DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND TOURISM

PROGRAMME FOR THE IMPLEMENTATION OF THE NATIONAL WASTE MANAGEMENT STRATEGY

Starter Document for Health Care Waste

Background Document on the Management of Health Care Waste

Final Draft

May 2000

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EXECUTIVE SUMMARY

A brief study into the current status of health care waste management, the approach used internationally and the needs in South Africa has been conducted as part of the implementation of the National Waste Management Strategy by the Department of Environment and Tourism. Two starter documents on the Management of Health Care Waste have been produced; a Background Document and a Framework Document that outlines a preliminary approach to the development of Guidelines and Regulations for health care waste management. This document is the Background Document and should be read in conjunction with the Framework Document.

Only limited consultation with I&APs was carried out because of limited time and funding. Consulted in the process were the Department of Environment and Tourism, Department of Water Affairs and Forestry and Department of Health, Pretoria, the Gauteng Department of Agriculture Conservation and Environment, a waste management company and a survey was conducted amongst 29 health care facilities.

In general, the state of health care waste management in South Africa is poor. Contributing to this state of affairs is a lack of training and awareness, limited financial resources, particularly at the Provincial health care facilities, plus a lack of capacity at the authority level. Disposal of health care waste to inappropriate landfills and informal dumps is common in South Africa. While some institutions are managing infectious waste in an acceptable manner, almost none have acceptable procedures and management systems in place for chemical, including pharmaceutical waste, and low level radioactive waste.

Codes of practice are available in South Africa for the management of infectious and radioactive health care waste and the Minimum Requirements documents published by the Department of Water Affairs and Forestry provide acceptable procedures for chemical waste, but these are not implemented correctly within health care facilities. These codes only need to be adapted, modernised in parts and integrated in order to provide an acceptable total approach to health care waste management.

South Africa requires a network of regional or local modern treatment facilities for infectious health care waste in order to be able to implement a “best practice” solution. However, in the short to medium term, an interim solution is required that can more safely dispose of infectious waste until a “best practice” solution is implemented.

It is recommended that:

- An integrated guideline covering the whole management process for all types of health care waste should be developed. A draft starter document has been produced as part of this study.
- The starter documents produced in this study should be used a basis for a programme of wide consultation with all I&APs.
- Provincial Governments need to undertake a survey to determine the quantities, types and location of all types health care waste within their areas as well as the status of the available treatment and disposal facilities.
- Training and awareness programmes must be developed based on the guidelines and run within all health care facilities.
- Sufficient funding must be made available in order to undertake the required studies and implement the training and awareness programmes.

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1. INTRODUCTION

1.1 Project Background

Historically, waste management in South Africa was not afforded the priority it warranted, as an essential function required to prevent pollution and protect the environment and human health. Consequently, insufficient funds and human resources were allocated to this function. In many instances this neglect resulted in a lack of long term planning, a lack of information, a lack of appropriate legislation and a lack of capacity to manage the waste stream.

Section 24 of the Constitution of the Republic of South Africa (Act 108 of 1996) states that the people of South Africa have a right to an environment that is not detrimental to human health, and imposes a duty on the state to promulgate legislation and to implement policies to ensure that this right is upheld. To date, a number of steps have been taken to ensure this environmental right, including the publication of the Environmental Management Policy for South Africa (1998), the publication of the Draft White Paper on Integrated Pollution and Waste Management (IP&WM) (Notice 1686 1998), the promulgation of the National Water Act (NWA) (Act 36 of 1998) and National Environmental Management Act (NEMA) (Act 107 of 1998), and the development of a National Waste Management Strategy (NWMS) (1999). The Waste Management Series (Version 2), known as the Minimum Requirements, developed in 1998 by Department of Water Affairs and Forestry.

The IP&WM process identified waste as a key issue, and subsequently the development of a National Waste Management Strategy for South Africa was undertaken over the period 1997 to 1999 by the Department of Water Affairs and Forestry (DWAF) and the Department of Environmental Affairs and Tourism (DEAT), with financial support from the Danish Co-operation for Environment and Development (DANCED). The final NWMS, Version D, was issued on 15 October 1999. The overall objective of the NWMS is to reduce the generation and environmental impact of all forms of waste, to ensure that the health of the people and the quality of the environmental resources are no longer affected by uncontrolled and uncoordinated waste management. In line with the IP&WM approach, the NWMS addresses all elements in the waste management hierarchy.

During 1999, Action Plans were developed to implement the short-term priority strategic initiatives identified in the draft NWMS. The Action Plans addressed Integrated Waste Management Planning, General Waste Collection, the development of a Waste Information System, Waste Minimisation and Recycling, Waste Treatment and Disposal, and Capacity Building. In addition, a Project Plan on Implementing Instruments was prepared. The Action Plans are intended to assist the relevant spheres of government by detailing the main activities that will have to be undertaken, in order to successfully implement the priority initiatives of the NWMS and are thus procedural in nature. The Action Plans define targets, activities, tasks, responsibilities, timing, control procedures and the results/outputs expected.

One of the short-term priority strategic initiatives identified in the NWMS, and addressed further in the Action Plan for Waste Treatment and Disposal is:

> *"DEAT will develop guidelines for the safe management of medical waste by 2001, which will include guidelines for the separation of waste at source into infectious waste that requires incineration (according to the Human Tissues Act) and non-hazardous medical waste that can be disposed of by alternative methods."*

The activities necessary to successfully implement this priority strategic initiative are detailed in the Action Plan for Waste Treatment and Disposal.

DEAT has recently launched Phase 1 of the *DEAT NWMS Implementation Programme*, which comprises a number of activities necessary to fast track the implementation of the NWMS, and enable DEAT to meet its obligations in terms of the NWMS. These activities relate to:

- Integrated waste management planning
- A waste information system
- Waste collection services for high density unserviced areas
- Waste recycling
- Safe management of health care wastes

The overall aim of Phase 1 of the DEAT NWMS Implementation Programme is to produce **draft starter documents** for the above five high priority activity areas over the period January to March 2000. Consultants have been appointed to compile these documents, with the assistance of DEAT staff members and additional technical input from specialist individuals and/or organisations, where appropriate. After completion of the draft starter documents, DEAT may consult wider stakeholders as part of the implementation process.

This document constitutes the draft starter document for the Safe Management of Health Care Wastes.

1.2 Scope of Project

The scope of the project includes the consideration of all types of health care waste. However, because general waste generated in a health care facility can be managed simply in accordance with the Department of Water Affairs and Forestry's Minimum Requirements [1,2,3], it is not considered in any detail.

1.3 Terms of Reference

The bases for this study on health care waste management are the National Environmental Management Act and the Department of Environmental Affairs and Tourism National Waste Management Strategy Action Plan on Waste Treatment and Disposal [4]. A draft starter document is to be produced that includes:

- A definition of health care waste.
- Identification of those institutions that generate health care waste.
- A brief survey of health care facilities.
- A description of current management systems including procedures for the handling, collection, storage and packaging.
- Systems are to be proposed for the minimisation, recycling and separation of health care waste.
- Transport of health care waste.
- Treatment and disposal of health care waste.
- Infection risks and protective measures, workers health and safety.
- Quality assurance.
- Emergencies
- The legal framework for managing health care waste.

In depth discussions were to be held with the Department of Health, Hospital Superintendents, Heads of Clinics, Doctors and Waste Service providers.

