Needs Assessment for Hospitals in African Countries in Relation to Infectious Waste Treatment

Final Report

Demonstrating and Promoting Best Techniques and Practices for Reducing Health Care Waste to Avoid Environmental Releases of Dioxins and Mercury

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EXECUTIVE SUMMARY

Demonstrating and promoting best techniques and practices for reducing health care waste to avoid environmental releases of dioxins and mercury is the initiative funded by the Global Environmental Facility (GEF) - through the United Nations Development Programme (UNDP), World Health Organization (WHO) and Health Care Without Harm (HCWH).

The proposed Project is a global demonstration project that is being implemented in seven countries: Argentina, India, Latvia, Lebanon, Philippines, Senegal and Vietnam. The Project has an additional component to be executed mainly in Tanzania that will develop, test and disseminate affordable non-burn health-care waste treatment technologies that can be built and serviced in Sub-Saharan African countries using locally available supplies and skills.

The broad objective of the assessment was to identify the requirements in relation to infectious waste treatment for hospitals in low-income African countries. The study therefore identified types of hospitals, range or average number of beds; determined amount of waste generated in hospitals; identified costs of materials related to healthcare waste management [e.g. typical costs of sharps containers, plastic bags, pressure cookers, small locally-built incinerators, electricity, bottled gas, etc.]; and assessed the availability of skills & materials, land disposal issues, and regulations related to healthcare waste and treatment requirements.

This rapid assessment included a search for literature and documents on healthcare waste management (HCWM) in various African Countries. Questionnaires and check lists were administered to request information through International POPs Elimination Network (IPEN), Global Anti-Incineration Alliance (GAIA) and Health Care Without Harm (HCWH) networks members in Botswana, Eritrea, Gambia, Ghana, Kenya, Lesotho, Nigeria, Senegal, South Africa, Tanzania, Uganda, and Zambia.

The study findings indicate that Africa has over 67,740 of healthcare facilities (HCFs) with different levels of capacity whose waste disposal needs to be taken into consideration. The generation of waste in Africa varies considerably between same levels of HCFs due to waste management methods, type of HCFs, proportion of patients treated daily and the degree of specialization of the health facility. In some countries surveyed, e.g. Gambia, Lesotho, the waste generation data shows that the ratio of infectious waste and general is almost 1:1; in Kenya the amount of infectious waste is higher than the general waste which indicates lack of proper segregation of waste. In South Africa and Zambia the situation is vice versa which indicates segregation is practiced to the satisfactory level.

Many of HCFs lack specific budget for Health Care Waste Management (HCWM) and depend much on the government budget to run various services including that of having a HCWM system. In surveyed countries the cost of sharp boxes ranges between 0.3

USD and 15 USD; bins ranges between 15 and 40 USD, liners between 0.125 USD and 6 USD.

Africa is estimated to have more than 1,000 incinerators. The capital costs range between 1,000 USD and 12,677 USD for the De Montfort type and reaches USD 250,582 for sophisticated ones. Construction costs depend on a number of factors, especially the availability and cost of refractory bricks, metal and metal-working facilities. Many of these incinerators have been reported inoperative or operating below standards. In some hospitals they have re-built their incinerators in a number of times due to frequently break down.

Many of countries surveyed lack elaborated legal policy specifically for HCW; institutional framework for HCWM in HCFs; and proper sanitary landfills that can provide geographical isolation of wastes from the environment, appropriate engineering preparations before the site is ready to accept wastes, staff to control operations and an organized deposit and daily coverage of waste.

The study recommends that issues identified in this study should be clearly considered when designing the technology for the GEF project and laying down strategies for up-scaling in various countries in Africa.

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ABBREVIATIONS

AFPRC	Arm Forces Provisional Ruling Council Hospital
AGENDA	AGENDA for Environment and Responsible Development
BDC	Bagamoyo District Hospital
CoET	Collage of Engineering and Technology
GAIA	Global Anti-Incineration Alliance
GEF	Global Environmental Facility
GOK	Government of Kenya
HCFs	Healthcare facilities
HCW	Healthcare Waste
HCWH	Health Care Without Harm
HCWM	health care waste management
IPEN	International POPs Elimination Network
JSI	John Snow Inc
KZN	Kwa-Zulu Natal
MoHSW	Ministry of Healthy and Social Welfare
NGOs	Non-Governmental Organizations
PHC	Primary Health Care
RVTH	Royal Victoria Teaching Hospital
TDTC	Technology Development and Transfer Centre
UNDP	United Nations Development Programme
USD	United States of America Dollar
WHO	World Health Organization

1.0 INTRODUCTION

Demonstrating and promoting best techniques and practices for reducing health care waste to avoid environmental releases of dioxins and mercury is the initiative funded by the Global Environmental Facility (GEF) - through the United Nations Development Programme (UNDP), World Health Organization (WHO) and Health Care Without Harm (HCWH).

The proposed Project is a global demonstration project that is being implemented in seven countries: Argentina, India, Latvia, Lebanon, Philippines, Senegal and Vietnam. The Project has an additional component that is executed in Tanzania where the team has been set to develop, test and disseminate affordable non-burn health-care waste treatment technologies that can be built and serviced in Sub-Saharan African countries using locally available supplies and skills.

The Tanzania component is executed by the University of Dar es Salaam in part through the Technology Development and Transfer Centre (TDTC) of the College of Engineering and Technology (CoET) in collaboration with AGENDA for Environment and Responsible Development (AGENDA), John Snow Inc (JSI) and Bagamoyo District Hospital (BDC).

As part of the process of developing the criteria for design on the technology, the rapid needs assessment was conducted by AGENDA in collaboration with University of Dar es Salaam to identify the requirements for hospitals in low-income African countries.

This report therefore, provides information on number of Health care facilities (HCFs), types of hospitals/health care facility, range or average number of beds for each hospital/health care facility type, types and amounts of waste per bed per day both for medium hospitals and small health care facilities, typical sizes of waste containers (sharp containers, waste collection bins) used in hospitals, costs of materials related to health-care waste management (i.e. typical costs of sharps containers, plastic bags/liners, waste collection bins, small locally-built incinerators, protective equipments for waste handlers), land disposal issues and regulations related to healthcare waste and treatment requirements specifically in various countries in Africa.

1.1 Methodology

Information required for the needs assessment was obtained through

- A search and collection of documents on health care waste management (HCWM), health structures/frameworks, regulatory frameworks for various African countries
- Questionnaires administered to request information through International POPs Elimination Network (IPEN), Global Anti-Incineration Alliance (GAIA) and HCWH networks members and other various actors in health sector in Botswana,

Eritrea, Gambia, Ghana, Kenya, Lesotho, Nigeria, South Africa, Tanzania, Uganda, and Zambia. Egypt, Malawi and Mozambique.
- Consultation with the Ministry of Health and Social Welfare in Tanzania and visits to several hospitals in Tanzania for data collection
- Assessment of all data collected.

1.2 Objectives

The overall objective of the study was to assess the requirements for hospitals in low-income African countries in health care waste management.

Specifically the assessment focused on

- Identifying types of hospitals, range or average number of beds;
- Determining amounts of waste generated in hospitals;
- Identifying costs of materials related to healthcare waste management [e.g. typical costs of sharps containers, plastic bags, pressure cookers, small locally-built incinerators, electricity, bottled gas, etc.]; and
- Assessing the availability of skills & materials, land disposal issues, regulations related to healthcare waste and treatment requirements

This information was primarily collected so as to provide baseline information needed to estimates the capacities, costs and manufacturability of the autoclave, shredder and sharp containers.

2.0 HEALTH CARE FACILITIES IN AFRICA

2.1 Statistics of Hospitals in African Countries

In Africa the health sector comprises in large extent the public health care providers under the auspices of the Ministry of Health. Other health care provides include religious organizations, NGOs, and the private sector that usually compliment the efforts of the public health facilities in delivering health care services.

In many countries the structure of the health services delivery system is hierarchical with dispensaries, health centres, clinics and health posts at the base forming the contact with the community into the health care system. The provincial and district hospitals provide both referral and outpatient services in addition to the requisite technical backstopping to the facilities at the periphery. Referral hospitals provide the highest specialized health care services for patients whose conditions cannot be managed at the above mentioned basic health facilities.

Many African countries have recognized the importance of good health of their respective nations and have given it a high priority. Most Governments have adopted a Primary Health Care (PHC) approach and expanded rapidly the number of health care facilities. Tables 2.1 to 2.7 below show the number of health care facilities in various countries.

Table 2.1: Number of Health Care facilities in Africa

Country	Hospitals (Major)	Hospitals (small)	Primary Health Centres	Remote Health Centre	Total HCFs
Algeria[a]	72	645	2152	4303	7172
Angola[a]	19	167	555	1111	1851
Benin[a]	2	18	61	122	204
Botswana	See Table 2.2 below				
Burkina Faso[a]	13	13	378	756	1260
Burundi[a]	7	59	198	396	660
Cameroon[a]	17	157	522	1044	1740
Cape Verde[a]	2	21	71	143	238
Central Africa Republic[a]	6	54	181	362	603
Chad[a]	6	58	192	383	639
Comoros[a]	1	6	20	41	68
Congo	Not available				
Côte d'Ivoire[a]	14	130	432	864	1440
Democratic Republic of Congo	Not available				
Djibouti[a]	0	4	14	28	47
Egypt[a]	54	489	1628	3257	5428
Equatorial Guinea[a]	3	29	97	194	324

Eritrea[a]	4	37	122	244	406
Ethopia[a]	74	666	2220	4440	7400
Gabon[a]	35	314	1045	2090	3484
Gambia[b]	See Table 2.3 below				
Ghana[a]	24	216	720	1440	2400
Guinea[a]	11	95	318	637	1061
Guinea-Bissau[a]	1	13	43	86	143
Kenya[c]	See Table 2.4 below				
Lesotho	2	17	56	111	185
Liberia[a]	1	5	15	30	50
Lybia[a]	15	137	456	912	1520
Madagascar[a]	32	290	966	1931	3219
Malawi	6	51	171	342	570
Mali[a]	50	450	1500	3000	5000
Mauritania[a]	9	78	260	520	866
Mauritius[a]	1	13	44	82	147
Morocco[a]	28	250	832	1664	2774
Mozambique[a]	13	115	383	766	1276
Namibia[a]	4	37	122	245	408
Niger[a]	27	246	819	1638	2730
Nigeria	See Table 2.5 below				
Rwanda[a]	4	37	124	248	414
Sao Tome and Principe[a]	1	6	19	38	63
Senegal[a]	See Table 2.6 below				
Seychelles[a]	0	1	5	10	16
Sierra Leone	Not available				
Somalia	Not available				
South Africa	See Table 2.7 below				
Sudan[a]	357	1016	1661	2404	5438
Swaziland	Not available				
Tanzania[a]	59	351	1771	3542	5904
Togo[a]	5	47	158	315	525
Tunisia	Not available				
Uganda[a]	129	1157	3858	7716	12860
Zambia	See Table 2.8 below				
Zimbabwe[a]	13	121	403	805	1342
Total					**67,740**

Source: Africa Health Inforway, eHealth solutions for districts in Africa 2008-2013

2.1.1 Botswana

Table 2.2: Health facilities by type in 2003

Type of HCF	Total Number
General Hospitals	16
Primary Hospitals	17
Clinics	257
Health Posts	336
Mobile Stops	761
Total	**1387**

Source: Botswana Ministry of Health Webpage (www.gov.bw) – (November 2008)

2.1.2 Gambia

Table 2.3: Distribution of Public, Private and NGO Health Facilities in Gambia in 2005

	WD, KMC, BCC	NBW	LRD	NBE	CRD	URD	TOTAL
Population	**803,930**	97,469	74,349	106,476	185,107	209,256	1,476,587
	Public	Public	Public	Public	Public	Public	Public
Hospital	2	0	0	1	1	0	4
Major H/C	2	1	1	0	1	1	6
Minor H/C	4	1	2	1	2	3	13
Dispensary	4	1	1	2	5	3	16
Total Public (Government) Health Facilities							**39**
NGO/Private clinics including others	27	2	1	2	2	0	**34**

Source: Gambia - The National Health Care Waste Management Plan, September 2005

2.1.3 Kenya

Table 2.4: List of Health Care Facilities in Kenya

Facility type	Government		NGO		PRIVATE		Total
	Number	%	Number	%	Number	%	
Hospital	139	50	67	30.7	42	19.3	218
Health centre	460	80	100	17.4.	15	2.6	575
Dispensary	1537	60.9	595	23.6	391	15.5	2523
Nursing & maternity home	0	0.0	11	58	180	94.2	191
Health clinics /medical centres	43	0.1	72	10.2	592	83.7	707
Total	**2158**	**51.0**	**845**	**20.1**	**1220**	**29.0**	**4214**

