfection 	As for district hospital
	As above	<ul style="list-style-type: none"> • Pyrolytic incinerator 	As for general hospital
	160kg/hr or one for 500kg/hr 4 - 7hrs / day	<ul style="list-style-type: none"> • Incinerator 350 LA or one for 1000 LA wood/coal fired 	<p>Multiple chamber design with automatic temperature control</p> <p>Hygienically destroy putrescible waste (hospital, abattoir, sewage works, industry, municipalities, etc.)</p> <p>Spare parts readily available in South Africa and requires trained personnel</p>

- NOTE:** 1.The final choice of treatment and disposal should be made carefully after taking into consideration advantages, disadvantages and other factors at play.
2. Use deep pits in rural areas.
3. No disposal of health-care waste for landfill on municipal dumpsites.

e) Regional / centralized incinerator

Most, if not all, final disposal sites in current use at health care facilities were established without assessments on health risk and environmental impacts of health-care waste on human health and environment. All health care facilities in Zambia require to undertake fresh systematic assessments of their health-care waste practices so as to bring them to such level as can be made amenable to proper waste management systems. Of the two proposed centralized sites, local authority that has an interest in the project, and should fit in well with the basic requirements with respect to siting has appropriately surveyed the Ndola site. The project proponents (project proposal submitted to WHO for funding by Ndola city council) have worked out the necessary logistics with respect to safe collection, transportation of health-care waste from institutions that would be availed the services at a fee based on the ‘polluter pays’ principle.

The waste streams from health care facilities, especially those in the higher MoH / CBoH hierarchy have an unquantifiable capacity to pollute. For example, chemical residues discharged untreated into sewage systems may have toxic effects on the operations of biological treatment plants or natural systems receiving waters.

When policy on environmental health is in place with acceptable regulations, guidelines and standards, there is need to develop proposals to use much cheaper landfill practices in remote rural sectors to reduce risks to human health and the environment.

i) Estimate cost benefits using various options

According to Johannessen, L M et al (2000) the estimated investment cost per ton of special health-care waste treatment is as shown below.

<i>Technology</i>	<i>Cost</i>
Incineration (with flue gas control)	120 – 200 000
Chemical disinfection	40 – 125 000
West thermal treatment (autoclaving)	40 – 125 000
Microwave irradiation	120 – 200 000
Landfill disposal	No initial cost because investment cost required for landfills is reflected in the tipping fee, which is about US \$8 – 15 per ton
Inertization	Nil

Source: Johannessen, L. M. et al (2000). Health care guidance note

Treatment and disposal cost per ton of special health-care waste for selected cities ranges from US\$150 / ton in Egypt to US\$1,500 / ton in Germany. Average treatment and disposal costs for special health-care waste for selected cities ranges between US\$0.26 per bed per day in Curitiba (Brazil) to US\$1.45 in Melaka (Malaysia).

In Zambia the provisional production figures for special health-care waste is approximately 9 tons per day (see table 8) countrywide most of which are generated at RHCs. The initial investment costs for both autoclaving as well as irradiation are extremely high. This factor mitigates against the choice of these technologies especially in the face of the rampant non-availability of competent technically qualified personnel to operate and maintain such equipment, plus lack of back up spare parts on the local scene. The afore-mentioned make the acquisition of such technologies out of reach of almost all government run health care facilities.

The RHCs are the least in terms of capacity to generate their own resources from the collection of user fees, and also have the least capacity in staffing strength to handle sophisticated waste treatment and disposal technologies. The majority of Zambians survive on less than one US dollar per day can only afford to spend less than US \$0.33 per patient per month

ii) Cost of health-care waste management

It must be stated that the cost of health-care waste management will vary from one institution to another. This is mainly because of varied problems and constraints in their institutional management practices such as lack of policy and technical guidelines on how to plan and manage health-care waste. Other problems are high costs of transportation, long distances of travel to designated disposal sites, limited number of operating incinerators, limited technical capacity and poor lack of health-care waste data bases.

To implement this plan it is estimated a total budget of about US \$3,580,000 would be required (for details on the calculation see table 13).

f) Legislative, legal and policy aspects

Although there are provisions under Section 67 of the Public Health Act (PHA) dealing with noxious matter, refuse, smoke or nuisances among which health-care waste could easily be classified for enforcement purposes, the local authorities have not effectively enforced the law. There is, therefore an urgent need for retraining of all individuals involved in health-care waste management to change their attitudes. There is also need to develop new specific regulations to deal with health-care waste in its totality using the “cradle to grave” principle by invoking the powers invested in the Minister of Health under Section 114 of the PHA to kick off an orderly inception of administrative mechanisms without having to wait for the approval of the National Environmental Health Policy.

The study also revealed the existence of major gaps in the legislative and administrative arrangements of the health care system in the following areas:

- Lack of written standards for waste operation procedures. Operating standards set out in the form of guidelines should be developed, within the National Environmental Health Policy, to facilitate their operationalisation at each health care facility level.
- Lack of guidelines for the construction of cost-effective and environmental friendly-engineered pits for final disposal technique. The local authorities in collaboration with MoH/CBoH and ECZ, should develop these guidelines.

It is important that as the Zambian health care system voluntarily enters a new phase in its metamorphosis, steps are taken to institute pragmatic mechanisms that will help future policy and administrative developments as follows:

- Urge health care facilities to establish comprehensive data capture systems to avail themselves of a reliable waste generation database.
- Introduce research at local, provincial and national levels on the health and environmental effects of health-care waste treatment technologies.
- Collaborate at sub-regional and international levels, and seek internationally agreed definitions and waste categories.