1.4 Limitations of Project

The major limitation for the project was the very short time frame – from the 18th January to the 24 March 2000. This considerably restricted the opportunity to discuss the project with a wide range of interested and affected parties. The Department of Health, Pretoria was consulted extensively, but only a limited number of hospitals and their responsible persons could be interviewed due to lack of funds and time. The report of these interviews is given in Appendix 1.

One extremely important aspect that must be addressed in the future is the identified need for education and awareness programmes on health care waste. Hopefully, this report can act as a foundation for the development of these programmes.

1.5 The South African Legislative and Policy Context

There are a number of laws, policies and guidelines administered by different spheres of government, which relate to the management of health care wastes; the most important of these are discussed briefly below.

1.5.1 Constitution of South Africa (Act 108 of 1996)

In terms of the Constitution, a number of functional areas relating to integrated pollution and waste management are a *concurrent national and provincial legislative competence*. These include environment, health services and pollution control. In the event of a conflict between national and provincial legislation, the national legislation will prevail.

Provincial planning and abattoirs fall within the functional area of *exclusive provincial legislative competence*, as does the regulation of certain local government matters, including cleansing; control of public nuisances; refuse removal, refuse dumps and solid waste disposal; cemeteries, funeral parlours and crematoria; facilities for the burial of animals; and municipal abattoirs.

The local sphere of government consists of metropolitan councils, regional services councils and municipalities, which have *legislative and executive authority* over the following matters relating to the management of waste: air pollution; cemeteries; control of public nuisances; municipal planning; refuse removal, refuse dumps and solid waste disposal; and sanitation services limited to domestic waste water and sewage disposal systems.

1.5.2 Environment Conservation Act (Act 73 of 1989)

In terms of Section 20 of the Environment Conservation Act (ECA) (Act 73 of 1989), no person may "establish, provide or operate any disposal site without a permit issued by the Minister of Water Affairs and Forestry". Permits are issued subject to certain conditions.

DWAF has developed the Minimum Requirements documents to set environmentally acceptable standards for (i) waste disposal by landfill; (ii) the handling, classification and disposal of hazardous waste; and (iii) water monitoring at waste management facilities. The standards set in the Minimum Requirements are based on a classification system described in the documents. The Minimum Requirements are enforced through the landfill permitting system. The classification system for hazardous waste is based on the SABS Code 0228, *Identification and Classification of Dangerous Substances and Goods*, which in turn is derived from the International Maritime Dangerous Goods Code. A significant proportion of health care wastes would fall into Class 6 of SABS Code 0228: *Toxic and infectious substances*. It is a Minimum Requirement that infectious waste be destroyed and any residue such as ash must be evaluated in terms of the Minimum Requirements and be given a hazard rating.

In addition, disposal of waste in terms of Section 20 was identified under Section 21 of the ECA (GN 1182 of 5 September 1997) as an activity "which may have a substantial detrimental effect on the environment". As a result, the Regulations regarding environmental impact reports (GN 1183 of 5 September 1997) are applicable to the disposal of waste, and written authorisation in terms of Section 22 of the ECA must be obtained, usually from the provincial environmental departments, before the activity may be undertaken.

However, the definition of waste for the purposes of the Environment Conservation Act (GN 1986 of 24 August 1990) excludes wastewater and effluent, building rubble used as fill material, radioactive materials, mining waste and ash resulting from power generation. Consequently, disposal of these materials is not subject to the requirements of Section 20 or related requirements. In some instances, there is uncertainty as to the legislation, which is applicable to certain materials, due to interpretation of the definition, and other legislation applicable to those materials.

1.5.3 Health Act (Act 63 of 1977)

In terms of Section 20 of the Health Act, local authorities have a responsibility to maintain their district in hygienic conditions. These powers also pertain to sewage purification and sewage sludge treatment, storage, processing, utilisation and disposal. These powers and authority were assigned to the Provinces in a Government Gazette Notice No R 152, 1994.

Section 33 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. In terms of Section 34, regulations relating to conditions dangerous to health may be made.

Section 38(1)(a&g) grants the Minister of Health power to make regulations to control a number of health-related solid or liquid waste aspects. *Proposed Regulations for the Control of Environmental Conditions constituting a Danger to Health or a Nuisance* were published in the Government Gazette on 4 February 2000, for comment. The proposed regulations contain definitions of, *inter alia*, "biomedical material" and "medical waste", and would regulate certain aspects of health care waste management, if promulgated in their present form.

1.5.4 Hazardous Substances Act (Act 15 of 1973)

The Hazardous Substances Act, administered by the Department of Health, 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.

Section 3A(1) relates to Group IV Hazardous substances; permission is required to produce, acquire, dispose, import or export, etc. such substances. This provision also relates to the "use of radioactive substances in industry, research and medicine (non-nuclear applications)", and would thus be relevant to the management of health care waste containing such substances. The body responsible for administering the legislation governing this legislation is the Directorate: Health Technology of the Department of Health in Cape Town. A "Code of Practice for the Management and Disposal of Non-nuclear Radioactive Waste", "Guidelines for the Safe Transport of Radioactive Material" and "Requirements for the Safe Use of Unsealed Radioactive Nuclides" have been published by this Directorate [5].

1.5.5 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.

1.5.6 Atmospheric Pollution Prevention Act (Act 45 of 1965)

Medical waste incineration was included in the Atmospheric Pollution Prevention Act (APPA) in 1993/1994. Before this, these incinerators were under the control of the local authorities. On implementation of the APPA, emission standards were defined in guidelines using international experience and taking into consideration the size and number of facilities in South Africa. However, since these emission standards could not

be achieved on any of the incinerators in South Africa, the following decisions were taken:

a) All existing incinerators must be upgraded or replaced to meet the required two-stage incineration temperatures and residence time by December 2001.

b) New incinerators, with a capacity of less than 1 000 kg/hour, must operate at the required temperatures and residence time. If the emission standards cannot be met, an acceptable dispersion model may be used to determine whether the incinerator is acceptably located.

c) All incinerators with a capacity of more than 1 000 kg/hour must be fitted with pollution control equipment.

1.5.7 Integrated Pollution and Waste Management (IP&WM) Policy

The *over-arching goal* of the IP&WM policy is to move from a previously fragmented situation of uncoordinated waste management to that of integrated waste management. The Government's White Paper on Integrated Pollution and Waste Management, which was published in March 2000, defines government's approach to the management of waste and pollution. It includes a holistic and integrated management approach extending over the entire waste cycle from cradle to grave including the generation, storage, collection, transportation, treatment and final disposal of waste.

The *IP&WM policy* represents a paradigm shift in South Africa's approach to waste management. Historically, pollution control focused primarily on impact management and remediation of pollution (although in the case of water quality management, the historical end of pipe control approach was replaced with a hierarchical approach, commencing with pollution prevention, as far back as 1992). However, to ensure sustainable development, the focus has moved to pollution prevention.

The National Waste Management Strategy process was undertaken to ensure that the IP&WM policy is translated into practice. Central to the development of the strategy for integrated waste management has been:

- The pollution avoidance/prevention and waste minimisation approach that focuses on the source of waste and moves away from "end-of-pipe" solutions.
- The need to extend an acceptable level of waste management services to all communities.
- To ensure public health and occupational health issues receive due attention in all waste management practices.
- To ensure that Department of Environmental Affairs and Tourism develops a framework within which all waste can be managed correctly. This includes ensuring that appropriate legislation, guidelines and regulations are developed, promulgated and enforced so that all unavoidable hazardous wastes are managed, treated and disposed in an acceptable manner.