Source: Kenya - National Health Care Waste Management Plan 2006-2015

2.1.4 Nigeria

Table 2.5: Number of HCFs in Nigeria in 2007

Zone	Number of LGAs	Teaching Hospital	General Hospital	Maternity Hospital	Clinic	Clinic Psychiatric Hospital	Orthopedic Hospital	Others	Total
North - East	112	1	120	116	459	1	0	1062	1759
North - West	186	5	115	39	405	1	1	2134	2700
North - Centre	121	6	97	241	4100	2	1	144	4591
South - East	95	8	552	798	744	3	7	646	2758
South - West	134	10	95	526	1175	6	1	624	2437
South -	126	9	152	143	761	3	0	1077	2145

South									
Nigeria	774	48	1106	2273	8360	21	11	5249	17068

Source: National Bureau of Statistics – Directory of Health Establishments in Nigeria, 2007

2.1.5 Senegal

Table 2.6: Number of HCFs in Senegal

Type	Characteristic	Number
National Hospital	Level 3 Hospital	9
Regional Hospital	Level 2 Hospital	10
District Hospital	Health Center	90
Health Post	Primary health Center	1000

Source: Dr. Ndoye *et al.*, 2009

2.1.6 South Africa

Table 2.7: Summary of number of hospitals and clinics in South Africa

Type of HCF	Ownership	Number	Total
Hospitals	Public	422	**836**
	Non-public	414	
Clinics	Public	3225	**3501**
	Non-public	276	
Total			**4337**

Source: Projection of hospital and clinic health care risk waste generation quantities and treatment capacities for the South African national waste management strategy implementation project 2006, by Rogers DEC, Molefe S, Gcwensa Q, Van Den Bergh C, Kristiannsen T, and Otto JB

2.1.7 Zambia

Table 2.8: Summary of Hospitals by Level and Ownership in Zambia

Facility Type		**GRZ**	**Private**	**Mission**	**Total no. of Facilities**	
					No.	**%**
Level 3 Hosp		5	0	0	5	0.3
Level 2 Hosp.		13	5	3	21	1.0
Level 1 Hosp.		39	4	29	72	5.0
Health Center	Rural HC	930	22	77	1,029	66.0
	Urban HC	206	53	6	265	17.0
Heath Posts		161	8	2	171	11.0
Total		**1,354**	**92**	**117**	**1,563**	**100**

Source: Health Institutions in Zambia, A Listing of Health Facilities According to Levels & Location for 2008, Ministry of Healthy, Lusaka, Zambia, February 2008

2.2 Capacity of Hospitals in African Countries

2.2.1 Botswana

Table 2.9: Health facilities by type and number of beds

Type of HCFs	Total Number of HCFs	Total Number of Beds	Average number of bed per HCF
General Hospitals	16	2,634	164.6
Primary Hospitals	17	685	40
Clinics	257	497	1.93

Source: Botswana Ministry of Health Webpage (www.gov.bw) – (November 2008)

2.2.2 Eritrea

Table 2.10: Number beds by HCF in Eritrea

Category	Number of beds	Number of serviced patients
Health Stations		10,000
Health Centres	20 - 30 beds	50,000
Secondary or Zoba Level Health Services		50,000 – 200,000
Tertiary or National Health Services		More than 200,000

Source: Eritrea: National Health-Care Waste Management Plan, 2004

2.2.3 Gambia

Table 2.11: Number beds by HCF in Gambia

Type of HCF	Number of beds
Major Health Facilities	557
	35-40
Regional Hospitals	150-200
Health Center	
Major Clinics	7-48

Source: The Gambia National Health Care Waste Management Plan, September 2005

2.2.4 Ghana

Table 2.12: Number of Hospital Beds by Region and Ownership

REGION	GOVT	QUASI GOVT	CHAG	MUSLIM	PRIVATE	TOTAL
WESTERN	1,192	300	439	49	-	**1,980**
CENTRAL	1,289	47	369	32	-	**1,737**
GREATER ACCRA	3,046	759	29	-	593	**4,427**
VOLTA	1,208	47	958	-	-	**2,213**
EASTERN	1,505	177	993	-	-	**2,675**
ASHANTI	1,929	202	1,145	130	594	**4,000**
BRONG AHAFO	606	44	1,090	68	9	**1,817**
NORTHERN	767	-	362	-	-	**1,129**
UPPER EAST	530	-	297	-	-	**827**

UPPER WEST	346	-	336	-	-	**682**
GRAND TOTAL	**12,418**	**1,576**	**6,018**	**279**	**1,196**	**21,487**

Source: www.moh-ghana.org (November 2008)

2.2.5 Kenya

Table 2.13: Number of beds in HCFs in different provinces in Kenya

PROVINCE	GOK	NGO/PRIVATE	ALL METERNITY	TOTAL BEDS
Central	2364	1984	1195	5543
Nairobi	10528	0	0	10528
North Eastern	472	252	30	754
Eastern	4222	2265	1200	7687
Rift Valley	4880	4591	1359	10830
Coast	2120	597	304	3021
Western	1872	2225	815	4912
Nyanza	3903	3137	970	8010

Source: Kenya - National Health Care Waste Management Plan 2006-2015

2.2.6 Nigeria

Table 2.14: Number of beds per Zone and per hospital type

ZONE	FEDERAL HOSPITALS	TEACHING HOSPITALS	SPECIALIST HOSPITALS	STATE/GEN. HOSPITAL	PRIVATE	TOTAL
North National	595	1561	300	256	34	2746
North East	2010	560	-	-	60	2630
South - South	65	1491	243	800	-	2599
South East	575	-	220	748	60	1603
South West	-	1117	700	187	262	2266
North West	1363	300	268	720	-	2651
Total	**4,608**	**5,029**	**1,731**	**2,711**	**416**	**14,495**

Source: Nigeria HealthCare Waste Management Plan, Draft of 2008

Table 2.15: Number of Hospital Beds in Nigeria

Description	2000	2001	2002	2003	2004
Medical Institutions					
Number of Hospitals	23,596	23,601	23,607	23,618	23,622
Number of Health Centers & Dispensaries	20,273	20,570	20,580	20,610	20,653
Number of Hospital Beds	71,520	71,930	72,600	73,230	73,680

Source: Nigeria HealthCare Waste Management Plan, Draft of 2008

2.2.7 Senegal

Table 2.16: Number of Hospital Bed in Senegal

Type	Characteristics	Average Number of bed
National Hospital	Level 3 Hospital	300 to 400
Regional Hospital	Level 2 Hospital	100 to 200

District Hospital	Health Center	About 50
Health Post	Primary health Center	

Source : Dr. Ndoye *et al*., 2009

2.2.8 South Africa

Table 2.15: Average number of beds in South Africa

Sector	**Public**				**Non-public**		
Province	**Hospitals**						
Units	Number	Total beds	% Occupancy rate	Average no. of beds per facility	No.	Total beds	Average no. of beds per facility
Eastern Cape	91	17805	89%	196	28	3 380	121
Free State	31	5865	88%	189	21	1 951	93
Gauteng	29	16835	94%	580	131	16 011	122
Kwa-Zulu Natal	74	28850	88%	390	76	3 932	52
Limpopo	47	11067	83%	235	3	340	113
Mpumalanga	31	4847	99%	156	13	1 251	96
North West	30	6958	85%	232	19	1 478	78
Northern Cape	30	1884	101%	63	16	779	49
Western Cape	59	10569	91%	179	62	4 670	75
Mining					45	4 514	100
Total	**422**	**104 680**	89.5%	**248**	**414**	**38 306**	**93**

Source: Projection of hospital and clinic health care risk waste generation quantities and treatment capacities for the South African national waste management strategy implementation project 2006, by Rogers DEC, Molefe S, Gcwensa Q, Van Den Bergh C, Kristiannsen T, and Otto JB

2.2.9 Tanzania

Table 2.16: Number of beds/patients in HCFs in Tanzania

Hospital Category	**Number of beds**	**Number of serviced patients annually**
Dispensary	NA	6,000 to 10,000 inhabitants
Health Centre	NA	50,000 and 80,000 people
District Hospital	60 - 150	
Regional Hospital	200 - 400	1 million people
*Referral or Consultant Hospitals	more than 400 beds	

*****Number of beds for specific referral hospital in Tanzania is indicated in table below

Source: Ministry of Health Statistical Abstract, 2008

Table 2.17: Number of beds per referral hospital in Tanzania

Name of Referral Hospital	**Number of beds**
Muhimbili National Hospital	1400
Kilimanjaro Christian Medical Centre (KCMC)	450
Bugando Referral Hospital	900
Mbeya Referral Hospital	477
Ocean Road Referral Hospital	130
Mirembe Mental	NA

Kibong'oto TB Hospital	250

NA – Current data not available
Source: Ministry of Health and Social Welfare, Director of Hospitals Office, 2008

2.2.10 Uganda

Table 2.18: Type of HCFs and beds distribution in Uganda

Type of HCFs	Number of beds
National Referral	850-1500
Regional Referral	140-332
District Hospital	100 - 254
UCMB - NGO	40 - 457
UPMB - NGO	20 - 285
UMMB - NGO	30 - 70
Private hospital	80 - 100
HC IV	24
HC III	8

Source: Design Report on Improvement of health care waste management in Uganda, July 2005

2.2.11 Zambia

Table 2.19: Distribution of beds/cots for HCFs in Zambia

Facility Type		Number of		Total no. of Facilities	Average Beds per HCF	Average Cots per HCF
		Beds	Cots			
Level 3 Hosp		2532	417	5	506.4	83.4
Level 2 Hosp.		4204	827	21	200	39.4
Level 1 Hosp.		6016	859	72	83.5	11.9
Health Center	Rural HC	9224	559	1,029	8.96	0.54
	Urban HC	1814	300	265	6.86	1.13
Heath Posts		198	11	171	1.2	0.06
Total		**23,988**	**2,973**	**1,563**	**15.35**	**1.9**

Source: Health Institutions in Zambia, A Listing of Health Facilities According to Levels & Location for 2008, Ministry of Healthy, Lusaka, Zambia, February 2008

3.0 MEDICAL WASTE GENERATION IN AFRICA

3.1. Introduction

Medical waste is generated in a wide variety of sources, starting from the hospital (a primary target), human and animal clinics, health centers, intermediate facilities, physician offices, research institute (animal and human health), and homes (especially homes of diabetics). This section focuses on hospital waste management in various countries in Africa.

In hospitals, health care wastes generation varies considerably depending on numerous factors, such as established waste management methods, type of health-care facility, the proportion of patients treated daily, the degree of specialization of the health facility. For a correct estimation of the waste production, the following parameters need to be considered: number of hospital beds; number of in-patients and out-patients; range of services provided; and any other activity causing health care wastes generation.

Between 75% and 90% of the waste produced by health-care providers is usually considered non-risk or general health-care waste, comparable to domestic waste. It comes mostly from the administrative and housekeeping functions of health-care establishments and may also include waste generated during maintenance of health-care premises. The remaining 10-25% of healthcare waste is regarded as hazardous (infectious) and may create a variety of health risks.

In general terms, infectious waste is suspected to contain pathogens (bacteria, viruses, parasites, or fungi) in sufficient concentration or quantity to cause disease in susceptible hosts. This category includes:

- Cultures and stocks of infectious agents from laboratory work;
- Waste from surgery and autopsies on patients with infectious diseases (e.g. tissues, and materials or equipment that have been in contact with blood or other body fluids);
- Waste from infected patients in isolation wards (e.g. excreta, dressings from infected or surgical wounds, clothes heavily soiled with human blood or other body fluids);
- Waste that has been in contact with infected patients undergoing haemodialysis (e.g. dialysis equipment such as tubing and filters, disposable towels, gowns, aprons, gloves, and laboratory coats);
- Infected animals from laboratories;
- Any other instruments or materials that have been in contact with infected persons or animals.
- Sharps waste

The primary method to estimate waste generation at a certain facility depends much on the availability of several data such as number and types of medical areas, number of beds in use in each medical area, number of inpatients and outpatients. If typical data

on health care waste generation are available within the country, then they can be used to estimate waste production in health care establishments that do not have estimates of the waste they produce. Waste production data are usually expressed as kilogram/occupied bed per day for inpatients and kilogram/appointment per day for outpatients. Estimates per patient can then be aggregated to give estimates for medical areas and the entire facility. The largest quantities of potentially infectious health care waste are produced typically in surgical, maternity, isolation and medical laboratory areas and emergency rooms.