The MoH/CBoH should work in collaboration with other stakeholders towards the achievement of harmonized international standards so as to arrive at equitable systems designed to:

- Regulate the segregation, storage systems and packaging requirements for hazardous health-care waste for their transportation at local, provincial and national levels
- Regulate alternative and novel treatment technologies for efficacy and emission into the environment
- Improve management of health-care waste

g) Classification of health-care waste

The following classification of health-care waste is based on the Basel Convention on the Trans-Boundary Movement of Hazardous Wastes and their disposal. The system, which is tailored to suit the types of waste generated in the health care sector, is hereby proposed for adoption into Zambian health care system. The pertinent classes are as follows:

Class A1: Health-care waste with similar composition to household and municipal waste. Examples include dressing material, swabs, syringes (without attached needle) and infusion equipment (without spike, bandages, etc).

Waste management guidance requires the imposition of special requirements from the point of generation in the health care facility and the use of double bags or containers made of comparable strong leak-proof material to be used for collection.

Class A2: Normal household and municipal waste.

Class B1: Human anatomical waste. Examples include tissue waste, removed organs, amputated body parts, placentas, etc.

Waste management guidance requires that special requirements be placed on human body parts, organs and tissue. Waste must be collected, in appropriate containers/bags as soon as possible and kept in tight receptacles (e.g. in wooden coffins commonly used in pathology) under cooled conditions for temporary storage, otherwise be handed over to a waste management facility within reasonable time. Waste must be incinerated completely in an appropriate facility, not in a household waste facility.

Where only small quantities are generated, they can be collected in appropriate containers and managed jointly with municipal waste at a volume of up to 0.5l per rubbish bag.

Class B2: Waste sharps include all objects and materials, which are closely linked to health care facility activities and pose a potential risk of injury and/or infection e.g. needles, drain tubes, syringes with attached needle, butterfly needles, spikes, broken glassware, ampoules, pipettes, scalpel blades, lancets and vials without content.

Class B3: Pharmaceutical preparations (e.g. expired / out of date medicines)

Class B4: Cytotoxic pharmaceutical wastes

h) Category of health-care waste

The most important part of health-care waste management is the segregation of waste according to colour of the storage container. This should be done within the health care facility. The following colour coding, type of storage container to be used for different waste category and the following suggested treatment options are recommended for adoption in Zambia.

Table 11: Colour coding and type of containers for health-care waste disposal

Colour coding	Type of storage container and category of waste	Treatment options for health-care waste
Yellow bag (anatomical waste)	Plastic bag: Human anatomical waste (human tissues, organs, body parts) and animal waste (animal tissues, organs, body parts carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary institutions, discharge from hospitals, animal houses).	Incineration or deep burial
Red bag (infectious plastics)	Disinfected container or plastic bag: Microbiology and biotechnology waste (wastes from laboratory cultures, stocks or specimens of micro-organisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biological, toxins, dishes and devices used for transfer of cultures), soiled waste (items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, lines, beddings, other material contaminated with blood), solid waste (wastes generated from disposable items other than the waste sharps such as tubing, catheters, intravenous sets, etc.) and waste sharps (needles, syringes, scalpels, blades, glass, etc. that may cause puncture and cuts. This includes both used and unused sharps).	Autoclave, microwave or chemical disinfection
Black bag	Plastic bag: Discarded medicines and cytotoxic drugs (wastes comprising of outdated, contaminated and discarded medicines), incineration ash (ash from incineration of any bio-medical waste) and chemical waste (chemicals used in production of biological, chemicals used in disinfection, as insecticides, etc.).	Secured landfill

Note: The options proposed above are based on available technologies. Operators wishing to use other technologies should seek authorization from MoH, ECZ and other authorized lead institutions. There is no need for chemical pretreatment before incineration. In the case of deep burial, it should be used in towns with population less than 80,000 and in rural areas.

i) Government ministries and departments

This plan has been prepared to provide information on general health-care waste guidelines with various options to minimize hazardous waste in selected waste streams. However, the waste minimization assessment approach described above can be used to minimize all wastes generated at a facility. This plan is directed towards health care facilities, administrators, regulatory agencies, hospital service organizations, consulting firms and environmental compliance personnel. It is against this background that the following recommendations are made:

i) Ministry of Health

- Ensure that the national environmental health policy is in place with the necessary statutory instruments governing and regulating the management of health-care waste, especially hazardous / special health-care waste.
- Collaborate with local authority agencies to develop byelaws that will deal more strictly with health-care waste.
- In consultation with line ministries, revise and incorporate content of health-care waste management in to curricula for schools and institutions of higher learning.
- Develop health-care waste management plans, which are designed to salvage the capacity of health care facilities and bring them to acceptable levels of sustainability.
- The Environmental impacts of health-care waste include among others the following; air pollution, land degradation/soil pollution, health impacts and water pollution. In order to respond to these challenges, it is recommended that all basic environmental permits and licenses be obtained, for large health care facilities.

ii) Ministry of Local Government and Housing

- Develop capacity building for landfill technology in all local authorities to deal with special types of waste.

iii) Ministry of Tourism, Environmental and Natural Resources

- Review and enact legal framework related to health-care waste management, and ensure its enforcement through ECZ.

iv) Central Board of Health

- Develop a health-care waste management code of conduct and technical guidelines.
- Conduct research to determine the total inventory on the type of wastes generated at all levels of the health care system and assess health and environmental impacts due to technologies on health-care waste treatment.
- Establish health management information systems on waste generation at all health care facilities.

- Establish health-care waste inventories for each facility using the same classification by type of waste.
- Facilitate development of integrated waste management plans for all levels of health care facilities.
- Institute best operating practices, to facilitate waste management procedures.
- Facilitate research in health-care waste characterization related to waste quantities and composition.
- Develop a culture in all health care facilities that will inculcate appropriate behavioral change among stakeholders to enhance success.
- Create health-care waste awareness raising campaigns through the use of electronic and print media (television, radio, pamphlets, posters, leaflets and brochures) to enhance capacity to deal with risks associated with health-care waste.

v) Health care facilities

- Ensure that all health care facilities have in place proper facilities for waste collection, storage, transport, pre-treatment, treatment and final disposal site.
- Choose appropriate, reliable and sustainable technologies for hazardous health-care waste treatment and final disposal in close consultation with stakeholders.
- Ensure that health-care waste is segregated according to colour of the container.