The proper management of health care waste was identified as a high priority issue.

1.5.8 SABS 0248

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 [6]. While there are some important issues that need attention, this code of practice, which is in line with international standards, forms a strong base for the development of regulations on the management of health care waste. Apparently, there are proposals by the SABS to revise and upgrade this code of practice in light of new requirements and a working group meeting is to be held on this matter in late March 2000.

2. OVERVIEW OF ISSUES

2.1 Definition of Activity under Investigation

Health care waste includes all waste generated by health care establishments, including veterinary facilities, research facilities and laboratories and includes waste from minor sources such as home dialysis and insulin injections. The management of health care waste must occur from its cradle – the health care facility – to its grave, the disposal facility where the waste itself or residues after treatment are disposed.

2.1 Review of the waste streams

Health care waste can be separated into a number of categories that identify the major hazard or risk that they pose to human health and the environment, i.e.

- infectious,
- chemical
- radioactive and,
- general waste

Each of these can be divided into subcategories in a number of ways. Commonly, one can identify a specific hazard such as with genotoxic waste or sharps or otherwise the source or origin of the waste, such as pharmaceutical waste.

In South Africa, various attempts at legislating hazardous wastes have given rise to somewhat different approaches and definitions. In this report, one of the objectives is to classify, characterise and define health care waste so that it fits in with a single overarching approach to the classification of all wastes. In terms of the Minimum Requirements for the Classification, Handling and Disposal of Hazardous Waste [1] published by the Department of Water Affairs and Forestry, infectious waste, chemical waste and radioactive waste are all defined as ***hazardous waste*** and this approach is adopted throughout this document (See section 5 for the definitions of the various categories of Health Care Waste and for an in-depth discussion of the classification system).

2.2 Economic and Social Issues

The costs associated with the treatment of the infectious waste stream by incineration followed by disposal of the residues to landfill are high. Recent estimates suggest that the actual cost of incineration is around R1.55/kg and depending on the transport requirements, the overall cost can reach as much as R3.00/kg. Many of our hospitals have limited financial resources and therefore this cost represents a considerable financial burden. As indicated in section 2.1.3, a lack of funds may result in illegal disposal.

The high cost of infectious waste management can be minimised by operating a well-managed programme that leads to the segregation of general waste from the infectious

waste (section 2.1.3). This can result in considerable cost savings for treatment and disposal.

For some rural health care facilities, which generate very small quantities of infectious waste, the high cost of modern incinerators means that this is often not a cost-effective solution to the waste problem. Alternative options, such as transporting the waste to an urban facility are often impractical, because of the high transport costs. Therefore, practical cost effective solutions are required that will also minimise its potential impact on the environment.

To implement a programme of correct management of health care waste within a facility requires not only commitment from the management team but also the employment of a responsible person. In small institutions this can be assigned to the infection control officer, but at larger facilities a new person may have to be employed. However, once implemented a programme can lead to considerable cost savings on treatment and disposal and in the minimisation of time lost due to needle stick injuries and infection potentially caused by the incorrect handling of the material.

At the Provincial and Local level additional inspectors will be required within the Department of Health and the Regional Department of the Environment. It is essential that sufficient capacity is available since monitoring and auditing of facilities is required, as this will minimise illegal dumping and disposal at informal or disposal sites that are not permitted for the disposal of health care waste.

The proper management of health care wastes has important social consequences since illegal dumping usually impacts on the poorer sections of the community and on scavengers and other persons that can access the landfill sites.

Job creation is a central theme of Government policy and the proper management of health care waste will create opportunities particularly in the handling, collection, and transport of the waste and in the provision of training.

2.3 Stakeholders

Stakeholders include the following Government Institutions:

- Department of Health
- Department of Environmental Affairs and Tourism
- Department of Water Affairs and Forestry
- Department of Transport
- Provincial Departments of Environment
- Provincial Departments of Health and
- Local Health Officers

Other important stakeholders include:

- Environmental NGO's
- Trade Unions
- Residents near waste management facilities.
- Heads of Health Care Facilities
- Medical and Dental Council
- South African Nursing Association
- Veterinarians
- Pharmaceutical Manufacturers Association
- Waste Management Companies
- Institute of Waste Management

2.4 Design and Implementation of an Effective and Sustainable Programme

The control and management of health care waste falls directly into the portfolios of the Department of Health, Department of Environmental Affairs and Tourism and the Department of Water Affairs and Forestry, with some involvement form the Department of Transport. It is therefore essential that these Departments reach agreement on their respective areas of jurisdiction in order to develop a management and control strategy that will be effective and efficient. The National Departments are responsible for the development of the strategy and overall guidelines, whereas the responsibility for implementation of the strategy is the responsibility of the Provincial Departments of Environment and the Provincial Health Departments.

Within health facilities the waste material should be controlled through the infection control programmes of the hospitals, but when it leaves the premises it must be treated and disposed according to the regulations published by the Department of Environmental Affairs Tourism, the Department of Water Affairs and Forestry and the Department of Transport. Clearly, co-operation and agreement between the departments at all levels is required.

In order to ensure that the programme is acceptable to all stakeholders (Section 2.3), the proposals should be workshopped, reviewed and discussed with as many I&AP's as practicably possible.

Implementation will require an education and awareness campaign through all the media and the development of courses that can be run at health care facilities nationally.

The penetration and success of the implementation of the approach should be researched and health facilities monitored and audited, at least, an annual basis.

3. CURRENT STATUS IN SOUTH AFRICA

3.1 Status Quo

3.1.1 3.1.1 Sources of Health Care Waste

Health care waste includes that generated by health care institutions such as hospitals, clinics, doctors, veterinary facilities, research facilities and laboratories. Table 1 gives a summary of the types of institution and the numbers of facilities in each sector [7].

Table 1: Possible Sources of Health Care Waste in South Africa

Source	Subcategories	Number
Hospitals	Public, Private, Mining, Psychiatric and Rehabilitation, Hospices, etc.	876
Clinics	Public, Private, Dental, Day and Step Down Clinics	1486
Blood Transfusion Centres	-	78
Pharmacies	Retail and Hospitals	2988
Medical Practitioners	Private and Public	15623
Dental Practitioners	Private and Public	3045
Allied Practitioners	Acupuncturists, Paramedics, Blood Care Services, Veterinary etc.	2521
	TOTAL	26617

The nature of the hospital and clinic listed above can vary considerable both in location, i.e. urban, rural informal settlement and in size, e.g. from Chris Hani/Baragwanath that has an estimated 2800 beds though to a facility with no beds.

3.1.2 Quantities of Health Care Waste

The baseline study, that was carried out prior to the National Waste Management Strategy project, indicated that approximately 81 000 tonnes of waste is produced annually from hospitals, assuming that each bed produces 1.95 kg per day (UK figure). This figure, includes general waste, since estimates from a major private contractor managing medical waste in South Africa, indicate that the amount of infectious waste, i.e. that available for incineration amounts to only 0.5 kg/bed/day. A Botswana study that is reported in the reference 7 gives the figures in table 2.