If typical in-country health care waste generation rates are not available then counting the number of bags or containers and applying an average weight to each is a fast way of getting a broad estimate of health care waste generation in a particular facility. Weighing programmes are more accurate but take more effort as a representative sample has to be identified, weighing repeated on various days and sufficient measurements collected to produce a reliable estimate.

In difficult situations, health care waste (general and hazardous) generation factors can be applied as recommended by WHO/World Bank resource materials on HCWM, as follows[1]:

- Primary health care clinic: 0.1 kg/patient per day
- Small district hospital: 1 kg/bed per day
- General hospital: 2 kg/bed per day
- Tertiary level or major teaching hospital: 4 kg/bed per day

This report presents data that were obtained from various sources of information in Botswana, Egypt, Eritrea, Gambia, Kenya, Lesotho, Mozambique, Nigeria, Senegal, South Africa, Tanzania, Uganda and Zambia.

3.2 Waste Generation in Surveyed Countries

3.2.1 Botswana

Table 3.1: Estimated Health Care Waste Production in Botswana

HCF	Health Care Waste excluding sharps (kg/day)	Sharps containers	General waste (kg/day)
Referral and Regional Hospitals	0.75/bed	1.5/100 beds per day	3/bed
Private Hospitals	1.0/bed	2/100 beds per day	4/bed

[1] **Better Health Care Waste Management -** An Integral Component of Health Investment, by World Health Organization Regional Office for the Eastern Mediterranean Regional Centre for Environmental Health Activities (CEHA), and The World Bank Middle East and North Africa Region, 2005

Primary Hospitals	0.5/bed	1/100 beds per day	2/bed
Urban Clinics with Beds	20	2/30 days	40
Rural Clinics with Beds	10	2/30 days	20
Urban Clinics	15	2/30 days	30
Rural Clinics	7	2/30 days	15
Health Posts	2.5	1/30 days	5
Medical and Veterinary practices	2.5	1/30 days	5

Source: Safe management of wastes from health-care activities Edited by A. Pruss, E. Giroult and P. Rushbrook, World Health Organization Geneva 1999

3.2.2 Egypt

Generally, in Egypt, the average amount of waste per bed per day is estimated to range from 0.7-1.7 kg/bed.day.

Table 3.2: HCW Waste Generation in Egypt

Type/Source of HCW	Amount of waste generated
Inpatient services	0.5 kg / bed / day
Laboratory	0.06 kg / sample
Operating theater	1.2 kg / operation
Blood bank	0.8 kg / unit of blood
Intensive care	0.05 kg / patient / day
Renal dialysis	1 kg / patient

Source: www.mohp.gov.eg (November 2008)

3.2.3 Eritrea

According to Eritrea Health Care Waste Management Plan an average of 0.28 kg/occupied bed/day of medical waste are being generated in the Eritrean Health Institutions.

Approximately 150 to 200 kg of syringes and needles are used and must be disposed of every day in the Eritrean HCFs.

Table 3.3: HCW Generation in HCFs in Eritrea

HCF	Category	No. of beds	Occupancy rate	Occupied bed	General Medical waste & sharps			
					litre / day	ratio	kg /day	kg/oc.bed/ day
Halibet RH	National Referral	450	74%	333	450	0.26	117	0.35
Mendefera RH	Regional Hospital	100	95%	95	100	0.26	29	0.30
Barentu RH	Regional Hospital	60	100%	60	60	0.26	16	0.26
Keren Hospital	Regional Hospital	188	80%	150	150	0.26	39	0.26
Assab RH	Regional	79	110%	87	100	0.26	26	0.30

	Hospital							
Massawa RH	Regional Hospital	120	80%	96	110	0.26	29	0.30
Gindha FCH	First-Contact Hospital	33	90%	30	30	0.26	8	0.26
Debarwa HC	Health Centre	36	100%	36	40	0.26	10	0.29
Mongolo Catholic HC	Health Centre	25	70%	18	20	0.26	5	0.30
Akurdet HC	Health Centre	24	85%	20	20	0.26	5	0,25
Enden HC	Health Centre	30	30%	9	10	0.26	3	0.29
Tio HC		28	65%	18	15	0.26	4	0.21
Average		**97.75**	**82%**	**79.34**		0.26		**0.28**

Source: Eritrea: National Health Care Waste Management Plan, September 2004

3.2.4 Gambia

Table 3.4: Health Care Waste Generated (Kgs) in Gambia

	Major Hospital			Health Center	Private clinics	Dispensary	Total Health care waste generated
	Public	Private	Regional				
No of Beds	557.00	75.00	500	610.00	142	n/a	1884.00
Sharps	3.87	0.52	16.95	31.80	8.03	9.24	70.41
Infectious	41.59	5.60	19.33	41.83	11.89	12.51	132.75
Pathological	11.64	1.57	10.95	0.00	0.00	0	24.16
Radioactive	0.00	0.00	0.71	0.00	0.00	0	0.71
Chemical	0.00	0.00	6.67	2.46	0.00	0	9.12
Pharmaceutical	3.34	0.45	22.14	43.88	7.44	6.38	83.64
Total Health Care Waste	**60.44**	**8.14**	**76.76**	**119.97**	**27.35**	**28.13**	**320.79**
General Waste	152.39	20.52	94.75	112.68	22.74	27.35	430.42

Source: The Gambia National Health Care Waste Management Plan, September 2005

Table 3.5: Health Care Waste Generated in Major Hospitals (Kgs) in Gambia

	Public	Private		Total
	RVH	AHMADIYA	MRC Faraja	
No of Beds	557	35	40	632
Sharps	3.87	0.24	0.28	4.39
Infectious	41.59	2.61	2.99	47.19
Pathological	11.64	0.73	0.84	13.21
Radioactive	0.00	0.00	0.00	0.00
Chemical	0.00	0.00	0.00	0.00
Pharmaceutical	3.34	0.21	0.24	3.79
Total Health Care Waste	60.44	3.80	4.34	68.58
General Waste	152.39	9.58	10.94	172.90

Source: The Gambia National Health Care Waste Management Plan, September 2005

Table 3.6: HealthCare Waste Generated by Regional Hospitals (Kgs) in Gambia

	BWIAM HOSPITAL	AFPRC	BANSANG	Total
No of Beds	200	150	150	500
Sharps	6.78	5.09	5.09	16.95
Infectious	7.73	5.80	5.80	19.33
Pathological	4.38	3.29	3.29	10.95
Radioactive	0.29	0.21	0.21	0.71
Chemical	2.67	2.00	2.00	6.67
Pharmaceutical	8.86	6.64	6.64	22.14
Total Health Care Waste	30.70	23.03	23.03	76.76
General Waste	**54.72**	**20.01**	**20.01**	**94.75**

Source: The Gambia National Health Care Waste Management Plan, September 2005

Table 3.7: Waste Generated by Major Private Clinics (Kgs) in Gambia

	Hospital Beds	Sharps	Infectious	Pathological	Radioactive	Chemical	Pharmaceutical	Total	General Waste
Lamtoro	48	2.71	4.09	0.00	0.00	0.00	2.51	**9.31**	7.69
Ndeban	18	1.02	1.53	0.00	0.00	0.00	0.94	**3.49**	2.88
Kololi Clinic	12	0.68	1.02	0.00	0.00	0.00	0.63	**2.33**	1.92
Westfield Clinic	24	1.36	2.04	0.00	0.00	0.00	1.26	**4.66**	3.84
Jahali	27	1.53	2.30	0.00	0.00	0.00	1.41	**5.24**	4.32
Bambo Clinic	6	0.34	0.51	0.00	0.00	0.00	0.31	**1.16**	0.96
BremenClinic	7	0.40	0.40	0.00	0.00	0.00	0.37	**1.16**	1.12
Total	**142**	**8.03**	**11.89**	0.00	0.00	0.00	**7.44**	**27.35**	**22.74**

Source: The Gambia National Health Care Waste Management Plan, September 2005

3.2.5 Kenya

Table 3.8: Estimated quantities of HCW by category generated by Kenya HCFs by type

HCW Categories	HCF Categories	Daily Mean	Annual Mean	No of facilities	Annual Total	Waste per unit population per annum
INFECTIOUS	National	561.8	205072.6	1	205072.6	0.006
	Referral	703.4	256725.4	1	256725.4	0.008
	Provincial	127.6	46559.4	7	325915.8	0.010
	District	42.8	15609.0	100	1560896.4	0.046
	Health Centre	4.6	1667.9	460	767243.0	0.023
	Dispensary	2.8	1019.0	1537	1566139.0	0.046
	Private Clinic	2.1	780.6	592	462096.1	0.014
PATHOLOGICAL	National	331.4	120961.0	1	120961.0	0.004
	Referral	56.4	20596.4	1	20596.4	0.001
	Provincial	30.5	11123.4	7	77863.6	0.002
	District	8.7	3192.9	100	319288.1	0.009
	Health Centre	2.4	873.0	460	401580.8	0.012
	Dispensary	0.3	105.9	1537	162691.5	0.005
	Private Clinic	0.1	52.6	592	31151.5	0.001
SHARPS	National	9.0	3285.0	1	3285.0	0.000
	Referral	16.0	5845.2	1	5845.2	0.000
	Provincial	13.8	5032.7	7	35229.2	0.001
	District	9.4	3440.2	100	344021.2	0.010
	Health Centre	1.7	612.4	460	281712.2	0.008
	Dispensary	1.0	346.8	1537	532954.8	0.016
	Private Clinic	1.7	630.8	592	373413.3	0.011
GENERAL	National	21.6	7873.6	1	7873.6	0.000
	Referral	459.9	167847.9	1	167847.9	0.005
	Provincial	71.0	25922.3	7	181456.1	0.005
	District	3.3	1186.3	100	118625.0	0.004
	Health Centre	3.3	1217.7	460	560126.4	0.017
	Dispensary	4.1	1502.9	1537	2309938.1	0.068
	Private Clinic	0.1	42.6	592	25209.3	0.001

Source: National Health Care Waste Management for Kenya, 2006-2015

3.2.6 Lesotho

Table 3.9: Summary of waste generation as measured at Queen Elizabeth II over a period of one month.

Date	Quantities of waste generated (kg)			
	Sharps	Infectious	Anatomical	General
Dec 7	0	35	70.8	129.5
8	8.7	146.5	79	246.6

9	16.3	122.7	75.2	146.5
10	4.5	47.9	64.2	290.8
11	1.4	63.5	16.4	30.7
12	0 4	2.7	6.9	9.4
13	9.9	116.6	92.2	300.7
14	22.7	105.2	37.2	259.2
15	1.5	71.9	69.9	199.1
16	5.8	101.6	50.8	224.1
17	28.6	66.8	87.3	190.7
18	4.1	51.2	43.1	43.1
19	0	46.6	24.3	5.1
20	6.5	137.2	91.8	260.5
21	2.2	92.8	66.4	169.0
22	0	82.8	50.3	125.5
23	0	121.8	43.1	167.0
24	12.5	101.8	55.1	152.5
25	0	50.7	49.0	27.0
26	0	50.7	26.0	0.6
27	1.4	157.7	56.1	198.0
28	3.2	98.0	85.5	157.1
29	20.4	91.0	68.9	106.6
30	0	90.0	41.4	145.6
31	24.4	107.5	39.8	96.2
Jan 1	4.1	32.7	33.6	2.6
2	0	28.6	49.2	10.1
3	7.4	171.2	56.1	181.2
4	5.5	78.2	14.7	194.2
5	53.2	81.5	36.3	226.4
Total	*244.3	**2592.4**	**1620.6**	**4278.3**

Source: Lesotho: National Health Care Waste Management Plan,2004

Table 3.10: Health Care Waste Generated by Major Facilities in Lesotho (extrapolated estimates)

Hospital	No.of Beds	Daily waste§ @ 1.44kg/b/d	Annual Waste	Extrapolated daily values @ 1.068 kg/b/d£	Extrapolated annual values	Hazardous waste amount @ 25%
Mafeteng	200	288	104,988	214	77964	22869
Mokhotlong	110	158	57,743	117	42880	12578
Butha-Buthe	129	186	67,717	138	50287	14751
Leribe	287	413	150,658	307	111878	32817
Berea	128	184	67,192	137	49897	14636
QE II (Maseru)	**450**	**647**	**236,223**	**481**	**175419**	**51455**
Mohales'Hoek	140	201	73,492	150	54575	16008
Quthing	148	213	77,691	158	57693	16923
Qachas, Nek	145	209	76,116	155	56524	16580
Thaba-Tseka	130	187	68,242	139	50677	14865
St. James (Mantsonyane)	60	86	31,496	64	23389	6861
Maluti (Mapoteng)	150	216	78,741	160	58473	17152
Botsabelo (Lepereng)	21	30	11,024	22	8186	2402

Itekeng Vocational R.	69	99	36,221	74	26898	7890
Mohlomi (Maseru)	150	216	78,741	160	58473	17151
Seboche (Butha-Buthe)	72	104	37,796	77	28067	8233
Scott (Morija)	102	147	53,544	109	39762	11663
St. Josephs (Roma)	140	201	73,492	150	54575	16008
Tebellong (Qachas' Nek)	55	79	28,872	59	21440	6289
Mamohau (Lejone)	43	62	22,572	46	16762	4917
Maseru Private Hospital	32	46	16,798	34	12474	3659
Averages	**131**	**189**	**69,017**	**140**	51252	

£ = values have been calculated on the basis of measurements made at Queen II hospital for a period of one month

§ = calculated on the basis of the number of beds and the average generation rate of 1.44 kg/bed/day, from SA Incinerator Co (Pty) LTD.