CHAPTER 6: STRATEGIES FOR HEALTH-CARE WASTE MANAGEMENT PLAN

In this plan it is advocated for individual institutions to develop their own waste management plans that are realistic and affordable for implementation. The development of such plans should provide for possible donor / agency support while taking into account

existing conditions, needs and available possibilities for waste management arrangements. An appropriate, safe and cost-effective health-care waste management plan should concentrate on treatment, recycling, transportation and options for final disposal. The process should start with a review of existing waste management arrangements and practices in line with national legislation, policies and guidelines. This should be done in consultation with officials from CBoH, ECZ and the local authority.

This plan emphasizes capacity building of all actors in health-care waste management with a view of building strong institutions, groups or individuals that will be able to manage health-care waste. This process requires acquisition of knowledge and practical management and technical skills. These skills and knowledge will help these officials, groups or individuals to perform their work efficiently to acceptable standards.

6.1 Resources for implementing health-care waste management

Solid waste management is currently being funded through local authorities under the Ministry of Local Government and Housing as a social service that over the years has proved unproductive. The afore-mentioned is made visible by serious problems of incapacity exhibited by councilors to adequately fund the disposal of communal waste. The problem has been made worse by the surge in highly unfriendly waste such as plastics, which are common even in health-care waste. The fact that health care facilities consign special health-care waste to communal waste for disposal sites raises elements of risk. The concept of service charge for waste disposal among governmental agencies is another sticky area because the principle of 'polluter pays' has not yet been implemented. A case in point is the situation that arose between Lusaka City Council (LCC) and University Teaching Hospital (UTH) where LCC's attempt to charge UTH for waste disposal services was unsuccessful because the latter argued that it was not fair or justifiable for LCC to charge UTH because both are government funded/aided. Eventually the two institutions agreed that UTH provides fuel for LCC's collection and transportation costs. This symbiosis is a highly unreliable arrangement because it does not tie down LCC to a consistent time routine, thus the health care facility's waste management programme is in jeopardy.

Financing of health care facilities through the CBoH managed basket funding system cannot immediately provide the needed injection of capital finance required to procure and install reliable equipment for effective management and final disposal. Thus, external financing through CBoH for acquisition of sustainable technology for health-care waste disposal would be most favourable. Thus, where local authority (Ndola city council) has capacity to prepare business proposal for external funding to acquire an incinerator with excess capacity to service neighbouring cities and towns should be encouraged and strongly supported by government.

The participation of private sector entrepreneurs in health-care waste is currently being hampered by non-availability of affordable financing on the local market. The few existing private sector players in communal solid waste disposal have not been successful. Their

unprofessional practices have led to seizure of their operational vehicles by ECZ because of their tendency to flout existing regulations.

Long term public-private partnerships require to be nurtured starting with local entrepreneurs supported by government on a pilot scale level and then eventually venture into applying the 'polluter pays' principle for longer term sustenance. Payment by small hospital and clinic / Rural Health Centers that do not have incinerators can be a source of revenue.

6.2 Critical issues identified in health-care waste management

The critical issues identified are based on data analysis generated during the study and they are as following:

- Inadequacies in the legal, regulatory, policy and administrative framework of health-care waste management and treatment
- Poor health-care waste management practices in health care facilities and local authority disposal sites with regard to handling inclusive of waste pre-treatment, collection, storage, transportation and final disposal
- Lack of research in health-care waste characterization related waste quantities and composition.
- Poor information system on waste generation
- Lack of appropriate equipment and technologies to deal with, health-care waste treatment and final disposal
- Inadequate knowledge and practical skills among those involved in health-care waste management
- Lack of regional / centralized disposal facility to handle large quantities of health-care waste
- Lack of health-care waste activities in District Health Plans
- Lack of awareness on health-care waste among health workers and the general public
- Low segregation of waste according to categories
- Poor management practices at local authority dumpsites
- Lack of collaboration with other stakeholders towards the achievement of harmonized international standards
- Lack of code of conduct and technical guidelines for safety measures

6.3 Priority service target areas

This plan will reach its objectives through activities financed under three components and these are:

- Strengthening public and private sector involvement
- Build management capacity at all levels
- Coordination, monitoring and evaluation of health-care waste management

6.4 Priority areas of concern

1. Strengthen management capacity through improved legislative, regulatory and policy on issues involving health-care waste

Objectives of service area

- Facilitate development of policy in order to guide revision of relevant legislation by the year 2006
 - Establish a comprehensive framework with strong community involvement for effective development of health-care waste management by the year 2004
 - Ensure that all generation sources of infectious and hazardous waste is segregated from communal / non hazardous waste by the year 2004
2. Provide support to the public and private sector on equipment and appropriate technology for each level of handling waste

Objectives of service area

- Ensure that most appropriate environmentally sound transport and disposal methods are applied at all health care facilities and municipal dumpsites by the year 2005
 - Develop and promote research determining types, total inventory of health-care waste and assess its impact on human health and the environment by the year 2006
3. Improve information system of health-care waste within the content of Health Management Information System (HMIS)

Objectives of service area

- Establish and strengthen a coordinated networking into health-care waste management by the year 2005
 - Incorporate statistics into health information system health-care waste by the year 2005
4. Enhance public awareness in health-care waste management