Table 2: Estimated Health Care Waste Production in Botswana

Facility	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
Primary Hospitals	0.5/bed	1/100 beds per day	2/bed
Urban Clinic 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

Note that from the above figures the amount generated at rural facilities tends to be about 50% of that generated in urban area.

It is clear from the figures obtained in the table 2 that the quantities generated are somewhat variable and often reflects poor separation at source. A South African example, quoted by staff of a waste contractor, is that the Chris Hani/Baragwanath Hospital, which has about 2800 beds and a well co-ordinated and effective training programme that emphasises the proper segregation of wastes, generates around 1600 kg of infectious waste or 0.57 kg/bed/day. On the other hand, another Provincial Hospital in Johannesburg that has only 1200 beds manages to generate around 3400 kg of infectious waste or 2.83kg/bed/day.

According to one waste contractor, the quantities of infectious waste received by their incinerators are often cyclic. A maximum occurs in the winter, when more persons tend to become sick, and a minimum occurs at the end of the financial year, which is brought about by a lack of available funds. Some of waste generated at the end of the financial year is at best being treated in inadequate incinerators, although disposal with the general waste and even illegal dumping are possibilities.

3.1.3 Persons at Risk from Health Care Waste

The improper management of health care waste can affect a wide range of persons, the most at risk being:

- Doctors, nurses, and maintenance personnel
- Patients
- Visitors

- Workers in support services such as laundries, transportation and waste handling
- Workers at waste management facilities including incinerators and landfills
- Scavengers and even the public when the waste is being dumped.
- Workers and public, due to poorly operated treatment facilities, such as incinerators.

The hazards arise from infectious waste, chemical waste and radioactive waste.

There appears to be little data available in South Africa about the impact of waste on medical workers or the public. A waste contractor indicated that they have as many as one needle stick injury every two weeks due to the disposal of sharps into the incorrect waste containers. These injuries occur to staff that are wearing thick leather gloves, overalls and boots. Fortunately, all the staff have routine medical check ups, are vaccinated against hepatitis and are immediately put on a programme of AZT to minimise the risk of contracting AIDs. Studies in Japan indicate that there is ~ 7% chance of getting hepatitis (B & C) from a needle stick injury [8] and a 0.3% chance of HIV, although the incidence of HIV is much lower in Japan than South Africa.

3.2 Current problems

The National Waste Management Strategy project that was completed during September 1999 identified the correct management of medical or health care waste as a priority issue [4]. It was clear that there were many important issues that concerned the interested and affected parties taking part in the project. These included:

- Indiscriminate dumping of infectious waste at informal sites and non-inappropriately permitted facilities is occurring and is placing the public at risk.
- Incidents of the dumping of infectious waste have been well publicised in the media.
- Most incineration facilities generally cannot meet international standards or are otherwise being operated poorly.
- Segregation of health care waste was not happening and both general and chemical waste is being incinerated with the infectious waste stream.
- A large quantity of PVC waste is incinerated.
- Although radioactive waste only originates from a few health care facilities, many incinerator operators are not aware of the issues surrounding radioactive health care waste.
- The correct containers are not always being used for the collection of sharps and other infectious waste.
- Alternative technologies should be used other than incineration.
- The special problems of rural areas must be addressed.

- There is a lack of capacity at National, Provincial and Local level to implement and monitor infectious waste management at health care facilities.
- Guidelines for the Safe Management of Health Care Waste are required.
- Training programmes for health care workers are required.
- A Medical Waste Awareness and Education Campaign is required.

In South Africa, there have been a number of initiatives that have lead to, at least, a portion of the infectious waste stream being managed in a reasonably acceptable manner. For example, guidelines for the disposal of waste materials within health care facilities that are based on a Canadian system were developed published in 1993 by the SABS, (SABS 0248; 1993 [6]). Also, since 1990, systems for the handling and disposal of infectious waste have been introduced by waste management companies in collaboration with the Department of Environmental Affairs and Tourism, the Department of Health and the Department of Water Affairs and Forestry [4]. These handling, collection, treatment and disposal systems are based on many of the principles contained in SABS 0228 and those in use in the USA. Thus, although, some of the medical waste stream is managed reasonably well, the regular presence of medical waste in the general waste stream, on unpermitted disposal sites and even discarded illegally, indicates that many facilities are managing their waste incorrectly and that there is a considerable threat to human health.

A recent study in the Northern Province [9] found some disturbing practices in the major hospitals:

- For the collection of sharps, 46% of hospitals were using 5l plastic containers that originally contained cleaning fluid, 3% were using cardboard boxes and one hospital was even using Coca-Cola cans.
- Only 38% of the hospitals were using colour-coded bags for the collection of infectious waste and 57% were using the normal black bags, which means that the waste can easily be confused with general waste.
- There was a general lack of certainty regarding the type of waste that should be incinerated.
- While two thirds of the hospitals were incinerating all infectious waste, the rest were not treating or disposing some or all of their infectious waste in an acceptable manner.
- Five hospitals were sending sharps and seven were sending other infectious waste to a general waste disposal site.
- Three hospitals were found to be sending human anatomical waste such as placentas to a general waste disposal site and two had a “placenta pit” in the hospital grounds.

As part of this study into health care waste, a survey was carried out at hospitals in the Gauteng region using a questionnaire developed from that given by the WHO [8]. The full report of this survey is included as appendix 1. Twenty-nine health care facilities

were surveyed; 2 provincial hospitals, 2 private hospitals and 23 general practices. The following observations were made (see appendix 1 for a full discussion):

- The health care waste management practices were highly variable among the participants. For the hospitals, private facilities were generally better, probably because of greater financial resources to invest in proper waste management.
- For the general practitioners, both doctors and dentists, there was a wide range of attitudes and therefore the standard varied considerably. Some used proper sharps bins and others open cardboard boxes. For other infectious waste, some smaller rural practices burnt their waste in 210l drums, but significant amounts of the waste ended up with the general waste on landfill sites.
- Although segregation was often practised, the general labourers often simply emptied the segregated health care waste into municipal black bags during their rounds, thus negating the whole purpose of the system.
- Inspections noted instances of excessive waste lying around, "sealed" boxes that had burst open and boxes that were squashed or not taped sufficiently and there were overfilled sharps containers.
- At one facility, black bags containing placentas and macerated foetuses had to be stored over the weekend without refrigeration.
- Flushing and sluicing of formaldehyde, solvents and pharmaceuticals was apparently a common practice.

The main findings and conclusions of the survey were:

1. Lack of Motivation and Awareness

Based on the survey, it can generally be stated that there is considerable apathy and lack of awareness amongst the health care professionals regarding health care waste management. This of course does not serve to motivate the majority of staff who have to handle the health care waste. This lack of motivation and awareness at professional level also results in a failure to promote awareness and training programs to improve the situation, as well as the development of proper job descriptions for the people doing the work. At this level, most felt overwhelmed by the enormity of the task and were apathetic.

2. Insufficient Adequate Training

Of the four people encountered, who had had some training, only one was aware of the risks associated with health care waste and the principles of health care waste management. On investigation it was found that the training received was a "once off" training day comprising several lectures. Although there are Infection Control Committees in hospitals and clinics, there was insufficient emphasis on training in the management of Health Care Waste. Since health care waste management training is not a priority, it follows that the standard of health care waste management leaves much to

be desired. Cleaners and casual labourers, who empty colour-coded bags into black bags, had apparently never been trained or instructed regarding health care waste.