Source: Lesotho: National Health Care Waste Management Plan, 2004

3.2.7 Mozambique

Table 3.11: Daily rate of health care waste generation at HCFs in Mozambique

Type of HCF	Waste generation rate in Kg/day
Central hospital	40 kg/day
General and Provincial hospital	20 kg/day
Rural hospital	10 kg/day
Health centre	3 kg/day
Health post	I kg/day

Source: Multisectoral Project for fighting against HIV/AIDS in Mozambique, Health Care Waste Management Plan, September, 2002

3.2.8 Nigeria

Table 3.12: Average Waste Generated (kg/bed/day) in Nigeria

ZONE	FED. HOSP.	TEACH. HOSP.	SPECIAL. HOSP.	STATE/GEN. HOSP.	PRIVATE	TOTAL	AVERAGE
North National	0.39	0.55	0.15	1.46	0.42	2.97	0.59
North East	0.62	2.87	-	-	0.08	3.57	0.71
South South	1.23	0.08	0.11	0.19	-	1.61	0.32
South East	0.50	-	0.49	0.57	0.57	2.13	0.43
South West	-	1.8	0.04	0.00	0.03	1.87	0.37
North West	0.99	0.58	0.28	0.56	-	2.41	0.48
TOTAL	**3.73**	**5.88**	**1.07**	**2.78**	**1.10**		
AVERAGE	**0.62**	**0.98**	**0.18**	**0.46**	**0.18**		

Source: Nigeria HealthCare Waste Management Plan, Draft of 2008

Table 3.13: Medical Waste Generation in surveyed Hospitals in Lagos

Hospital type	Number of beds	Total waste generated (kg/day)	Generation rate (kg/bed.day)
Private	40	22.5	0.563

Private	50	28.1	0.562
Teaching/Specialist Hospital	600	399.6	0.666
Referral Hospital	378	161.3	0.427
Total	1068	611.5	0.573
Average = 0.573 kg/bed.day			

Source: A Preliminary study on medical waste management in Lagos Metropolis, Nigeria, March 2006

3.2.9 Senegal

Table 3.14: Amount of waste generated per day for small health care facilities

Health Facility	Characteristic	Production per day (Kg/bed)
National Hospital	Level 3 Hospital	4.1 to 8.7
Regional Hospital	Level 2 Hospital	2.1 to 4.2
District Hospital	Health Center	0.5 to 1.8
Health Post	Primary health Center	0.05 to 0.2

Source : Dr. Ndoye *et al*., 2009

3.2.10 South Africa

Table 3.15: Summary of public hospital waste generation rates for Gauteng, Free State, and Kwa-Zulu Natal

	Gauteng	KZN	Free State	Avg.	Median	Std dev
Category	**Kg/pbd**	**Kg/pbd**	**Kg/pbd**	**Kg/pbd**	**Kg/pbd**	**Kg/pbd**
National central hospital	1.26	1.22	-	1.24	-	-
Provinsial tertiary hospital		1.36	1.70	1.53	-	-
Regional hospital	1.11	1.12	0.92	1.05	1.11	0.11
District hospital	0.59	0.71	0.65	0.65	0.65	0.06
Specialised hospital	0.04	0.15	0.30	0.17	0.15	0.13

Source: Projection of hospital and clinic health care risk waste generation quantities and treatment capacities for the South African national waste management strategy implementation project 2006, by Rogers DEC, Molefe S, Gcwensa Q, Van Den Bergh C, Kristiannsen T, and Otto JB

Table 3.16: HCW generated (kg & percent) in the iLembe district, 2006

Municipal	Gene ral (kg)	Infectious (kg)	Sharps (kg)	Pathologicals (kg)	Pharmaceuticals (kg)	Total (kg)	%
KwaDukuza	41.8	5.9	1.9	0.0	2.5	52.0	**24.8**
Ndwedwe	21.9	12.4	2.5	2.0	0.0	38.7	**18.4**
eNdondakusuka	67.0	13.0	5.8	1.8	7.1	94.7	**45.2**
Maphumulo	14.0	3.7	1.4	0.0	5.2	24.3	**11.6**
Total	**144.6**	**35.0**	**11.5**	**3.8**	**14.8**	**209.7**	**100.0 0**
Percent %	**69.0**	**16.7**	**5.5**	**1.8**	**7.04**	**100.0**	

Source: Health Care Waste Management in Public Clinics in the Ilembe District: A Situational Analysis and Intervention Strategy, Sibusiso Derrick Gabela: Health Systems Trust University of KwaZulu Natal National Department of Health, November, 2007

Table 3.17: HCW generation rates in the iLembe District, 2006

Local Municipality	HCW (kg/day)	Number of patients	Generation rate (kg/patient/day)
KwaDukuza	52	1406	0.04
Ndwedwe	39	641	0.06
eNdondakusuka	95	1138	0.08
Maphumulo	24	435	0.06
Total for district	**210**	**3620**	**0.06**

Source: Health Care Waste Management in Public Clinics in the Ilembe District: A Situational Analysis and Intervention Strategy, Sibusiso Derrick Gabela: Health Systems Trust University of KwaZulu Natal National Department of Health, November, 2007

3.2.11 Tanzania

According to the Ministry of Healthy and Social Welfare (MoHSW) it is estimated that around 0.41 kg/occupied bed/day of clinical waste are generated in Referral, Regional and District Hospitals. In Healthcare Centres and Dispensaries, around 0.03 kg/patient/day of clinical waste are generated. Table 3.17 to 3.22 below and figure 3.1 indicates waste generation data in hospitals from various sources.

Table 3.18: Health Care Waste Generation in HCFs in Tanzania

HCF	Category	No. of beds	Occupancy rate	Occupied bed	General Medical waste & sharps		
					Litre/ day	Kg/ day	Kg/oc .bed/ day
Amana Hospital	District	150	200%	300	537	161	0.54
Mbeya Hospital	Referral	477	95%	453	600	180	0.40
Iringa Regional Hospital	Regional	365	85%	310	450	135	0.44
Mafinga District Hospital	District	130	120%	156	150	45	0.29
Mtwara Regional Hospital	Regional	320	170%	544	960	288	0.53
Muhimbili National Hospital	Referral	1400					0.45
Dodoma Hospital	Regional	395	71%	280		30	0.11
Korogwe Hospital	District	142	50%	71		50	0.70
Bagamoyo Hospital	District	88	44%	39		13	0.33
Mwananyamala Hospital	District	115	110%	127		156	1.24
Average		**237**	**101%**	**241**			**0.41**

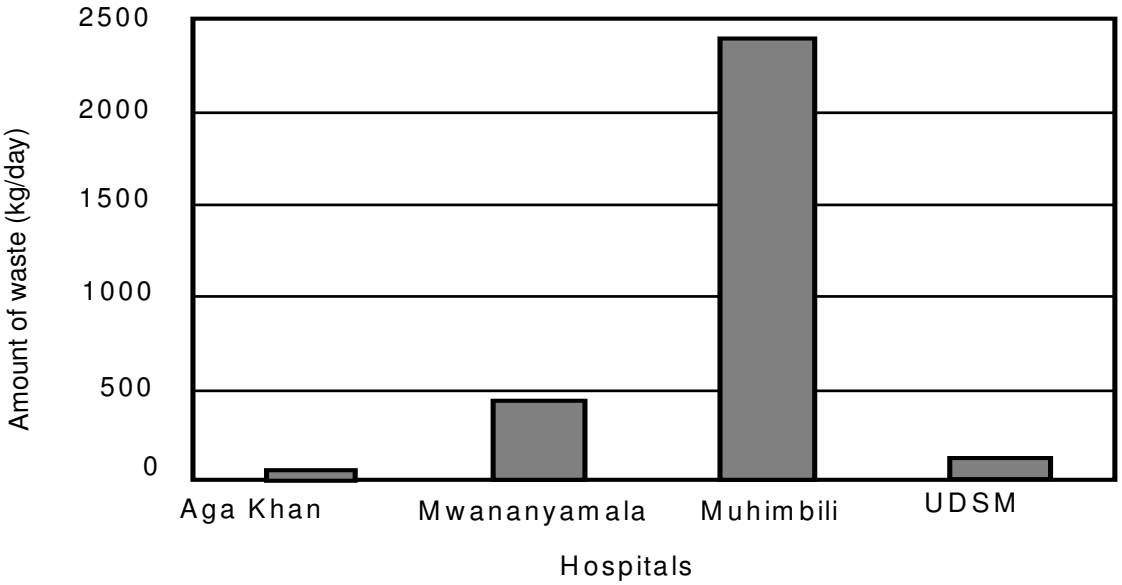
Source: Tanzania- National Health Care Waste Management Plan, 2003

Table 3.19: HCW data for HCFs Surveyed by AGENDA in 2005 in Tanzania

HCF	Category	No. of beds	Occupancy rate	Occupied bed	Outpatient attendance rate per day	HCW Generation [kg/day]
Aga Khan Hospital	Private	71	68%	48	350	121
Mwananyamala District Hospital	District	197	102%-127%	200-250	1000-1200	NA
Mlandizi Health	Health	45	67%-78%	30-35	60 – 70	5 -10

Centre	Center					

Source: AGENDA Health Care Waste Management Project Survey Report, December 2005



Source: Medical Waste Management in Tanzania: Current Situation and the Way Forward, Samwel V. Manyele

Figure 3.1: Infectious medical waste generation in Dar es Salaam (Manyele *et al.*, 2003)

Table 3.20: Summary Waste Generation in Bagamoyo District Hospitals for October

AMOUNT OF WASTE GENERATED - OCTOBER 2008 (21 DAYS)														
Services	**Monday**		**Tuesday**		**Wednesday**		**Thursday**		**Friday**		**Saturday**		**Sunday**	
	I [kg]	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**
Ward #1	5.8	11.2	2.7	9.7	4.1	6.2	4.4	6.4	5.4	6.3	5.1	2.8	3.5	6.5
Ward #2	2.3	0.7	0.8	0.3	1.9	0	1.8	0	0	0	2.7	0	1	0.1
Ward #3	1.3	0	2.8	0	0.6	0	1.7	0	0.5	0	3.8	0.4	1	0.1
Ward #4	1.2	0	1.8	0.9	0.9	0	1.3	0	3.1	0	1.7	0	0.6	0
Ward #5	0	0	0	0	0	0	2.3	0	0	0	0	0	0	0
Major Theater	3.7	6	4	11.7	2.5	0.6	4	0.8	3.6	7.6	3	2.2	0	3.3
Minor Theater	0.7	1.5	4.8	1	4	0	5.6	1.7	3.2	0	5.9	0.4	0	1.3
Dental	1.5	0.2	2.7	0.9	1.3	1.8	1.3	0.9	1.8	0.5	0.6	0.3	0	0
Labs	2.5	2.1	0.7	2.1	1.5	0.9	1.5	4.5	3.4	0.6	2.3	2.7	0.7	1.2
VCT	0.7	0	1.8	0.2	0.6	0	1.5	0	0.1	0	0	0	0	0
CTC	0.7	0.9	1.2	0	0.8	0.3	1.5	0.7	0	2.6	0	0	0	0
Malaria Project	0	0	0	0	3.2	1.2	1.7	2.7	2	0	0	0	0	0
Insurance Ward	0	0	0	0	0	0	0	0	1.1	0	0	0	0	0
Clinic	2.9	0	1.2	0	4.4	0.5	0.5	0	5.4	0.6	0.8	0	0	0
Injection Room	0.5	0	2.2	0	0	0	0.2	0	0	0	0	0	0	0
Total	**23.8**	**22.6**	**26.7**	**26.8**	**25.8**	**11.5**	**29.3**	**17.7**	**29.6**	**18.2**	**25.9**	**8.8**	**6.8**	**12.5**
Average	**7.933**	**7.533**	**8.9**	**8.933**	**8.6**	**3.833**	**9.77**	**5.9**	**9.87**	**6.067**	**8.63**	**2.933**	**2.27**	**4.167**