Objectives of service area

- Develop the implementation of communication strategy to create awareness on potential risks associated with health-care waste by the year 2004
- Incorporate into curricula for secondary schools, nursing, paramedical and other institutions of higher learning content of health-care waste by the year 2005
- Promote education component of health-care waste management into Primary Health Care by the year 2005

5. Strengthen monitoring and evaluation of health-care waste management

Objectives of service area

- Ensure financial management systems accountability and transparency through in health-care waste management by the year 2006
- Formulate resource mobilization framework through SWAp by the year 2004
- Develop indicators for reporting by various stakeholders by the year 2004
- Develop monitoring and evaluation system at all levels by the year 2006

Table 12: Health-care waste management plan

1. Priority areas of concern: Strengthen management capacity through improved legislative, regulatory and policy in issues involving health-care waste. Objectives: As outlined above (6.4).		
Strategies	Activities	Verifiable indicators
Providing an efficient and effective health-care waste collection, storage and segregation system in health care facilities	Use and provide appropriate collection, storage and segregation containers at all health care facilities	Each health care facility has a minimum of three (bins / plastic bags) storage containers per ward / unit: 91x12x3 bins/plastic bags for hospital wards. 234x5x3 bins/plastic bags for UHC. 953x2x3 plastic bags for RHC.
Developing a National Environmental Health Policy to deal with management of health-care waste	Develop National Environmental Health Policy to deal with management of health-care waste.	Approved copy of environmental health policy
Revising health sector technical guidelines to include management of hazardous health-care	Revise health sector technical guidelines on management of hazardous health-care	Presence of health sector technical guidelines containing health-care waste
Developing occupational safety guidelines for those involved in handling health-care waste	Develop occupational safety guidelines for health care workers and promote them.	Presence of occupational safety guidelines
Establishing and putting into operation effective institutional and legal framework for health-care waste management	Review and propose amendments to relevant legislations governing and regulating management of health-care waste	10 relevant legislations reviewed Relevant law in place on health-care waste

<p align="center">2. Priority areas of concern: Provide support to public and private sector on equipment and appropriate technology for each level of handling waste. Objectives: As outlined above (6.4).</p>		
Establishing an appropriate cooperative technology for on-site and alternative treatment and final disposal at health care facilities and municipal dumpsites	Provide technology (cooperative, on-site and alternative) for health-care waste treatment and final disposal of health-care at health facilities and disposal sites: 91 x hospitals 1187 x health centres 72 x local authority	75 % of the local authorities and health care facilities use appropriate technologies for HCW disposal. 2 x Cooperative health-care waste treatment established on the
Procure two motor vehicles for transporting health-care waste from generation sites to final disposal	Procure equipment for public / private sector and communities to transport health-care waste.	Two health-care waste motor vehicles procured and stationed on sites
Establishing and promoting research framework to determine total inventory on the types and assess impact of technology on human health and the environment	Conduct research to determine total inventory on the types of waste generated and assess health and environmental impact due to technologies	Number of research themes identified. Number of research reports published
<p align="center">3. Priority areas of concern: Improve health-care waste information system within the content of Health Management Information System (HMIS). Objectives: As outlined above (6.4).</p>		
Conducting supervisory and exchange visits to disposal sites	Conduct supervisory and exchange site visits to disposal sites.	Conduct supervisory visits with each health care facility conducting exchange visits to final disposal sites per year.
Establishing effective networking system with all stakeholders	Health-care waste consultative forum establish & strengthen links between & among stakeholders. Encourage information sharing	Presence of stakeholder forum & reports. No. of stakeholders' meetings & minutes
Establishing statistics into health information system to include health-care waste	Establish health-care waste statistics into health information system	Presence of health-care waste data in health information system

<p align="center">4. Priority areas of concern: Enhance public awareness in health-care waste management.</p> <p align="center">Objectives: As outlined above (6.4).</p>		
Integrating health-care waste education components into all new and ongoing PHC programmes	Scrutinize all new / proposed PHC programmes for appropriate integration of health-care waste components including community management.	No. of new and ongoing PHC programmes with health-care waste management components.
Revising curricula for both secondary schools and institutions of higher learning to incorporate education content for health-care waste	Revise and incorporate content for health-care waste management into curricula for secondary schools and institutions of higher learning. Procure teaching / learning materials.	80 % of curricula for primary and secondary schools and institutions of higher learning (nursing and paramedical staff) reviewed with inclusion of health-care waste management content
Conducting workshops / seminars to sensitize health workers and the general public at all levels	Conduct training sensitizing workshops / seminars for health workers at all levels Conduct advocacy workshops / seminars Conduct promotional programmes for activities	10 national sensitizing workshops / seminars for health workers conducted No. of advocacy strategies developed and implemented. 30 x English and 240 x local vernacular programmes aired. No of cooperating partners supporting various strategies
Developing and producing fliers, brochures, pamphlets, and other appropriate aids on issues of health-care waste	Develop and produce IEC materials (fliers, brochures, pamphlets, and other appropriate aids) on health-care waste issues	5 titles of either fliers, brochures, pamphlets, and other appropriate aids on health-care waste issues are produced
<p align="center">5. Priority areas of concern: Strengthen monitoring and evaluation of health-care waste management.</p> <p align="center">Objectives: As outlined above (6.4).</p>		
Establishing efficient mode of allocating resources for health-care waste management and incorporate it into financial management system	Pilot the system in selected areas and review for purposes of scaling up. Develop criteria for resource allocation	Financial / accounting records. Audit reports. Monthly expenditure

	Review and strengthen audit procedures	returns. National, provincial and district budget. Plans and register of participants.
Developing capacity building programme for resource mobilization framework	Conduct situation analysis. Develop funding framework.	A mount of funds flowing into the sub sector. No. of cooperating partners supporting sub sector.
Establishing reporting system for health-care waste management	Develop standardized formats & guidelines for reporting health-care waste	Set up mechanism for documented publishing & dissemination of health-care waste data Baseline data available
Ensure effective monitoring and evaluation system in place at all levels	Develop monitoring and evaluation system at all levels	80% of institutions at all levels adhering to set standards

CHAPTER 7: MONITORING AND EVALUATION

Monitoring and evaluation is a follow-up on decisions made to intervene in various activities of health-care waste management in order to protect human health and the environment. This can be achieved through periodic internal and external processes of monitoring and evaluation on a continuous basis, at all institutional levels. In this way managements will be able to assess compliance with regulatory requirements at local, national and international levels. In all cases, the issues of concern will be clearly identified.