3. Lack of Time and Accountability

Many people interviewed used "lack of time" as an excuse for the low standard of health care waste management observed. This simply means it is not a priority, however, most people claimed that there wasn't time to do health care waste management within the time framework of their daily tasks. The reason for this is that, with one exception, health care waste management was not an integral part of someones job description. Consequently, no one was accountable for health care waste management and tended to pass the responsibility on to others. For example, doctors said they relied on nursing staff to clear up after them. One said it is an "inborn culture." The nurses on the other hand said that the medical students and doctors were totally unaware of health care waste management.

The following solutions are based on the experience of the consultants and the views of the people interviewed in the survey:

a) Management Involvement
b) Standardised Policy
c) Documentation
d) Training and Motivation
e) Development of Teams
f) Quality Assurance and Monitoring

There is clearly a need for proper guidelines that cover the whole health waste management cycle that can be used as a starting point, for the implementation of a co-ordinated programme for the controlled management of the hazardous waste streams. The management systems, when in place, should be monitored regularly by the management of the facility. A system of internal audits, regular inspections by the authorities and possibly annual external audits by accredited professionals should be used.

4. REVIEW OF INTERNATIONAL INITIATIVES

As indicated previously, the current approach to the management of infectious waste from health care facilities is based on systems and treatment methods that are utilised internationally. However, some of the management programmes and treatment facilities that are available are definitely not of such a high standard as those found overseas. Although, often this is related to the cost of modern facilities and a lack of capacity and resources at the authority level to properly implement the standards that are currently in place.

The management of hazardous waste in South Africa has been improved immensely since the publication of the first edition of the Minimum Requirements [1] in 1994. Compared to overseas, South Africa does lack general incinerators for the treatment of organic hazardous waste and this again is at least in part due to the high cost of these facilities. However, the waste classification system and the permitting procedure for landfills have been recognised by the World Health Organisation and other international bodies as being highly innovative and appropriate for a developing country.

The approach to the management of health care waste that has been used to guide the development of this report is that published by the World Health Organisation [8]. The overall approach is similar to that already used in South Africa, but there are some useful innovations particularly for the management of health care waste for rural clinics and other small generators.

In order to limit the overall size of this report, any appropriate new international initiatives have been built into the approach proposed for South Africa in section 5 below.

5. ANALYSIS OF CURRENT INITIATIVES AND THEIR IMPLICATIONS FOR SOUTH AFRICA

5.1 The South African Approach to the Classification of Health Care Waste

As indicated in section 2.2, infectious waste is considered a sub-category of hazardous waste. The Minimum Requirements for the Classification, Handling and Disposal of Hazardous Waste [1], uses as a primary classification scheme the International Maritime Dangerous Goods (IMDG) Code, which has been published as SABS Code 0228. The code divides hazardous materials, in this case hazardous wastes, into 9 categories based on their hazardous characteristics, i.e.

Class 1, Explosives

Class 2, Compressed Gases

Class 3, Flammable Liquids

Class 4, Flammable Solids

Class 5, Oxidising Substances and Organic Peroxides

Class 6, Toxic and Infectious Wastes

- 6.1, Toxic (poisonous) Wastes
- 6.2, Infectious Wastes

Class 7, Radioactive Wastes

Class 8, Corrosive Wastes and

Class 9, Miscellaneous Dangerous Wastes

Note that infectious waste is a subcategory of Class 6. Other wastes produced in the Health Care Sector include toxic materials such as many pharmaceuticals, drugs and cytotoxic substances; flammable liquids such as ether, alcohol and many formulated products such as cough mixtures; radioactive substances, which are class 7; and compressed gases, which are class 2. Radioactive wastes and infectious wastes are generally managed separately from the other categories, which all classify as chemical hazardous waste, whether they arise from a health care facility or the chemical and petroleum industry.

The Department of Health, recently published proposed regulations for the "control of conditions constituting a danger to health or a nuisance", that includes definitions and classification of health care waste [10]. The proposed approach closely follows that used in this document, except that the definition of chemical waste has been extended to include acutely toxic chemicals in-line with the Minimum Requirements [1].

5.1.1 Definition of Hazardous Waste:

The definition of hazardous waste is defined in the Minimum Requirements for the Classification, Handling and Disposal of Hazardous Waste [1] as:

> *Waste that may, by circumstances of use, quantity, concentration or inherent physical, chemical or infectious characteristics, cause ill health or increase mortality in humans, fauna and flora, or adversely affect the environment when improperly treated, stored, transported or disposed of.*

Note that *infectious waste* is considered in this definition as a hazardous waste.

5.1.2 Definition of Infectious Waste:

There are numerous definitions used for infectious waste and after considerable deliberation a modified version of the definition used in the Minimum Requirements for the Classification, Handling and Disposal of Hazardous Waste [1] is recommended.

> *Infectious waste is that waste that contains or is suspected to contain pathogens, bacteria, viruses, parasites or fungi in sufficient concentration or quantity to cause disease in susceptible hosts. It includes any waste that is generated during diagnosis, treatment or immunisation of humans or animals; in research pertaining to this; in the manufacturing or testing of biological agents – including blood, blood products and contaminated blood products, cultures, pathological wastes, sharps, human and animal anatomical wastes and isolation wastes.*

The definition is conservative and utilises the Precautionary Principal. Although much of the waste will not be hazardous, the risks posed by its potentially infectious nature are sufficient that it must be considered infectious unless proven otherwise. In South Africa, the waste is classified in terms of SABS Code 0228, "The Identification of Dangerous Substances and Goods" as Class 6.2 Infectious Substances

Within the definition of infectious waste are two subcategories that are sometimes referred to:

> *Anatomical (Pathological) Waste is waste that consists of tissues, organs, body parts, foetuses and animal carcasses (excluding blood and body fluids, teeth, hair, etc.).*

The sub-category, anatomical waste, is a useful one since it is usually managed in different way to other infectious wastes. In terms of the Human Tissue Act, human tissue must be incinerated and because of its generally offensive nature, technologies such as autoclaving and microwaving are not generally appropriate. In South Africa, certain religious customs require the burial of certain items of anatomical waste. An attempt was made to obtain information directly from the Muslim community religious leaders but this was not obtained within the short time period available for the project. The Muslim community should be consulted as an interested and affected party.

> *Sharps are items that could cause cuts and puncture wounds and includes needles, hypodermic needles, scalpels and other blades.*

Sharps and in particular needles that give rise to "needle stick" injuries are a major health hazard in Health Care facilities.

Infectious waste, such as old bandages, plasters, sanitary towels and babies nappies are often disposed with the general waste. In the UK, this infectious or potentially infectious waste collected from households with the general waste stream is not considered a major problem, because it is generated from a "generally healthy population". The same approach is generally accepted in South Africa, since like other hazardous waste in general waste, it is usually catered for when the landfill sites are constructed and operated. However, when the potentially infectious waste is collected in increased volumes, such as *sanitary waste* from ladies toilets, in public areas such as large buildings, shopping malls and airports then the risk becomes slightly greater. In South Africa, there are a number of companies providing services that provide storage bins in toilets and a regular collection service. Often these wastes are disinfected with a "proprietary disinfectant", the bins cleaned and the waste disposed to landfill. There has been no real control over this practice and *it is recommended that South Africa Guidelines developed and Regulations are promulgated to regulate this practice and that practitioners are permitted as waste treatment companies in terms of the Minimum Requirements* [1,2,3]. Note that, disinfectants are often highly hazardous in their own right (see table 5, section 5.3.4) and their disposal to landfills should be controlled. Also, decisions must be made as to whether disinfection of this waste stream is acceptable or sterilisation will be required, see section 5.3.2.