Total Waste-December	**286**
Total infectious Waste	**167.9**
Total Highly Infectious	**118.1**
Waste Generated per Day	**13.62**
Infectious Waste per day	**7.995**
Highly infectious per day	**5.624**

Table 3.21: Summary Waste Generation in Bagamoyo District Hospitals for November

AMOUNT OF WASTE GENERATED - NOVEMBER 2008 (28 DAYS)														
Services	**Monday**		**Tuesday**		**Wednesday**		**Thursday**		**Friday**		**Saturday**		**Sunday**	
	I [kg]	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**
Ward #1	9.4	12.2	8.7	10.4	10.5	9.4	9.2	8.8	11.7	10.2	10.5	6.8	7.9	7.3
Ward #2	5.3	2.5	7.6	2.7	5.5	3.1	5	1.6	6.6	1.8	4.8	1.2	4.4	1.7
Ward #3	3.5	1.5	5.8	1.8	6.3	1.5	4.5	1.9	3.6	0.8	3.6	1.2	6.4	1.2
Ward #4	4.2	1.2	5.9	0.9	4	1.5	7.3	1.4	4.6	1.4	5.8	1.4	7.1	1.3
Ward #5	3.9	0.9	5.2	0.7	3.1	0.8	5.1	0.4	3.8	0.7	2.5	1.7	4.2	1.1
Major Theater	5.9	5.8	7.1	6.2	7.2	8	8.7	4.5	6.1	7.4	7.6	2.9	6.4	4.7
Minor Theater	3	3.7	7.21	3.1	5.1	4.4	3.5	4.9	5.2	3.2	1.1	1.3	3.9	1.2
Dental	2.4	1.5	3	2.1	4	1.3	3.6	2.3	2.7	1.4	2	1.2	1.9	1.1
Labs	9.4	8.2	10.1	7.9	7.1	4.9	13.4	6.7	9.5	6.7	6.8	3.9	7	4.1
VCT	4.6	2	3.4	1.6	3.3	1.1	4.6	1.8	4.6	1.3	2.9	1.1	3.1	0.4
Clinic	3.7	2.7	3.3	2.4	4.7	2.1	3.5	1.7	4	1.5	2.4	1.2	2.4	0.9
Malaria Project	18.2	13.1	14.2	9.3	11.4	6.7	11.1	10.5	14.2	9.8	7.2	4.9	8.2	6.6
Insurance Ward	2.5	0	0.5	0	0.7	0	0.8	0	1.3	0	0.4	0	0.6	0
Counselling Section	4.5	3.2	3.6	2.1	3.32	2.4	4.2	2.4	4.7	1.5	3.2	1.7	2.7	1.7
Injection Room	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**80.5**	**58.5**	**85.6**	**51.2**	**76.2**	**47.2**	**84.5**	**48.9**	**82.6**	**47.7**	**60.8**	**30.5**	**66.2**	**33.3**
Average	**20.125**	**14.63**	**21.4**	**12.8**	**19.1**	**11.8**	**21.1**	**12.23**	**20.7**	**11.93**	**15.2**	**7.625**	**16.6**	**8.325**

Total Waste-December	**853.73**
Total infectious Waste	**536.43**
Total Highly Infectious	**317.3**
Waste Generated per Day	**30.49**
Infectious Waste per day	**19.158**
Highly infectious per day	**11.332**

Table 3.22: Summary Waste Generation in Bagamoyo District Hospitals for December

AMOUNT OF WASTE GENERATED - DECEMBER 2008 (28 DAYS)														
Services	**Monday**		**Tuesday**		**Wednesday**		**Thursday**		**Friday**		**Saturday**		**Sunday**	
	I [kg]	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**	**I [kg]**	**HI [kg]**
Ward #1	12.9	10.3	9.6	7.5	11	6.7	11.5	5.61	12	7.9	8.4	5.8	7	5.8
Ward #2	8.2	3.7	7.4	3.7	6.5	2.6	6.5	3.4	6.1	3.1	5.6	2.3	5.3	2
Ward #3	7.3	2.7	6.3	2.3	5.5	2.7	6	2.8	5.6	2.7	5.3	2	5.1	2.7
Ward #4	6.2	1.6	5.8	1.4	4.7	1.6	5.7	1.3	6.3	2.2	5.4	2.2	6.2	1.5
Ward #5	5.9	0.7	4.1	1.5	5.2	1.4	4.6	1.6	4.8	1.6	4.8	1.5	4.4	1.9
Major Theater	15	9.9	12	6.7	11.5	8.6	13.7	8.6	11.1	5.2	12.2	7.5	6.9	5.4
Minor Theater	10.7	8.1	10.1	7.4	10.3	6.6	10.2	6.6	9	5.8	11.3	6.2	9.9	7.7
Dental	2.5	2.7	2.6	1.9	2.5	7.2	2.6	2.3	2.9	2.5	3.2	2.5	2.3	1.2
Labs	15	8.2	10.6	6.5	11.2	7.1	10.8	7	9.8	6.5	8.5	5.1	6.4	5.4
VCT	5.2	1.9	4.1	2.1	4.1	2.3	4.5	2.3	3.7	2	3.8	2.2	3.3	1.6
Clinic	6.2	2.4	5	2.8	4.8	2.8	4.9	2.6	4.5	2.3	4.6	2.6	5	2
Malaria Project	18.8	13.6	15.9	10.3	12.7	6.3	15.5	8.9	12.4	8.7	14.2	9.2	11.8	8.1
Insurance Ward	2.9	0.3	2.1	0.2	2.1	0.3	2.2	0.2	2.6	0.5	2.6	0.7	0.8	0.7
Counselling Section	4.5	0.4	4.7	0.6	3.4	0.7	4.1	1.1	4.4	1.7	4.3	1.2	4.3	1.5
Injection Room	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**121**	**66.5**	**100**	**54.9**	**95.5**	**56.9**	**103**	**54.31**	**95.2**	**52.7**	**94.2**	**51**	**78.7**	**47.5**
Average	**30.3**	**16.625**	**25.1**	**13.73**	**23.9**	**14.23**	**25.7**	**13.58**	**23.8**	**13.18**	**23.6**	**12.75**	**19.7**	**11.88**

Total Waste-December	**1072**
Total infectious Waste	**688**
Total Highly Infectious	**384**
Waste Generated per Day	**38.3**
Infectious Waste per day	**24.6**
Highly infectious per day	**13.7**

According to the National Health Care Waste Management Plan of 2003, the overall production of clinical waste in Tanzania is estimated between 12 and 14 tons per day. About 50% of the HCW is generated in the regions of Dar-Es-Salaam, Kagera, Iringa, Kilimanjaro, Arusha, Pwani and Mwanza.

Table 3.23: Clinical Waste Production in Tanzania

REGION	CLINICAL WASTE PRODUCTION				
	Kg/bed/day			% total production	% cumulative
	Hospitals	Health Centres	Total		
Rukwa	164.4	60.4	224.8	2	2
Morogoro	326.36	45.6	371.96	3	4
Kigoma	315.7	70.8	386.5	3	7
Mara	375.6	70.2	445.8	3	10
Lindi	419	42	461	3	13
Singida	476.4	45.2	521.6	4	17
Mtwara	453.1	72.8	525.9	4	21
Shinyanga	446.9	86.2	533.1	4	25
Tabora	512.5	74.6	587.1	4	29
Tanga	617.5	114	731.5	5	34
Ruvuma	672.8	76	748.8	5	40
Mbeya	665.8	87	752.8	5	45
Dodoma	696.2	66.8	763	5	50
Dar Es Salaam	698.2	123.6	821.8	6	56
Kagera	710.1	126	836.1	6	62
Iringa	737.6	158.6	896.2	6	69
Kilimanjaro	823.3	92	915.3	7	75
Arusha	934.4	72.6	1007	7	82
Coast Region	1118.9	38.4	1157.3	8	91
Mwanza	1045.5	272.6	1318.1	9	100
TOTAL	**12210.2**	**1795.4**	**14005.6**		

Source: National Health Care Waste Management Plan, 2003

3.2.12 Uganda

Table 3.24: Healthcare Waste Generation Rates for Different Levels of Health Facilities

Health Care Facility	Estimated Waste Generation Rate	Comments
District Hospital	0.1 kg/bed/day (without pathological waste)	
HC IV	1.5 kg/day (without pathological waste)	Estimates were based on Kabale, Arua, Mbale and Masaka regions with an average of 50 outpatients/day, and an average of 5 inpatients per day.
HC III	0.6 kg/day	Estimates were based on Kabale Arua, Mbale and Masaka regions with average 25 outpatients/day, and average of 3 inpatients, a month.
HC II	0.5 kg/day	Estimates are based on Kabale Arua, Mbale and Masaka regions with average of 25 outpatients/day.

Source: Design Report on Improvement of health care waste management in Uganda, July 2005

3.2.13 Zambia

Table 3.25: Estimated Daily Health Care Waste Generation Levels in Zambia

HCF	Level of institution	No.of beds	Total Waste generated in kg/day		
			Healthcare waste	Household waste	Total waste
University Teaching Hospital	National reference	1905	952.5	3810	4762.5
Kitwe Central Hospital	Level III	643	321.5	1286	1607.5
Arthur Davison General Hospital	Level II	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 Leprosarium	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	2,150
Kalomo District Hospital	Level I	57	28.5	114	142.5
Chipata Clinic	Urban Health Centre	57	11.4	114	125.4
Mutanda	Rural Health Centre	40	8	80	88
Mutanda Research	Rural Health Centre	1	0.2	2	2.2
Kazungula	Rural Health Centre	4	0.8	8	8.8
Monze Clinic	Urban Health Centre	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**

Source: National Solid Waste Management Strategy for Zambia, Environmental Council of Zambia, September 2004

The above data on waste generation in different countries in Africa can therefore be used to estimate the capacity of the treatment facility of the project. In order to estimate the capacity of the treatment facilities below factors need to be considered for the small, medium to large scale facilities

- Can the technology handle a minimum volume per batch (for batch processes) of 19 liters or 5 gallons?
- Can the technology handle a minimum processing rate (for batch, semi-continuous or continuous processes) of 10 kg per 8-hour day or 1.25 kg/hr (22 lbs per 8-hour day or 2.75 lbs/hr)?
- Is the processing rate below the maximum rate (for batch, semi-continuous or continuous processes) of 50 kg/hr (110 lbs/hr)?

Other data that might be useful:

- Density: 0.12 kg/liter (WHO Standard)
- Chemical composition: 50% carbon, 20% oxygen, 6% hydrogen, other elements

Other average bulk densities for health-care waste have been reported in the literature: 594 kg/m^3 (urban hospitals, Tanzania).

4.0 COST OF SHARPS BOXES, BINS AND LINERS IN AFRICAN COUNTRIES

In African countries probably the most frequent risk in health care facilities is created by sharps (needles, scalpel blades, blood vials, glassware, etc.) in contact with infectious germs. Therefore in health facilities, needles and sharps are collected in non-reusable containers, such as puncture-proof “sharps boxes”, specific cardboard, metal or plastic boxes, or in empty rigid plastic bottles (with a tight fitting lid), if financial resources are not available.

In some countries the sharp boxes are supplied for free through the ministry of health and this is usually for public health care facilities. In many countries one of the major factors that prevent the wider use of safety boxes is their cost. These safety boxes/sharps containers if used throughout the waste disposal system would account considerably of the cost of the whole system. The price from various sources could be reduced by competition and local manufacture. For example in Asia, India and Indonesia have embarked on local manufacture but, except in South Africa, few African countries have organized local manufacture of the boxes in an effort to reduce prices.

In surveyed countries Many HCFs have no specific budget for waste management equipment (e.g. bins, sharp boxes, liners, PPE etc); any resources required for this purpose come partly from government budget as well as operational budgets which are passed onto the patients through the cost sharing system. Also there are programmes such as that of Making Medical Injection Safer (MMIS) run by John Snow Inc. (JSI) in various countries where they do provide HCFs with Sharp boxes.

Below are the costs of various suppliers for HCW management in HCFs in surveyed countries.