The following will be used to monitor progress in the achievement of health-care waste management goal and objectives:

- Development of National Environmental Health Policy and technical safety guidelines on health-care waste management
- Enactment of necessary legislation governing, regulating and creating community awareness raising campaigns addressing health-care waste concerns
- Development of relevant institutional arrangements to plan, implement policies and review various curricula for addressing health-care waste concerns
- Development of human resource capacity in all health care facilities and incorporation of health-care waste into HMIS on waste generation
- Development of collaborative mechanisms with social sectors and cooperating partners to finance new of technology
- Development of research capacity and agenda to determine total inventory on the types of waste generated for health-care waste management

7.1 Health-care waste performance monitoring plan

This is a detailed plan for managing the collection of data to monitor performance. It identifies the indicators to be tracked, specifies the source of data, methods of collection and schedule of collection for each piece of datum required and assigns responsibility for collection to specific office, team or individual.

Table 13: Monitoring plan: logical framework matrix

Objective / Output	Key performance indicators	Frequency / means of verification	Cost in US \$
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Goal: To organize and put in place a technically, socially, economically, affordable and acceptable health-care waste management system which will reduce transmission of communicable diseases through indiscriminate disposal of health-care waste at health care facility and dumpsites.

1. Objective: Strengthen management capacity through improved legislative, regulatory and policy in issues involving health-care waste by the year 2005

Ensured all generated infectious and hazardous waste is collection, storage and segregation	Each health care facility has a minimum of three (bins / plastic bags) storage containers per ward. 91x12x3 bins/plastic bags for hospital wards. 234x5x3 bins/plastic bags for UHC. 953x2x3 plastic bags for RHC.	Quarterly returns from District Health Boards to CBoH.	500,000
Facilitated development of policy to guide revision of legislation	A copy for National Environmental Health Policy	Presence of a copy for Environmental Health Policy	50,000
Effective institutional and legal framework for health-care waste management established and functional	10 relevant legislative review meetings held Relevant regulations addressing health-care waste management in place.	Twice per year through provincial returns to CBoH	100,000
Health sector technical guidelines on management of hazardous health-care revised	Presence of health sector technical guidelines for health care workers and their implementation	Once through CBoH annual report to MoH	50,000
Occupational safety guidelines for health	Presence of occupational safety	Once through CBoH annual report to MoH	50,000

care workers developed	guidelines for health care workers and their implementation		
Established comprehensive framework with community involvement	Establish a framework with full community involvement	Number of minutes for meetings held with the community on issues related to health-care waste management	20,000
		Sub Total	770,000
2. Objective: Provide support to public and private sector on equipment and appropriate technology for each level of handling waste by the year 2004			
Ensured appropriate environmentally sound technology and disposal methods are applied	75 % of the local authorities and health care facilities use appropriate technologies for HCW disposal. 2 x Centralized / cooperative stations health-care waste treatment established (one each in Lusaka and Copperbelt)	Quarterly returns from District Health Boards	800,000
Two health-care waste collection motor vehicles procured to transport waste	Two health-care waste collection motor vehicles procured and stationed on sites	Presence of motor vehicles on designate sites	100,000
Developed and promoted research to determine types, total inventory of health-care waste and assess its impact	Number of research themes identified. Number of research reports published	Quarterly returns form District Health Boards, reports from CBoH and presence of research papers at station and CBoH	150,000
		Sub Total	1,050,000
3. Objective: Improve health-care waste information system within the content of Health Management Information System (HMIS) by the year 2004			
Established a strengthened supervisory exchange site visits to disposal sites conducted.	Conduct supervisory visits with each health care facility conducting exchange visits to final disposal sites per year.	Presence of stakeholder forum & reports. No. of stakeholders' meetings & minutes	30,000
Coordinated effective networking system	One stakeholder forum per each district		

established.			
Incorporated statistics into health information system	Presence of health-care waste data in health information system	Quarterly reports containing data on health-care waste generation	20,000
		Sub Total	50,000
4. Objective: Enhance public awareness in health-care waste management by the year 2004			
Promoted education component of health-care waste management into all new and ongoing PHC programmes.	No. of new and ongoing PHC programmes with health-care waste management components.	Presence of health-care waste management components in PHC programmes	10,000
Incorporated into curricula for secondary schools, nursing, paramedical and other institutions of higher learning content of health-care waste.	80 % of curricula for secondary schools nursing, paramedical and other institutions of higher learning are reviewed and contain health-care waste management content	Presence health-care waste content in various training programmes for cadres involved in waste management	700,000
Developed the implementation of communication strategy to create awareness on potential risks through workshops / seminars	10 national sensitizing workshops / seminars for health workers conducted No. of advocacy strategies developed and implemented. 30 x English and 240 x local vernacular programmes aired. No of cooperating partners supporting various strategies	Presence of reports on sensitization workshop at the CBoH Copies of advocacy material in various languages List of cooperating partners supporting	350,000
Developed and produced fliers, brochures, pamphlets, and other appropriate aids on health-care waste issues	5 titles of either fliers, brochures, pamphlets, and other appropriate aids on health-care waste issues are produced	Presence of various materials for sensitizing the health workers and the community in relation to health-care waste	20,000