5.1.3 Chemical Waste

The definition of chemical hazardous waste is included in section 2.2.3 under hazardous waste, if one excludes the infectious characteristic. Chemical hazardous waste includes any waste that has one or more of the following four characteristics [1]:

- Corrosivity, pH <6 and pH >12
- Reactivity, (explosive, reacts with water, air or other wastes)
- Flammability, Flash Point <61°C
- Toxicity (poisonous)

Toxicity is defined in terms of the following parameters:

- acute toxicity to mammals ($LD_{50'}$)
- ecotoxicity (LC_{50}, fish)
- chronic toxicity
  - carcinogenicity,
  - mutagenicity,
  - teratogenicity
- biodegradability
- persistency

- bioaccumulation
- concentration and
- assimilation capacity of the environment.

Using these parameters the Minimum Requirements [1], classifies chemical waste into five hazard groups (HG1, HG2, HG3, HG4, Non-toxic):

Extreme Hazard (Group 1): is waste of first priority concern, containing significant concentrations of extremely hazardous waste, including certain carcinogens and teratogens, such as mercury, dioxins and polychlorinated biphenyls, and infectious wastes.

High Hazard (Group 2): is waste of second priority concern with highly toxic constituents, which are not persistent, including certain carcinogens such as arsenic trioxide and benzene.

Moderate Hazard (Group 3): is waste of third priority concern, which is moderately toxic or which contains constituents that are potentially highly harmful to human health or to the environment but are not persistent such as phenol and fluoride.

Low Hazard (Group 4): is waste that often occurs in large quantities and which contains potentially harmful constituents in concentrations that in most instances would represent only a limited threat to human health or to the environment - ethanol, acetic acid.

Non-toxic - Hazard Rating Lower than Group 4: if the hazard rating falls below hazard rating 1 to 4, the waste can be considered as non-toxic (N/T) and be disposed of as a delisted hazardous waste in a permitted general waste landfill.

Within the definition of chemical waste are a number of subcategories that are sometimes used:

Genotoxic waste has mutagenic, teratogenic or carcinogenic properties.

Note that genotoxic wastes, which include *cytotoxic (or antineoplastic)* drugs, are simply a sub-class of chemical waste and generally fall into the extreme hazard, HG1, and high hazard, HG2, groups.

Pharmaceutical waste includes expired, unused, spilt and contaminated pharmaceutical products, drugs, vaccines and sera that are no longer needed.

This category, which is simply an indication of the source of the waste, is not very useful since it implies to many people that the wastes are somehow different to chemical and other wastes. Whilst some live vaccines and possibly sera must be managed as infectious waste, most pharmaceuticals contain one or more active chemical ingredients that are often toxic plus many other chemicals added to act as a carrier for the drug, to add flavour, etc. Almost all pharmaceuticals must be treated as a hazardous chemical waste.

Compressed gases include gas cylinders, gas cartridges and aerosols.

In general, gas cylinders are not a problem for the health facility as they are recovered by the suppliers, both because they are valuable and in terms of the duty of care. Compressed gases are classified as SABS Code 0228, class 2 wastes. Aerosols, should be discarded only when empty and never included in the infectious waste stream since they explode in an incinerator causing rapid expansion of the gas with a transient increase in the emission of particulates and other pollutants and potentially damage the incinerator.

Heavy Metal Wastes includes mercury from broken thermometers, blood pressure gauges and used batteries.

Mercury and its compounds are an extreme hazard, HG1 and must be managed as a chemical hazardous waste.

5.1.4 Radioactive Waste from Health Care Facilities

Radioactive waste, which includes solid, liquid and gaseous wastes, contaminated with radioactive nuclides is generated in health care facilities in two forms, *unsealed* or open sources and *sealed* sources [5,8]. Sealed sources are usually contained in equipment or as needles or seeds that may be re-used after sterilisation for other patients. The disposal procedures for sealed sources differ from those for unsealed sources. Sealed sources are usually disposed at the Atomic Energy Corporation's landfill site at Pelindaba or even re-exported to their country of origin.

Radioactive material is defined [5]as:

> *"Any substance, which consists of or contains any radioactive nuclide whether natural or artificial and whose specific activity exceeds 74Bq/g (0.002μCi/g) of chemical elements and which has a total activity greater than 3.7kBq (0.1μCi)."*

The unsealed sources of radioactive material used in health care facilities usually results in low-level radioactive wastes (<1MBq), but waste in sealed sources may be of fairly high activity. In general, the low-level waste can be disposed with the normal infectious waste stream provided the appropriate controls are in place [5]. However, the treatment of sealed or high level radioactive waste with the infectious waste stream must be avoided particularly when it is to be incinerated, since the ash and even the incinerator can end up being contaminated with unacceptable levels of radioactivity.

The definition of low-level waste is based on the concept of "Annual Limit on Intake" (ALI) and there are different ALI values published for ingestion and inhalation. The ALI_{min} is the lesser of these two values for each radionuclide and a table of values has been published [5]. For both solid and liquid waste the total activity supplied to the disposing facility, i.e. sewer, incinerator or even landfill cannot exceed 10 ALI_{min} per month for each laboratory or corresponding entity and each release to the sewer or package containing solid waste must not exceed $1ALI_{min.}$

5.1.5 General Waste from Health Care Facilities

General waste is defined in the Minimum Requirements for Waste Disposal to Landfill as:

> *"Waste that does not pose an immediate threat to man or the environment, i.e., household waste, builder's rubble, garden waste, and certain dry industrial and commercial waste. It may, however, with decomposition, infiltration and percolation, produce a leachate with an unacceptable pollution potential".*

Clearly, most of the waste generated within a health care facility is of the general waste type, i.e. kitchen waste, waste from offices, packaging etc. and one of the key management problems is to ensure that the general waste stream does not receive infectious, chemical or even radioactive hazardous waste. Conversely, if the infectious waste stream receives too much waste that is not infectious and that could be disposed with the general waste stream, the costs for treatment and disposal rise considerably. Separation of these two waste streams is extremely important.

It must be recognised that the General Waste stream emanating from households and even health care facilities contains small amounts of chemical hazardous waste such as paint, oil and pesticides and infectious hazardous waste, such as old bandages, plasters, sanitary napkins and babies nappies. While under ideal circumstances, chemical waste should be separated at source and collected separately, as happens in a number of first world countries, it is unlikely that this will happen for many years in South Africa. However, landfills permitted in terms of the Minimum Requirements for Waste Disposal to Landfill are constructed and operated on the premise that the waste does contain these low amounts of hazardous wastes.

5.2 Avoidance, Recycling and Segregation of Health Care Waste

The integrated waste management approach is a cornerstone of the government's National Waste Management Strategy and waste minimisation practices, which include waste avoidance, waste recycling and waste segregation, can be applied in health care facilities.