Table 4.1: Costs of Sharps Containers/Boxes in Various Countries in Africa

Country	Type of Equipment	Size	Costs [USD]
Tanzania	WHO/UNICEF Sharp boxes	5L	0.3
	Plastic bins	80L	40
	Black refuse bag		6
Lesotho	Sharp containers	10L	5.5
		25L	7.8
	Container bins	90L-200L	44
	Plastic bags		0.167
Kenya	Sharp boxes Type A	1-4	4
	Type B	4-8	6
	Type C	8-15	9.94
	Type D	15-25	15
	Type E	5-10 litres (600 mm tall)	16
	Liners		4.56
Gambia	Sharp boxes	5 L	0.6

	Bins		8
	Twine		1
South Africa	Sharp containers	5 L	0.956
	Sharp containers	10 L	1.529
	Bags		0.125
Senegal	Containers/bins	100L	13
	Sharp containers		0.9
	Bags		0.44
Malawi	Sharp boxes		15
	Container bins		15
Mozambique	Baskets for syringes		10
	Bins in health care rooms		10

5.0 INCINERATORS IN AFRICA

Incineration used to be the method of choice for most hazardous healthcare wastes and is still widely used. There are now estimated to be over 1,000 De Montfort incinerators in Africa. Many of these incinerators have been reported inoperative or operating below standards. In some hospitals they have re-built their incinerators in a number of times due to frequently break down.

Incinerators can range from extremely sophisticated, high-temperature operating plants to very basic combustion units that operate at much lower temperatures. In many countries in Africa small-scale incinerators are being promoted by WHO and respective Ministry of Health. The exact type of incinerator is the dual chamber type De Montfort incinerator of Mark III size. Also other types have been promoted too.

The capital cost for incineration in many countries in Africa ranges between 1,000 to 12,000 USD for the De Montfort Incinerators. The main operating cost is the cost of fuel and waste preparation equipment. Other cost factors include operating charges in some countries, maintenance and higher operator skills. Air emissions, water emissions and the characteristics of treated waste are other factors that must also be considered.

Construction costs depend on a number of factors, especially the availability and cost of refractory bricks, metal and metal-working facilities. Table 5.1 below indicates cost of constructing incinerators in surveyed countries. Other costs of De Montfort incinerators under two usage scenarios with and without enhanced operation are shown in appendix A1.

Table 5.1: Costs of constructing incinerators in African countries

Country	Type	Costs of Construction [USD]
Tanzania	Mark II Demonfort	1,000 USD
	Mark III Demonfort	2,000 USD
	Mark V Demonfort	2,500 USD
Kenya	Fenced multi-fault incinerator	6,329 and 7,595
	Non - fenced multi fault	3,797.5
Gambia	Demonfort 9	1,500
	Demonfort 8a	1,000
South Africa		12,500
Lesotho	15/30 LA –	3,044
	220/450 LA	18,200
	70/150 LA	10,500
	120/250 LA	12,677
Uganda	Sophisticated incinerator, with flue gas cleaning at national level (Capacity: 80 kg/hour ~ 200 tons/year)	250,582
	Mark 3 – De Montfort brick incinerators at district level – Capital costs	1,748
Senegal	Big Incinerators	71,845
	Small Incinerators	9,709

6.0 LEGAL INSTRUMENTS RELATED TO HCW MANAGEMENT IN AFRICAN COUNTRIES

6.1 Introduction

National legislation is the basis for improving health-care waste practices in any country. It establishes legal controls and permits the national agency responsible for the disposal of health-care waste, usually the Ministry of Health, to apply pressure for their implementation. In some countries the Ministry of Environment or National Environmental Protection Agency is the principal authority or may also be involved and usually designation of responsibilities before the law is enacted is considered.

A national law on health-care waste management may stand alone or may be part of more comprehensive legislation such as the following:

- Law on management of hazardous wastes: application to health-care waste should be explicitly stated;
- Law on hospital hygiene and infection control: a specific chapter or article should be devoted to health-care waste.

In many of the African countries surveyed there are legal frameworks that relate to the management of waste in general but not specifically on medical waste. In general, the legal provisions in Africa fail to enforce the medical institutions and other actors such as the City Councils and Municipal Authorities to reduce the risks associated with the management of HCW through the establishment of HCWM plans at the HCF, City or Municipal levels. This prevents also the medical institutions from setting-up integrated HCWM plans since they do not have the possibility to refer themselves to a precise legal framework that should at least provide the platform.

Apart from the lack of specific legal frameworks, also many African countries policies and legislation still promote incinerators as the main means of treating medical waste, which is a major source of dioxin/furan and other toxic air emissions such as acid gases and heavy metals and are not trapped with pollution control devices. In most cases it is referred as the most currently technology available to treat medical waste in HCFs.

This section discusses the legal framework in various countries surveyed. The details of legal framework for each country are under appendix A2.

6.2 Legal Instruments Related to HCW Management in Surveyed Countries

6.2.1 Eritrea

There are currently significant gaps in the legislation for an efficient and well-monitored HCWM system in the Eritrean HCFs. There are no legal indications on authorized HCWM practices (segregation, colour coding system, packaging, on-site transportation,

contingency plans, etc.). There is no specification regarding HCW treatment and disposal technologies that might be considered acceptable in the Eritrean context.

6.2.2 Gambia

There are a number of legal provisions, which regulate the Health sector and provide standards and guidelines for the management of the Sector. There are currently no specific laws or regulations or technical guidelines for the management of healthcare waste. However, there are relevant legislations that can be used to address HCW. These include The Drug Policy, The Public Health Act 2001, The National Health Policy-Changing for Good (1994-2000), The Draft Environmental Health Policy, National Environment Management ACT 1994, and Waste Management Bill, 2003.

The Gambia is a party to a number of International Convention and treaties. Significant to Medical Waste Management is the Basel Convention that is concerned with the trans-boundary movements of hazardous wastes which is also applicable to medical waste. Stockholm Convention on Persistent Organic Pollutants is also relevant to the management of Medical Waste. Two of the twelve POP chemicals covered by the Stockholm convention are Dioxin and Furan. According to the Dioxin and Furan inventory report of the Gambia (Njai et al 2002) medical waste is one of the source categories of Dioxins and Furans in the Gambia.

6.2.3 Ghana

Currently, there is no specific legislation, regulations or bye-laws for the management of Health-care waste in the country. Ghana is also yet to have a Public Health Act. There are several policies and legal framework that addresses the management of hazardous waste in general, thery include The National Environmental Sanitation Policy (1992), Local Government Act 462 (1993), Town and Country Planning Ordinances Cap 84 (1944), Ghana Building Regulations LI. 1630 (1997), Vaccination Ordinance Cap 76, Quarantine Ordinance Cap 77, Mosquito Ordinance Cap 75, Infectious Disease Ordinance, Food and Drugs law 305b (1992), Environment Protection Act 490 (1994), Environmental Assessment Regulation 1652 (1999), Criminal Code Act 29 (1960), and Mortuaries and Funeral Facilities Act 563 (1998)

6.2.4 Kenya

Kenya's policy and legal framework on health care waste management is found mainly in the following statutes: the Public Health Act, Chapter 242; the Environmental Management and Coordination Act, 1999; and the Medical Practitioners and Dentists Act, Chapter 253. Additionally there are efforts to develop regulations specifically dealing with health care waste management, and NEMA has drafted the Bio-Medical Waste (Management and Handling) Regulations of 2004.

Kenya is a signatory to a number of international environmental agreements. The agreements relevant to HCW are Stockholm Convention on Persistent Organic Pollutants, Basel Convention on the Control of Transboundary Hazardous Wastes, and

Rotterdam Convention on Procedures for Hazardous Chemicals and Pesticides in International Trade.

6.2.5 Lesotho

There are legal instruments in Lesotho that cover waste management and pollution control but they are not specific on management of medical waste. However the national policies and legal instruments that have to be taken into consideration in management of medical waste management include Health and Social Welfare Policy, National Environment Policy, Constitution of Lesotho, Public health Order 1970, Environment Act 2001, Urban Government Act 1983 and Sanitary Services and Refuse Removal Regulations 1972.

6.2.6 Nigeria

Nigeria has several laws that address issues of solid and hazardous waste management Decree n° 58 of 1988, Decree n° 42 of 1988 Harmful Waste (Special Criminal Provisions, etc), Decree n° 86 of 1992, S.I. 8: National effluent limitation of 1991, S.I. 9 National pollution abatement in industries and facilities generating wastes of 1991, S.I. 15 Management of Solid and Hazardous Wastes Regulation of 1991, Nigeria's National Policy on Environment was first published in 1989 and revised in 1999, Draft blueprint on municipal solid waste management in Nigeria 2000, and Blueprint: Handbook on hazardous waste management. These existing legal and regulatory HCWM frameworks in Nigeria do not stimulate the Management Teams at the HCFs to establish and maintain a safe HCWM system.

Nigeria has recently drafted National Healthcare Waste Management Guidelines and National Healthcare Waste Management Regulations. Development of a HCWM bill would establish legal controls and permit the regulatory bodies responsible for the safe disposal of healthcare waste to apply pressure for their implementation.

At an international level, Nigeria has ratified the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal (1992). It is also party to the Stockholm Convention on the Persistent Organic Pollutants (2002).

6.2.7 Senegal

Senegal has an order which regulates the management of Biomedical Waste only since 2008.

6.2.8 South Africa

South Africa has several legislations that address the management of HCW. They include DEAT – DRAFT HCRW POLICY – VERSION 2 - 23RD DECEMBER 2008, Draft HCRW Regulations – Version 2.2 13th January 2009, SABS 0248 Code of Practice for the Handling and Disposal of Waste Materials within Health Care Facilities, Integrated Pollution and Waste Management (IP&WM) Policy, Constitution of South Africa (Act 108 of 1996), Environment Conservation Act (Act 73 of 1989), Health Act (Act 63 of 1977),

Hazardous Substances Act (Act 15 of 1973), Human Tissue Act (Act 65 of 1983), Atmospheric Pollution Prevention Act (Act 45 of 1965)

These legulatory frameworks mention non-incinaration technologies as one of the alternative technology that can be employed on HCW management.

6.2.9 Tanzania

In Tanzania the legulatory framework that is relevant to HCWM includes the National standards and procedure for healthcare waste management in Tanzania, the Healthcare Waste Management National Policy Guidelines and the Healthcare Waste Management Monitoring Plan all of 2006. Other related legislation and guidelines include the National Environmental Policy 1997, Environmental Management Act, 2004, The National Environmental Action Plan, Air emission standards, Ministry of Health Waste Management Guidelines, The Local Government (District and Urban Authorities) Act of 1982, The Public Health Act (2001). These framework addresses issue of waste management in general to various generators.

Although incineration of medical waste is considered as the main means of treating medical waste in HCFs, the National Environmental Policy of 1997 requires that the use of environmentally sound technology (i.e. technologies that protect the environment, are less polluting, use all resources in a more sustainable manner, recycle more of their wastes and products, and handle residue wastes in a more acceptable manner than the technologies for which they are substituted) should be promoted.

Tanzania also has ratified several multilateral agreements that address issues of waste such as the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and their Disposal (1992) and the Stockholm Convention on the Persistent Organic Pollutants. The National Environmental Management Act, 2004 has provision that address POPs.

6.2.10 Zambia

The Environmental Protection and Pollution Control Act no. 12 of 1990, amended in 1999, is the principal law on environment and came into effect in 1992. This provides for the requirements for handling waste such as the licensing or permitting process for collection, transportation, treatment and disposal of waste. The Hazardous Waste Management Regulations Statutory Instrument No. 125 of 2001 provide for the control of hazardous waste so that the waste is managed in an environmentally sound manner through waste prevention, reduction, recycling, incineration and land filling. Also there is a Infection Prevention Guidelines of 2003.

Other supporting pieces of legislation with regard to waste management include the Local Government Act of 1991, Public Health Act of 1930, Local Government Act, Water and Sanitation Act, 1997, Environmental Impact Assessment regulations, Mines and Minerals Act of 1995, National Health Services Act of 1996, and Ionising Radiation Act of 1975.

7.0 LAND DISPOSAL ISSUES IN AFRICA

7.1 Introduction

In African countries there are two distinct types of waste disposal to land i.e. open dumps and sanitary landfills. In some countries if a municipality or HCF lacks the means to treat wastes before disposal, the use of a landfill is regarded as an acceptable disposal route. However, in most cases the primary objections to landfill disposal of hazardous health-care waste, especially untreated waste, may be cultural or religious or based on a perceived risk of the release of pathogens to air and water or on the risk of access by scavengers.

In health-care establishments that use minimal programmes for healthcare waste management, particularly in remote locations or in areas experiencing exceptional hardship, the safe burial of waste on hospital premises is the only viable option available. In most cases hospitals in remote area practice open burning of healthcare waste.