			Sub Total	1,080,000
5. Objective: Strengthen monitoring and evaluation of health-care waste management by the year 2004				
Ensured accountability and transparency in financial management systems in waste management sector	Financial / accounting records. Number of audited reports and monthly returns on expenditure at all levels. National, provincial and district budget. Plans and register of participants.	Presence at health offices and CBoH audited reports showing proper accountability	500,000	
Formulated resource mobilization framework	A mount of funds flowing into the sub sector. No. of cooperating partners supporting sub sector.	Presence of records showing external support	50,000	
Developed indicators for reporting by various stakeholders	Set up mechanism for documented publishing & dissemination of health-care waste data Baseline data available	Presence of reporting indicators by various stakeholders.	30,000	
Developed monitoring and evaluation systems	80% of institutions at all levels adhering to set standards	Presence of monitoring and evaluation tools at CBoH	50,000	
			Sub Total	630,000
			Grand Total in US \$	3,580,000

Table 14: Gantt chart for health-care waste management plan

No	Activity	2004				2005				2006					
		Quarter				Quarter				Quarter					
1	Use and provide appropriate collection, storage and segregation containers at all health care facilities	X	X	X	X										

2	Develop National Environmental Health Policy to deal with management of health-care waste.											X	X	X
3	Revise health sector technical guidelines on management of hazardous health-care			X	X									
4	Develop occupational safety guidelines for health care workers and promote them.							X	X					
5	Review and propose amendments to relevant legislations governing and regulating management of health-care waste					X	X	X	X	X	X	X	X	X
6	Provide technology (cooperative, on-site and alternative) for health-care waste treatment and final disposal of health-care at health facilities and disposal sites: 91 x hospitals 1187 x health centres 72 x local authority					X	X	X	X	X	X	X	X	X
7	Procure equipment for public / private sector and communities to transport health-care waste.					X	X	X	X	X	X	X	X	X
8	Conduct research to determine total inventory on the types of waste generated and assess health and environmental impact due to technologies	X	X	X	X									
9	Conduct supervisory and exchange site visits to disposal sites. Health-care waste consultative forum establish & strengthen links between & among stakeholders. Encourage information sharing													
10	Establish health-care waste statistics into health information system			X	X									
11	Scrutinize all new / proposed PHC programmes for appropriate integration of health-care waste components including community management.										X	X	X	X
12	Revise and incorporate content for health-care waste management into													

	curricula for secondary schools and institutions of higher learning. Procure teaching / learning materials.	X	X												
13	Conduct training sensitizing workshops / seminars for health workers at all levels Conduct advocacy workshops / seminars Conduct promotional programmes for activities	X	X	X	X	X	X								
14	Develop and produce IEC materials (fliers, brochures, pamphlets, and other appropriate aids) on health-care waste issues							X	X	X	X	X	X		
15	Pilot the system in selected areas and review for purposes of scaling up. Develop criteria for resource allocation Review and strengthen audit procedures	X	X	X	X	X	X								
16	Conduct situation analysis and develop funding framework.	X	X												
17	Develop standardized formats & guidelines for reporting health-care waste	X	X												
18	Develop monitoring and evaluation system at all levels					X	X								

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APPENDICES

1 List of stakeholders consulted

- Churches Health Association of Zambia
- Environmental Council of Zambia
- Zambia Institute of Environmental Health
- Zambia Institute of Waste Management

2 List of districts per province and number of health care facilities

District	Health centre		First level (district)	Hospital Second level (general)	Third level (central and teaching)	Total beds and cots
	Rural health centre	Urban health centre				
Central Province						
Chibombo	23	0	1	0	0	335
Kabwe Urban	3	16	0	2	0	724
Kapiri Mposhi	16	2	1	0	0	227

Mkushi	11	0	1	0	0	237
Mumbwa	19	2	1	0	0	262
Serenje	13	0	2	0	0	312
Sub-Total	85	20	6	2	0	2,100

Cooperbelt Province

Chililabombwe	0	10	1	0	0	223
Chingola	1	12	1	1	0	666
Kalulushi	3	8	1	0	0	225
Kitwe	0	34	0	0	1	1,398
Luanshya	1	19	1	0	0	742
Lufwanyama	0	13	0	0	0	122
Masaiti	0	18	0	0	0	152
Mpongwe	0	10	0	0	0	272
Mufulira	3	18	1	1	0	512
Ndola Urban	0	38	0	0	1	1,358
Sub Total	8	170	5	2	2	5,670

Eastern Province

Chadidza	12	0	0	0	0	247
Chama	16	0	0	0	0	125
Chipata	32	1	0	1	0	963
Katete	15	0	0	0	0	581
Lundazi	20	0	1	0	0	482
Mambwe	6	0	0	0	0	131
Nyimba	11	0	1	0	0	161
Petauke	24	0	1	0	0	671
Sub Total	136	1	3	1	0	3,363

Luapula Province

Chiengi	6	0	0	0	0	63
Kawambwa	19	0	1	0	0	251
Mansa	24	2	0	1	0	565
Milenge	6	0	0	0	0	70
Mwense	12	0	0	0	0	344
Nchelenge	8	0	0	0	0	331
Samfya	20	0	0	0	0	381
Sub Total	95	2	1	1	0	1,955

Lusaka Province

Chongwe	27	0	0	0	0	179
Kafue	25	0	0	0	0	123
Luangwa	8	0	0	0	0	123
Lusaka Urban	0	34	0	0	1	3,123
Sub Total	56	34	0	0	1	3,548

Northern Province

Chilubi	8	0	0	0	0	97
Chinsali	14	0	1	0	0	351
Isoka	9	0	1	0	0	156
Kaputa	8	0	0	0	0	80
Kasama	18	2	0	1	0	647
Luwingu	10	0	1	0	0	129