5.2.1 Waste Avoidance

The following can lead to a reduction in the amount of waste produced:

<u>Source Reduction:</u>

- Purchasing reductions: careful selection of supplies that are less wasteful or less hazardous, e.g. the replacement of chlorinated solvents where possible with less hazardous alternatives.
- Use of physical rather than chemical cleaning methods; e.g. steam cleaning rather than using detergents and disinfectants.
- Prevention of wastage

Management and Control Measures

- Centralised purchasing of hazardous chemicals
- Control and monitoring of purchasing and use of chemicals and pharmaceuticals
- Monitoring of the flow of hazardous wastes to treatment and disposal
- Training programmes for all staff on the need for management of hazardous materials and wastes.

Stock management of chemicals and pharmaceuticals

- Order small quantities frequently rather than large amounts.
- Use oldest batch first (First in first out principal).
- Use all the contents of a container.
- Check expiry date on delivery.

5.2.2 Recyclable Products

Recyclable products should be purchased where possible. Sterilisation of medical and other equipment for reuse can be practised, provided it has been designed for the purpose and that approved sterilisation methods are employed. The recycling of disposables is practised in some third world countries – this is undesirable must not be allowed in South Africa because of the risk of transfer of infection, however small.

Recyclable containers for infectious waste, such as the normal 210 l wheeled bin, are used in the US and Australia, but there is a strict and well-controlled procedure for sterilisation. Under no circumstances must the cardboard boxes currently used in South Africa be re-used, even though they are lined with a plastic bag. It must be noted that these boxes are quite expensive at R4 to R5 each and there have been instances where the temptation to minimise costs by recycling the boxes has been too great. The boxes can easily be contaminated even though there is no real visual evidence of contamination e.g. staining. In addition to this, the removal of the waste in order to save the box is a high-risk practice for waste handlers.

Recycling of chemicals is often not a major option in health care facilities because of the small volumes used. However, silver from photographic plates and chemical baths is often worth recovering. It is recommended that a company specialising in the recovery of silver is used – there are many small companies in South Africa recovering silver from these wastes.

5.2.3 Waste Segregation

Waste segregation is the most important way of minimising the costs of the treatment and disposal of infectious waste and minimising the risks to the health and the environment. Different coloured containers for each waste stream that are clearly marked for a particular waste must be used – see Appendix 2B and 1C for a comprehensive outline of the proposed requirements.

The ability and willingness of all staff involved in the handling and management of health care waste to separate wastes correctly is of paramount importance. A training programme that is given to all staff and for new staff when they join the facility is the key. Reinforcement of the message is required by making a regular retraining programme compulsory and by using a system of regular management and authority audits.

5.3 Treatment and Disposal of Health Care Waste

5.3.1 Introduction

After separating health care waste into its four different types, i.e. infectious waste, chemical including pharmaceutical waste, radioactive waste and general waste, there is a need to apply different management procedures to the treatment and final disposal of each type. Treatment is, in terms of the IWM strategy, generally applied to unavoidable waste and that cannot be recycled or re-used (see section 5.2). The objective of the treatment of waste is to eliminate or, at least, reduce the hazard to levels that minimise the risk to human health and the environment. Subsequent options for the treated waste still include the possibility of re-cycling and re-use, although, at this stage, any resulting residues are usually disposed to landfill. The options for treatment are extremely varied and include physical and chemical treatment, thermal treatment, biological treatment and stabilisation, cementation and microencapsulation. The choice of technology will depend on many variables and most of these are considered briefly below. However, the special problems associated with the treatment and disposal of waste generated in rural health care facilities, where transport distances are large, the volumes of waste are small and the financial resources limited, were highlighted by the participants in the National Waste Management Strategy process for special attention.

5.3.2 Infectious waste treatment:

According to the Minimum Requirements for the Classification, Handling and Disposal of Hazardous Waste, *sterilisation* is a minimum requirement before disposal of any residue in a permitted H landfill [1]. The Department of Water Affairs and Forestry have interpreted this, as requiring incineration of infectious waste before disposal of the ash to a hazardous waste landfill. The reason for this is that the infectious waste disposed, such as sharps, can be reused, even if sterile. As many sites still have scavengers, disposal at these sites would be unacceptable. Furthermore, it is difficult to monitor the sterility of infectious waste arriving at a landfill site if it remains in its original physical form. However, often due to insufficient facilities, breakdown of equipment and other reasons, special permission has been given for direct disposal to permitted H and G landfills. It is well known that infectious waste is finding its way into the general waste stream in considerable quantities – at best, this results in disposal at permitted landfills, but frequently infectious waste ends up in informal landfills or dumped in the veld.

The definitions of sterilisation and disinfection given below are based on those published by the Centre for Disease Control in Atlanta, Georgia [8]:

> *<u>Sterilisation</u> is a process that reduces the number of microorganisms by a factor of one million (10^6 or more than 99.9999% are killed).*

High-level Disinfection is when all microorganisms with the exception of small numbers of bacterial spores are killed.

Intermediate Level Disinfection is where Myocardium tuberculosis, most viruses and fungi are killed, but not necessarily bacterial spores.

Low Level Disinfection is where most bacteria, some viruses and some fungi are killed, but the complete absence of resistant microorganisms such as tubercle bacilli or bacterial spores cannot be relied on.

Note that although sterilisation implies the complete absence of any microorganisms, the definition allows the presence of small numbers of microorganisms. For disposal purposes, sterilisation is an ideal that should be achieved, if possible. *However, there may be circumstances where disinfection or possibly even no treatment could be acceptable, before disposal.* These issues are discussed below in section 5.3.3.

In South Africa, incineration is still the method of choice for infectious waste, however, there are a number of new technologies that are available that compete with incineration and can be accepted provided they meet certain objectives. The final choice depends on many factors, but must as a minimum meet certain environmental and health and safety requirements. Issues that must be considered are:

- It should be appropriate technology that is cost effective.
- The sterilisation or disinfection efficiency.
- The waste should not be able to be reused.
- The potential impact of poor segregation of wastes, e.g. impact of chemical wastes, aerosols, etc.
- The ability to meet the requirements of the Occupational Health and Safety Act.
- The emergency procedures required, e.g. after a needle stick injury.
- The impact of the technology on the environment and the need to pass a full Environmental Impact Assessment that includes scoping with the public.
- Any gaseous emissions including fugitive emissions.
- Disposal of water, e.g. to sewer.
- Regulatory requirements
- The quantity of waste for treatment and the capacity of the system.
- The volume of waste and mass reduction.
- The residues after treatment – classification and disposal procedures
- Infrastructure requirements.
- Training requirements.
- Operation and maintenance requirements.

- Available space.
- Location.
- Capital and operating costs – the technology should be cost effective.
- Public acceptability.

Possible acceptable alternative technologies that can be used to treat all or part of the infectious waste stream include incineration, chemical disinfection, autoclaving and microwave technology. It is proposed that:

"Any appropriate technology can be used, provided the operator/owner can demonstrate that it can meet all health, safety and environmental requirements including passing a full environmental impact assessment and public scoping study."

A permit will have to be obtained from the relevant authorities, i.e. the Department of Environmental Affairs and Tourism, Department of Water Affairs and Forestry and the Provincial Department of the Environment.

A brief description is provided below for selected technologies for the handling of infectious waste - the absence of a particular technology does not imply that it is unacceptable.