In all countries surveyed sharps waste are not allowed to be disposed in the dump site. In some countries hospitals have constructed sharp pits for sharps disposal. Residue from incineration i.e. ash is disposed in pit at the hospital premises and in some countries ash is disposed in the landfill; anatomical waste and placenta are often disposed in pit usually constructed in HCFs premises, however, in most African countries only few hospitals have placenta pits.

In town and cities in most cases open dumping is practices especially for the municipal solid waste (households waste). Dumping of untreated HCW is also practiced in many countries due to unavailability of treatment facilities as well as frequently breakdown of incinerators. However, this type of dumping is not often controlled as they are no agreed rules of on-site working with scavengers, no fence to secure dumping perimeter and in most cases no soil to cover the waste dumped in the site. Many municipalities also lack necessary equipment that can make provision of burring waste on-site.

Generally, many African countries lacks proper sanitary landfills that can provide geographical isolation of wastes from the environment, appropriate engineering preparations before the site is ready to accept wastes, staff to control operations and an organized diposit and daily coverage of waste. This is due to the fact that upgrading from open dumping directly to controlled dumpsite if not sophisticated sanitary landfills may be technically and financially difficult for many countires municipalities.

7.2 Land Disposal Issues in Surveyed Coutries

Below are land disposal issues from various countries surveyed in Africa.

7.2.1 Gambia

There is currently no sanitary landfill in the country. There are three authorized Dumpsites (Bakoteh, Mile II, and Tambana in KMC, Banjul, and Brikama). Most of the health care waste generated in these three municipalities finds its way to these dumpsites. In all these sites domestic waste is co-disposed with HCW including sharps. None of these sites are fenced and there is no control over the tipping. Children and animals frequent the sites and the waste is frequently burnt.

In order to consider the option of Land filling of HCW in the Gambia, there needs to be a landfill in the first place, appropriately secured and equipped to ensure the proper management of HCW. HCW needs to undergo some form of treatment to decontaminate at the level of health facility before final disposal.

7.2.2 Ghana

In Ghana, disposal at dumping site through the municipal authority is the most method employed in the disposal of solid waste i.e. infectious, general, and pharmaceutical and in some cases sharps. The dumping grounds are not engineered to serve as sanitary landfill sites. They therefore constitute high potential for the spread of infections through run offs during rains and contamination of underground water.

7.2.3 Kenya

According to the national plan 90% of waste, which are generally collected from various HCFs in Kenya, is disposed through crude dumpsites. Many institutions do not have dumpsites. The plan emphasised that special measures are further has to be introduced for the disposal of treated HCRW (when using an autoclave), as un-shredded residues should under no circumstances be accessible to waste reclaimers due to the presence of sharps as well as the remaining risk of infection.

7.2.4 Lesotho

In the whole country there is no sanitary landfill. The Ministry of Local Government is the one responsible for allocation and management of disposal sites. And the areas currently used in urban areas for disposal of solid waste are undeveloped and inappropriate sites that have been selected for such purpose by the municipality or town clerks. The very same sites are used for disposal of medical waste in urban areas. Most of these sites are also unprotected and this can attract the people to come for scavenging.

There are no legal or official disposal sites in rural areas. Each health center has its own way of disposing of the waste. As mentioned above some clinics send their needles to the hospitals for incineration, and the hospital will take care of the disposal too. The

anatomical waste is buried, and in some other cases the needles are buried along with anatomical waste, while the rest of the waste is burned at the disposal heap. There are a few clinics that have built kilns where they burn all their waste and bury it afterwards.

7.2.5 Nigeria

The poor disposal practices of many hospitals, clinics and health centres in Abuja are likely representative of practices throughout Nigeria. Almost all the healthcare institutions dispose of all wastes to municipal dumpsites without pre-treatment. Sometimes the Institutions bury their waste in the hospital premises. There is no proper sanitary landfill where treated medical waste can be disposed off. However, the laws required that health care waste shall be disposed off in a way that wil not be detrimental to public health.

7.2.6 Senegal

In Senegal there is no sanitary landfill that can be used to dispose of waste. Cemeteries are used for disposing of anatomical waste.

7.2.7 South Africa

According to the draft HCRW management regulations in terms of the national environmental management (Waste management Act 2008); final disposal of treated healthcare risk waste may not occur in a manner which causes harm to the public health or the environment. The regulations requires that

1 All healthcare risk waste must be treated by a licensed treatment facility prior to disposal.
2 Treated healthcare risk waste that is solid or semi-solid may only be disposed of at a waste disposal facility that is licensed to receive such waste and which is registered on the National Waste Information System.
3 Treated healthcare risk waste that is liquid must be discharged to a public sewage system in a manner that complies with all applicable wastewater discharge by-laws of the relevant Municipality and any other legislative requirements.
4 The disposal facility must maintain a records of the volume all treated healthcare risk waste received for disposal for a minimum of 3 (three) years.
5 The disposal facility must submit to the Department, upon request, copies of any records which the disposal facility is required to maintain.

7.2.8 Tanzania

In Tanzania there is no sanitary landfill suitable for disposal of HCW. The Environmental Impact Assessment (EIA) and Audit Regulations of 2005 require that EIA shall be carried out before hazardous waste is disposed of into soil, land, air or body of water.

National standards and procedure for healthcare waste management in Tanzania elaborated that untreated HCW should not be disposed in the dumpsite. Moreover in case of disposal of treated waste daily covering is required to prevent scavenging activities. The dumpsites are controlled by the municipal/City Authority; however in most cases these sites are not secured and controlled. Also the authorities' lacks equipments required to ensure proper disposal.

7.2.9 Zambia

Land disposal of healthcare waste with safe burying with provision and use of liners to prevent ground water contamination is adviced when other treatment oprions is not available. Rubbish pit should be dip and protected to prevent scavenging. In most cases in Zambia untreated HCW dumped at general waste dumpsites and access to the disposal sites is not always restricted.

8.0 CONCLUSION AND RECOMMENDATION

8.1 Conclusion

The assessment concluded that there are considerable number of health care facilities in Africa with different capacities and its waste disposal need to be highly considered. Many of these HCFs are public driven and they depend much on the government budget to run various servises including that of having a HCWM system.

The generation of waste in Africa varies considerably between same levels of HCFs due waste manegement methods, type of HCFs, propotion of patients treated daily and the degree of specialization of the health facility. In some countries surveyed e.g. Gambia, Lesotho the waste generation data shows that the ratio of infectious waste and general waste is almost the same which indicate that segregation is not well conducted. However, data indicated in this reports from various countries can be used as baseline to estimate the capacity of the treatment facility under the project.

In surveyed countries Many HCFs have no specific budget for waste management; any resources required for this purpose come partly from government budget as well as operational budgets which are passed onto the patients through the cost sharing system.

Many of HCFs lack elaborated legal, policy specifically for HCW and institutional framework for HCWM. However, many of the countries surveyed and others in Africa has ratified Stockholm, Basel and Rotterdam Conventions and therefore has obligation to make sure that treatment and disposal of HCW does not cause harm to human health and the environment. HCFs do also face with inadequate and sub-standard healthcare waste treatment and disposal facilities. Many countries use De Montfort incinerators and there has been reports on inoperative or operating below standards. In some hospitals they have re-built their incinerators in a number of times due to frequently break down.

In African countries lacks proper sanitary landfills that can provide geographical isolation of wastes from the environment, appropriate engineering preparations before the site is ready to accept wastes, staff to control operations and an organized diposit and daily coverage of waste.

8.2 Recommendations

The study therefore recommends that issues identified in this study should be clearly considered when designing the technology for the GEF project and laying down strategies for up-scalling in various countries in Africa.

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APPENDIX

APPENDIX A1: Cost of De Montfort Incinerators under two usage Scenarios

Table A.1: Costs of De Montfort type incinerators under two usage scenarios with and without enhanced operation

Category	Unit rate	Current Conditions				Enhanced Operation, Training, Maintenance			
		Low Use Scenario		High Use Scenario		Low Use Scenario		High Use Scenario	
		Unit price or quantity	Annual Cost	Unit price or quantity	Annual Cost	Unit price or quantity	Annual Cost	Unit price or quantity	Annual Cost
Waste Burned	Weight waste per box (kg)	0.75		0.75		0.75		0.75	
	No. safety boxes per burn	15		50		15		50	
	Burns per year	12		52		12		52	
	Total weight burned (kg/yr)		135.00		1950.00		135.00		1950.00
Initial Costs	MWI construction cost ($)	2000.00		2000.00		2000.00		2000.00	
	Shelter, Pit, etc. cost ($)					300.00		500.00	
	Lifetime (year)	3.00		3.00		3.00		3.00	
	Interest rate (%/year)	4.50		4.50		4.50		4.50	
	Annualized cost ($/yr)		727.55		727.55		836.68		909.43
Operating Costs	Person hours (hr/burn)	2.00		6.50		3.00		7.50	
	Labor cost ($/hr)	0.67		0.67		0.67		0.67	
	Total Labor cost ($/year)		16.00		225.33		24.00		260.00
	Fuel cost /burn (1L kerosene, $)	0.47		0.47		0.47		0.47	
	Solid fuel (3.5 kg/kg waste, $/kg)	0.07		0.07		0.07		0.07	
	Total fuel costs ($/yr)		14.86		157.98		14.86		157.98
	Cost of safety boxes ($)	1.33		1.33		1.33		1.33	
	Total safety box cost ($)		240.00		3466.67		240.00		3466.67
Maintenance Costs	Percent of Capital costs (%)	10.00		10.00		20.00		20.00	
	Maintenance cost ($/yr)		200.00		200.00		460.00		500.00
Training + Oversight	Operator training costs (24 hrs/year)					16.00		16.00	
	Inspections (1 hr 12 times/year)					8.00		8.00	
	Management and permitting (4 hr/year)					40.00		40.00	
	Total additional labor costs						64.00		64.00
Total annual cost ($/yr)			1198.40		4777.53		1639.54		5358.08
Cost per kg ($/kg waste)			8.88		2.45		12.14		2.75

Source: Findings on an Assessment of Small-scale Incinerators for Health-care Waste, S. Batterman, Water, Sanitation and Health Protection of the Human Environment World Health Organization Geneva 2004

APPENDIX A2: LEGAL INSTRUMENTS

Table A.2: Legal Instruments Related to Health Care Waste in African Countries

Country	Legal Instruments	Focus Related to Waste Management/HCW
Tanzania	National standards and procedure for healthcare waste management in Tanzania 2006	They do provide framework for managing healthcare waste in health care facilities in the country. They address issue on type of waste, segregation, training, transportation and disposal facilities. Also issue of health care worker safety are considered.
	Healthcare Waste Management National Policy Guidelines 2006	
	Healthcare Waste Management Monitoring Plan of 2006	
	The National Environmental Action Plan	Addresses Urban Environmental Pollution and solid waste management by setting-up standards and defining permitting requirements as well as promoting environmentally sound waste collection, transportation and disposal systems for urban and protected areas or by establishing emergency sites for solid waste disposal, until permanent ones can be found
	Air emission standards and the prepared Waste Management Guidelines	They provide comprehensive management guiding principles. The provisions contained for the management of hazardous waste, including HCW, are incomplete and not directly applicable for the municipal authorities and the HCFs.
	The Local Government (District and Urban Authorities) Act of 1982	The Municipal and District Authorities are responsible for the collection and transportation of the solid waste generated in their area of jurisdiction. With the current decentralisation process, this responsibility is constantly increasing. details the responsibilities of districts and urban councils, including solid waste management'
	The Public Health Act (2001)	Represents a major step forward to regulate and consolidate the promotion, the prevention and the maintenance of public health in Tanzania. This Act broaches the public health services and related topics in a comprehensive and functional manner. The provisions related to solid waste management or occupational, health and safety reflect the current situation encountered in the country but no specifications are consigned in this document to enforce hygiene and infection control in the Tanzanian HCFs.
	Guildeline Standards for Health Facilities edited by the MOH in 1996	Contains specific provisions related to wastes generated in medical institutions: "a functioning incinerator for waste management is required" for Dispensaries and Health Centres but neither further details are provided regarding the type of incinerator nor for the equipment that is needed for segregation, handling and transport
	National Environmental Policy 1997	
	Environmental Management Act,	