Mbala	16	0	0	1	0	526
Mpika	21	0	1	0	0	503
Mporokoso	11	0	1	0	0	156
Mpulungu	7	0	0	0	0	97
Mungwi	13	0	0	0	0	223
Nakonde	9	0	0	0	0	97
Sub Total	144	2	5	2	0	3,055
North Western Province						
Chavuma	6	0	0	0	0	228
Kabompo	11	0	2	0	0	419
Kasempa	14	0	0	0	0	264
Mwinilunga	18	0	1	0	0	395
Solwezi	36	3	0	1	0	737
Zambezi	7	0	1	0	0	426
Mufumbwe	11	0	0	0	0	78
Sub Total	103	3	4	1	0	2,537
Southern Province						
Choma	30	1	0	1	0	763
Gwembe	9	0	1	0	0	151
Kalomo	26	0	1	0	0	410
Kazungula	14	0	0	0	0	104
Livingstone	0	12	0	1	0	574
Mazabuka	26	3	1	0	0	984
Monze	23	1	0	0	0	568
Namwala	12	0	1	0	0	118
Itezhi-tezhi	12	0	1	0	0	93
Siavonga	14	0	1	0	0	274
Sinazongwe	12	0	1	0	0	356
Sub Total	178	17	7	2	0	4,405
Western Province						
Kalabo	14	0	1	0	0	361
Kaoma	20	0	1	0	0	401
Lukulu	12	0	0	0	0	156
Mongu	24	3	0	1	0	426
Senanga	13	0	1	0	0	280
Sesheke	13	0	1	0	0	337
Shangombo	12	0	0	0	0	105
Sub Total	108	3	4	1	0	2,066
Grand Total	913	252	35	12	3	28,699

Note: Source MoH (2003); Total Hospitals 91(50 x GRZ; 28 Mission; 13 Private)
Source MoH (2003); Total Health Centres 1,187 (1 165 GRZ; 23 Mission/Private)

3 List of participants to consultative meeting (Mulungushi International Conference Centre 4 to 5th November 2002)

Name	Station	Post
F Mbewe	World Bank: Min. of Finance	Programmes coordinator

G. K. Bola	National AIDS Council	Director General
R. M. Sunkutu	Central Board of Health	Director PH& Research
J Munkomba	University Teaching Hospital	Env. Health Technologist
D Squarre	PHO - Eastern	Environmental Health Specialist
C Siame	PHO - Central	Environmental Health Specialist
C.Chinyama	Chongwe DHMT	District Director of Health
A S Ngulube	Ministry of Health	A/CPA Environmental Health
P Katoti	Ndola City Council	Director Public and Health
T J Bbuku	Central Board of Health	Medical Equipment Officer
G Kahenya	Central Board of Health	Laboratory Specialist
C Malijani	Ministry of Health	CPA (Food/ C/ M)
B Mwape	Central Board of Health	Medical Imaging Specialist
D S Mwewa	Ministry of Health	CPA (Nursing Services)
M. M. Mbea	University Teaching Hospital	Director of Nursing
R. Mukandawire	University Teaching Hospital	Senior Nursing Officer
Lt. G. Kasonde	MSMH	Senior Nursing Officer
C. K. Melele	Central Board of Health	Health Promotion Specialist
M. Mwale	Ministry of Health	CPA (Medical Equipment)
Z. Mutinta	St. Johns MC	Nurse Superintendent
F. M. Goma	St. Johns MC	Chief Medical Officer
S. Kunda	MLGH- Lusaka	Community Health Expert
M. Phiri	Zambia Information Service	Journalist
R. M. Chitembure	Ministry of Health	Senior Statistician
M. S. Mazhamo	Food & Drugs Control Lab.	A/ Consultant
G. E. Mundia	Food & Drugs Control Lab.	Principal Analyst
C. Sichone	Ministry of Health	Director Health Policy
R. M. Kampamba	Ministry of Health	Pharmacist
E. Sinyinza	Central Board of Health	Disease Control Specialist
M. Moonga	Central Board of Health	Health Mgt. Specialist
E. Munkonze	Central Board of Health	Quality Assurance Specialist
E. Banda	Central Board of Health	Doc. & Statistics Specialist
M. K. Bwalya	Central Board of Health	A/ Child Health Specialist
R. Lifuka	Solid waste & sanitation	Consultant
C. Chilufya	University Teaching Hospital	Env. Health Technologist
S. N. Sizimbulwe	University Teaching Hospital	A/ Admin. Officer
V. C. Mukonka	Central Board of Health	A/ DCCD
J. Chileshe	Dev. & Env MLGH.	Consultant
J. Nikisi	Central Board of Health	Clinical Care Specialist
A. S. Sinonge	Central Board of Health	Senior Admin. Officer
C. Malijani	Ministry of Health	CPA Food/Cosmetics/Medical
D. Mulenga	KGH/ KMH	Executive Director

4 List of individuals consulted

Name	Position	Station / Location
R Sunkutu	Director P H and Research	Central Board of Health

F Nyirenda	Environmental Health Specialist	Central Board of Health
C K Melele	Health Promotion Specialist	Central Board of Health
E Banda	Documentation & Statistics Specialist	Central Board of Health
K Ngoma	Health Planner & Costing Specialist	Central Board of Health
R Maswenyeho	Chief Accountant	Central Board of Health
G Bola	Director General	National AIDS Council
E Sinkamba	Director, Programmes	National AIDS Council
Dr. H Ng'uni	Director	Solwezi DHM Board
E Samu	Environmental Health Technologist,	Solwezi DHMT
G Hazuze	A/ Senior Principal Health Inspector	Solwezi DHMT
Mwalimu	Office Manager	PHO Solwezi
L Nyirenda	Data Management Specialist,	PHO Solwezi
W Kapila	District Council	P/Health Dept.
S Kunda	Executive Director	Solwezi General Hospital
J Moonga	Hospital Administrator	Solwezi General Hospital
Sister Njovu	Night Superintendent	Solwezi General Hospital
D Chipulu	Senior Pharmacy Technician	Solwezi General Hospital
K Kalunga	Pharmacy Technician	Solwezi General Hospital
E Simwanza	Acting Stores Manager	Solwezi General Hospital
C Ngambi	Executive Director	Kitwe Cententral Hospital
T Chalwe	General Hospital Manager	Kitwe Cententral Hospital
E H Mwape	Clients Relations Manager	Kitwe Cententral Hospital
C Temba	Manager, Purchasing & Supplies	Kitwe Cententral Hospital
C Mocha	Supplies Officer	Kitwe Cententral Hospital
G Phiri	Catering Supervisor	Kitwe Cententral Hospital
F Mtambirwa	Senior Radiographer	Kitwe Cententral Hospital
S Addo	Acting Chief Laboratory Technician	Kitwe Cententral Hospital
F Moonga	Health Inspector	Kitwe City Council
S Phiri	Executive Director	Arthur Davis Hospital
C Mhango	Matron	Arthur Davis Hospital
S Siame	Human Resource Manager	Arthur Davis Hospital
D Sondashi	Pharmacy Technologist	Arthur Davis Hospital
W Zimba	Assistant Clerical Officer	Arthur Davis Hospital
F Mulumbwa	Acting Head – Laboratory	Arthur Davis Hospital
Nyendwa	Chairman – Infection Control Committ	Arthur Davis Hospital
M Sikavizye	Stores Officer	Arthur Davis Hospital
P Katoti	Director, Public Health Department	Ndola City Council
C N Kande	Medical Superintendent	Liteta leprosarium Hospital
A Kaumba	Principal Clinical Officer	Liteta leprosarium Hospital
P K Muchaya	Senior Clinical Officer	Liteta leprosarium Hospital
A Mafulauzi	Senior Env. Health Technician	Liteta leprosarium Hospital
Dr. Lubahita	Executive Director	Chipata General Hospital
Luhanga	Hospital Administrator	Chipata General Hospital
Musonda	Senior Env. Health Technician	Chipata General Hospital
Mr Banda	Hospital Administrator	Lundazi District Hospital
Mr Mpanza	Clinical Officer	Kamoto Mission

Mrs Phiri	Nurse	Kamoto Mission
J. Khunga	Manager Planning	Mambwe DHM Board
J. K Chizabo	Acting District Director	Chama DHM Board
A. Kamanzi	Medical Officer in Charge	Chama Stage II
T Lambart	Managing Director	University teaching Hospt.
K Nangana	Administration Manager	University Teaching Hospt.
Sr. Mbewe	Director – Nursing Services	University Teaching Hospt.
P Mbangweta	Public Relations Manager	University Teaching Hospt.
K Makukula	Customer Relations Officer	University Teaching Hospt.
G Munkomba	Environmental Health Technician	University Teaching Hospt.
Mr. Daka	Engineering Department..	University Teaching Hospt.
Mr Siwila	Incinerator Supervisor	University Teaching Hospt.
Lwenje Zulu	Incinerator Operators	University Teaching Hospt.
E kandawire	Catering Officer	University. Teaching Hosp
W Njovu	Medical & Surgical Stock Controller	University Teaching Hospt.
Y. Siulapwa	Lecturer	Evelyn Hone College
F.W. Muwanei	Lecturer	Chainama College
M. M.Chikoya	Manager, Planning & Development	Lusaka DHM Board
E C Musonda	Manager, Administration	Lusaka DHM Board
R Munkomba	Nursing Sister	Chipata UHC Lusaka DHB
Sr. Mulemwa	Registered Nurse	Chipata UHC Lusaka DHB
J Mataa	Environmental Health Technician	Chipata UHC Lusaka DHB
E Kabila	Laboratory Technician	Chipata UHC Lusaka DHB
C Kapembwa	Nurse	Chipata UHC Lusaka DHB
M Mwankotami	Catering Officer	Chipata UHC Lusaka DHB
R Tembo	Incinerator Operator	Chipata UHC Lusaka DHB
J Goma	Chief Medical Officer	St. John’s Medical Centre
N Kwaleyela	Nursing Sister	St. John’s Medical Centre
W Kaonga	Medical Officer	Mwandi Mission Hospital
G Nchukwa	Environmental Health Technician	Mwandi Mission Hospital
J Jensen	Medical Officer	Yeta General Hospital
A Sitali	Sister-In-Charge	Kazungula RHC
R Njambila	Health Inspector	Kazungula RHC
C Phiri	Executive Director	Livingstone General Hospt.
N Kaiko	Hospital Administrator	Livingstone General Hospt.
Mr. Mtonga	Environmental Health Technician	Livingstone General Hospt.
J Chinyonga	District Director of Health	Livingstone D H M Board
Mr. Chisanga	Acting Public Health Director	Livingstone City Council
M Musenga	Environmental Health Technician	Livingstone City Council
J Banda	District Director	Kalomo D H M Board
P Monji	Medical Officer	Kalomo District Hospital
P Sikatulu	Principal Clinical Officer	Kalomo District Hospital
K Mwilima	Records Officer	Kalomo District Hospital
B Munenga	Environmental Health Technician	Kalomo District Hospital
J Banda	District Director	Monze DHM Board
A Mutunda	Health Information Officer	Monze DHM Board

F Matakala Clinical Officer
Mrs. Mutale Hospital Administrator
G Mwiche Medical Superintendent
R L Mungalu Hospital Administrator
A H Chiyobela Nursing Sister

Monze Urban Clinic
Monze Mission Hospital
Mazabuka District Hospital
Mazabuka District Hospital
Mazabuka District Hospital