	2004	
Nigeria	Decree n° 58 of 1988	Establishes the Federal Environmental Protection Agency with: a) the responsibility to monitor and help enforce environmental protection measures; b) the duty to co-operate with Federal and State Ministries, Local Governmental Councils and research agencies on matters and facilities relating to environmental protection; c) the powers to establish standards, inspect, search, seize and arrest offenders.
	Decree n° 42 of 1988 Harmful Waste (Special Criminal Provisions, etc)	Prohibits the carrying, depositing and dumping of harmful wastes (injurious, poisonous, toxic or noxious substance) and prescribes penalties for those found guilty of improper practices.
	Decree n° 86 of 1992.	Sets out the procedures and methods for environmental impact assessments on both public and private projects and states that the "construction of incineration plants" requires an environmental assessment
	S.I. 8 National effluent limitation of 1991	Makes it mandatory for industrial facilities to install anti-pollution equipment and make provision for effluent treatment. It also prescribes maximum limits of effluent parameters allowed for discharge.
	S.I. 9 National pollution abatement in industries and facilities generating wastes of 1991	Imposes restrictions on the release of toxic substances and stipulates requirements for monitoring of pollution to ensure that permissible limits are not exceeded.
	S.I. 15 Management of Solid and Hazardous Wastes Regulation of 1991	Deals with facilities that generate solid and hazardous waste. It also covers hazardous waste treatment and disposal facilities and indicates requirements for such facilities including contingency planning, emergency procedures, and alike. Part 12 of this regulation provides for the tracking of wastes from their point of generation to the final disposal with specific details at §103 regarding HCW. Schedule 6 lists the different types of "infectious wastes
	Nigeria's National Policy on Environment was first published in 1989 and revised in 1999.	It describes strategies for achieving the policy goal of sustainable development. Sanitation and waste management as well as toxic and hazardous substances are presented. No specific mention is made of HCW, although a number of points can be applied to hazardous substances
	Draft blueprint on municipal solid waste management in Nigeria 2000	This comprehensive document presents strategies for the sustainable management of municipal waste which take into account technical, legal and financial as well as public awareness aspects. It discusses the responsibilities of the different levels of authority (local government, state and federal, pp. 14-16) and highlights a number of critical areas and hints possible solutions.
	Blueprint: Handbook on hazardous waste management	This document provides a number of definitions and strategies regarding hazardous waste management as well as a categorization scheme based on the Basel Convention on Control of the Trans-boundary Movements of Hazardous Waste and their Disposal, signed and ratified by Nigeria.

	Blueprint on environmental enforcement, a citizen's guide	This document aims at defining who the enforcers are (FMENV, SEPA, LGA); how compliance, monitoring and inspections are conducted as well as types of enforcement actions and tools available. Citizens are encouraged to play an active role both by complying with environmental laws/rules at home and on the job as well as signalling any suspect activities they may notice.
	Blueprint on compliance monitoring inspections	This guide provides some basic information about the different types of inspections and how to carry them out.
Zambia	The Environmental Protection and Pollution Control Act • The Hazardous Waste Management Regulations • The Waste Management Regulations	This provides for the requirements for handling waste such as the licensing or permitting process for collection, transportation, treatment and disposal of waste.
	Public Health Act, Cap 295	• Prevention and suppression of diseases and to regulate all matters connected with public health • Confers powers and imposes duties on local authorities regarding the disposal of solid and liquid waste
	Local Government Act	Sets out the functions of the local authorities with respect to waste management
	Water and Sanitation Act, 1997	• Established the Central Board of Health • Established the National Water and Sanitation Council • Regulates water supply and sewerage service provision
	Environmental Impact Assessment regulation	Assists to plan to mitigate environmental impacts likely to arise from developmental projects
Uganda	The National Environment Management Act Cap 153 LOU	
	Occupational Safety and Health Act No 9, 2006	

Ghana	The National Environmental Sanitation Policy (1992)	Guide development in accordance with environmental quality requirements to prevent, reduce and as far as possible, eliminate pollution and nuisances. Requires all health institutions to establish institutional waste management systems for the primary storage wastes. The health institutions are required to pre-treat Health-care waste (e.g. by autoclaving) prior to storage. The policy further states that District Assemblies shall provide separate collection of hazardous and Health-care waste. Transport of such waste shall be in closed no-compaction vehicles which should be cleaned and/or disinfected at the end of every collection day.
	• Local Government Act 462 (1993) • Town and Country Planning Ordinances Cap 84 (1944) • Ghana Building Regulations LI. 1630 (1997) • Vaccination Ordinance Cap 76 • Quarantine Ordinance Cap 77 • Mosquito Ordinance Cap 75 • Infectious Disease Ordinance • Food and Drugs law 305b (1992) • Environment Protection Act 490 (1994) • Environmental Assessment Regulation 1652 (1999) • Criminal Code Act 29 (1960) • Mortuaries and Funeral Facilities Act 563 (1998)	Laws and regulations pertaining to the protection of the environment and health.
Eritrea	National Environmental Management Plan in 1995	
		Although there is no Public Health Act in Eritrea to regulate and consolidate the promotion, the prevention and the maintenance of public health, the MOH prepared in 2002 standards20 providing guidelines to improve the quality of care in Eritrean HCFs.
Kenya	Public Health Act Cap 242	This Act provides the impetus for a healthy environment and gives regulations to waste management, pollution and human health.
	Radiation Protection Act Cap 243	The Act prohibits the unauthorized manufacture, production, possession or use, sale,

		disposal, lease, loan or dealership, import, export of any irradiating device or radioactive material. All authorized buyers, sellers, users, of such device must be properly licensed. The Act is administered by the Chief Radiation Protection Officer assisted by a Radiation Protection Board.
	Pest Products Control Act 346	This Act therefore may be relevant to the management of health care waste with respect to the handling of waste arising from the use of pest control products within health care establishments. Such products must be handled in ways that meet the requirements of this Act both in terms of classifying the products but also in terms of labeling them.
	Medical Practitioners and Dentist Acts 253	The Medical Practitioners and Dentists Act, Chapter 253 provides for registering medical practitioners. It establishes a Medical Practitioners and Dentists Board as the regulatory authority. Under the Medical Practitioners and Dentists (Private Practice) Rules) no private practitioner shall operate a private clinic unless the premises where the clinic is situated have been approved by the Board. In the context of its responsibility to approve health care establishments the Board imposes requirements for the handling and disposal of health care waste.
	Environmental Management and Co-ordination Act 1999	The Act provides for the establishment of an appropriate legal and institutional framework for the management of the environment in Kenya and for matters connected therewith and incidental hereto. It obligates the Standards and Enforcement Review Committee to prescribe standards for waste, their classification, and analysis and to formulate and advise on standards of disposal methods and means for such waste. The draft Bio-Medical Waste (Management and Handling) Regulations have been prepared under these provisions.
	Physical Planning Act	This Act provides for the preparation and implementation of physical development plans for any development whether they are HCFs or infrastructure like incinerators. Any one who deposits refuse, scrap or waste materials in a designated area without the consent of the planning authority or the relevant local authority shall be guilty of an offence under the regulations.
Gambia	The Drug Policy	One of the aims of the drug policy is to ensure that all unwanted drugs and medical supplies and associated waste are disposed of promptly, efficiently and safely. It recommends suitable measures to be instituted for the regular identification, collection and safe disposal of expired or otherwise unwanted drugs and medical supplies in public health facilities, through inter-sector collaboration with stakeholders in order to minimize hazard to the community and damage to the environment.
	The Public Health Act 2001.	The draft Public Health Act 2001 has made provision of HCW. Section 23 of the revised Public Act 2001 empowers the Secretary of State for Health (SOS) to set guidelines for the storage or disposal of soiled or infected equipment, materials and infected organs from a hospital, health center or medical treatment unit.
	The National Health Policy-Changing For Good (1994-2000)	The policy was envisaged as a framework for future National Health Development; with the aim of improving the health status of The Gambian population to enable them live an

		economically productive life. While there was clarity of purpose, with good intentions to provide an efficient and effective service, environmental health issues have not been addressed in particular HCW management.
	The Draft Environmental Health Policy	The draft Environmental Health Policy has identified poor solid waste management as a major health problem particularly in the urban centres. This policy also fails to address specifically the management of HCW among its policy issues.
	National Environment Management ACT 1994	The Act amoung other things provide procedure for Solid waste management. In part A of the Schedule to the Act, Environment Impact Assessment (EIAs) is specifically required for sites earmarked for solid waste disposal, such as landfills and incinerators and for hazardous waste disposal. The Act does not address healthcare waste management issues in detail. .
	Waste Management Bill, 2003	The Draft Waste Management Bill is the only specific legislation on waste. It has provision for the development of regulations on special waste streams such as medical waste, industrial waste etc.
South Africa	DEAT – DRAFT HCRW POLICY – VERSION 2 - 23RD DECEMBER 2008 Draft HCRW Regulations – Version 2.2 13th January 2009	
	SABS 0248 Code of Practice for the Handling and Disposal of Waste Materials within Health Care Facilities	
	Integrated Pollution and Waste Management (IP&WM) Policy	
	Constitution of South Africa (Act 108 of 1996)	
	Environment Conservation Act (Act 73 of 1989)	Restrict establishment, provision or operation of any disposal site without a permit issued by the Minister of Water Affairs and Forestry". Permits are issued subject to certain conditions.
	Health Act (Act 63 of 1977)	Provides for regulations relating to communicable diseases, which may address the disposal of any waste or other matter that may cause the development of a communicable disease.
	Hazardous Substances Act (Act 15 of 1973)	Provides for the control of substances that may cause injury or ill health to or death of human beings by reason of their toxic, corrosive, irritant, etc. nature.
	Human Tissue Act (Act 65 of 1983)	Section 37(1) (a) provides for the Minister of Health to make regulations regarding the disposal of human bodies and tissue.
	Atmospheric Pollution Prevention Act (Act 45 of 1965)	

	Integrated Pollution and Waste Management (IP&WM) Policy	The pollution avoidance/prevention and waste minimisation approach that focuses on the source of waste and moves away from "end-of-pipe" solutions.
	SABS 0248 Code of Practice for the Handling and Disposal of Waste Materials within Health Care Facilities	Provides guidelines on the handling of waste materials within health facilities
	Draft HCRW Regulations – Version 2.2 13th January 2009	Seek to address the management of Healthcare risk in Healthcare facilities in South Africa from its generation to disposal.
	DEAT – DRAFT HCRW POLICY – VERSION 2 - 23RD DECEMBER 2008	This policy document presents the framework within which the healthcare risk waste shall be implemented in South Africa. The policy deals with healthcare risk waste, its management and the treatment thereof.
Lesotho	Health and Social Welfare Policy	This policy encompasses the subject of waste management in general and does not pin-point on medical waste.
	National Environment Policy	One of the policy objectives is to ensure that there are guidelines for the proper handling and disposal of waste in order to reduce pollution and the spread of disease. The strategies to achieve this objective include: the design of environmentally friendly waste disposal and treatment systems; establishment of standards; and establishment of monitoring programmes.
	Constitution of Lesotho	"Lesotho shall adopt policies to protect and enhance the natural and cultural environment of Lesotho for the benefit of both present and future generations and shall endeavor to assure all citizens a sound and safe environment adequate for their health and well being."
	Public health Order 1970	In this mandate are found the clauses that address the issue of waste management at community, business and industrial levels only. It does not give provisions on waste generated from health institutions and applicable standards to its management. This mandate is to be enforced by health officers and other officers that may be appointed by the Ministry of Health and Social Welfare.
	Environment Act 2001	The Act does not have sections that precisely address issues on Medical Waste Management but there are sections that may be applicable. Under Section 27 of this Act, it is stipulated that Environmental Impact Assessment shall be undertaken for all projects and activities listed in the schedule attached to the Act, and some of the activities listed are applicable in construction of health facilities, treatment of medical waste and its disposal. The act also authorizes the Lesotho Environment Authority (LEA) to monitor and audit operation of such facilities. This Act further address the issues of management of hazardous waste, importation and

		exportation of hazardous waste and acquisition of disposal sites are addressed. And according to Section 77, for an institution to own and operate a waste disposal site or plant other than one used for domestic waste, it has to be in possession of a license to operate such facility.
	Urban Government Act 1983	In this Act the urban councils are mandated to provide, when a need arises, the sanitary services and refuse removal within the defined boundaries of the municipality.
	Sanitary Services and Refuse Removal Regulations 1972	In these regulations, the clauses that are relevant to medical waste are found in Section 14. The general stipulation of these is that no waste should be deposited or kept or stored within a public view in such a manner that it becomes nuisance, injurious and dangerous to health.
Senegal	Decree regulating the management of biomedical waste, August 2008	Article 4 of the decree give definition on type of waste generated in healthcare facilities. Article 11 highlighted on the disposal of healthcare waste while article 12 elaborate on the requirements on installation of the incinerator. With this decree any biomedical waste operator as stipulated under article 14must obtain an agreement from the Ministry in charge of health.