Incineration

Background:

Incineration has been the method of choice in South Africa and almost all currently operated infectious waste treatment facilities use some form of incineration. Incineration is a process in which combustible materials are burnt producing combustion gases, products of incomplete combustion and a non-combustible residue or ash. Combustion studies completed on various incineration facilities in South Africa have shown that the waste has a calorific value generally between 12 and 14MJ/kg, which can sustain combustion without a significant input of an external fuel, and is thus highly suitable for incineration. The advantages of incineration are that it is applicable to the whole infectious waste stream including general infectious waste, sharps and pathological waste and that it results in a large reduction in waste volume. The waste is also transformed into an unrecognisable or reusable form, i.e. ash. The combustion of the organic component of infectious waste results in the desired sterilisation of the waste and the formation of gaseous emissions mainly in the form of carbon dioxide and steam. However, certain toxic substances such as hydrogen chloride, dioxins and other products of incomplete combustion, metals, plus particulate matter and solid residues in the form of ash are also produced. Depending on the type of incinerator and if the combustion conditions are not properly controlled then carbon monoxide, dioxins and significant amounts of particulates can be emitted.

The types of incinerator used in South Africa include small single chamber incinerators that normally burn up to 100kg an hour and pyrolytic double chamber incinerators, both the Los Angeles Retort type and Controlled Air Incinerators, are generally used for larger volumes of waste from 100kg and higher. Other configurations are available

internationally, among which the rotary kiln appears to have some significant advantages, since it can also treat many of the chemical wastes produced in health care facilities. Rotary kiln are however relatively expensive. The efficiency of an incinerator depends on three key parameters: time, temperature and turbulence, i.e. the amount of time the gases remain in the combustion zone, the temperature in the final combustion chamber, which should be between 1000°C and 1200 ^{o}C and the efficiency of mixing of the gases with the combustion air. Incineration is a scheduled process (no.39) in terms of the Atmospheric Pollution and Control Act and the Department of Environmental Affairs and Tourism has published regulations that include emission standards, structural requirements and operating parameters for incinerators. Very few definitive studies on the emissions and operating parameters on incinerators in South Africa have been completed, but those that have been done, show that most incinerators are generally being operated well below the standards required for efficient combustion and that the emissions often do meet the required standards. Temperatures, particularly, in many of the single chamber incinerators are well below the required standard of 900°C in the primary and 1100 ^{o}C in the secondary chamber. Also, the infectious waste stream in South Africa includes significant amounts of PVC and other chlorine containing compounds and therefore the emissions of HCl are generally above the limit of 30 ppm currently set by the Department of Environmental Affairs and Tourism. Very few infectious waste incinerators include scrubbers that can remove acid gases such as HCl and particulates. However, the Department of Environmental Affairs and Tourism has recognised that due to various factors such as location and the volume of waste incinerated, incinerators that do not meet the emission standards may still not impact significantly on human health and the environment. However, the burden of proof is on the operator/owner of the incinerator and this would require a full multi-pathway health risk assessment before the Department could grant a permit.

The participants in the development of the National Waste Management Strategy [4] identified a number of key concerns and actions:

- Information on the composition and quantities of health care waste including infectious waste that requires treatment, e.g. by incineration is required.
- That most of the incinerators currently operating in South Africa could not meet either local or international standards.
- That the toxic emissions from incinerators are impacting adversely on human health and the environment.
- There was a significant lack of control on the management of infectious waste due to a lack of capacity within the Department of Environmental Affairs and Tourism and local Departments of Health.
- New guidelines that conform to the best international practice for health care waste and incinerators should be drawn up.
- That incinerator that cannot meet the guidelines should be closed once sufficient modern treatment capacity had been installed.
- New technologies that may be more appropriate than incineration should be investigated.

- The special treatment and disposal needs of rural communities must be investigated.
- Insufficient separation at the source was resulting in general waste ending up in the infectious waste stream and thus increasing the amount of waste requiring incineration.
- Many chemical hazardous wastes, mainly pharmaceuticals, solvents and aerosols are being incinerated with the infectious waste stream in facilities that are not designed to accept such waste.

In order to take account of the needs of small rural clinics that may not have access to large regional infectious waste treatment facilities, it is proposed that different regulations be applied to large incinerators compared to small incinerators.

The CSIR proposed that the amount of infectious waste that can be incinerated in approved small incinerators be limited to 10kg/week [11]. However, from the data available from Botswana, section 3.1.2, this may be too low since they generate on average 7 kg/day plus 2 sharps containers per month. Although, the potential environmental impact needs to be researched further, *it is proposed that the limit be raised to 50kg/week to take account of the expected higher volumes encountered in practice.*

<u>Requirements for large-scale incinerators burning more than 50kg/week</u>

Incineration is an acceptable technology for the treatment of infectious health care waste as has been demonstrated both in South Africa and internationally. However, there are a number of key issues that need to be included in the guidelines and within the permits for such units:

1. During permitting, the operator must demonstrate that the incinerator is operating efficiently and effectively within certain set operating parameters, i.e. temperature of combustion, maximum feed rate, etc. Adherence to these settings must be mandatory and verified by the permitting authority or their designated representative on a regular basis. Continued failure to comply will result in the loss of the permit.

2. The correct separation of infectious waste at source can greatly minimise the pollution potential of incinerators. Health care wastes that cannot be incinerated include aerosols and other pressurised containers that can explode and chemical waste, such as large quantities of pharmaceuticals, photographic wastes, solvents, batteries and broken thermometers with a high content of mercury. Infectious waste incinerators are normally designed to handle waste with an average calorific value between 12 and 20 MJ/kg, whereas many chemical wastes have a much higher calorific value and also contain halogens and sulphur that give rise to acid gases.

3. The use of PVC items that will require incineration due to their infectious nature should be restricted to only essential uses. The PVC bags used for blood, sera and other fluids should be replaced, if possible, by inexpensive non-halogenated plastics. Restrictions on the use of PVC will greatly reduce HCl emissions from incinerators and thus reduce the need for scrubber systems.

4. Incineration facilities that are burning more than 50kg/week of infectious waste that cannot demonstrate that their emissions are either below the emission standards (see table 3) and/or that they do not impact significantly on human health and the environment will be required to fit a gas cleaning system.

5. The ash from infectious waste incinerators can leach significant amounts of heavy metals, such as lead, chromium and zinc. The ash must be classified according to the Minimum Requirements for the Classification, Handling and Disposal of Hazardous Waste, Department of Water Affairs and Forestry, 1998 and, if required, treated to minimise its hazardous nature and then disposed to an appropriate H or G landfill. For wet de-ashing systems the cooling water must also be evaluated for its potential impact on the environment and disposed accordingly.

6. For incinerators fitted with scrubbers the solid or liquid residues must be evaluated according to the Minimum Requirements for the Classification, Handling and Disposal of Hazardous Waste and disposed in a manner required by the regulations.

Table 3: Recommended Technical Performance of Small Scale Incinerators Compared to Current Requirements for Large Incinerators [11]*

Parameter	**Small Scale Incinerators**	**Permitted Large Scale Incinerators**	**Comment**
Hours of operation/week	Up to 10	≥40	
Quantity of waste, kg/week	Up to 50	4000 to 40000	Some large units operate at 300kg/hr for 6 days a week.
Stack Height, m	1.8 to 3	9	In practice stack heights for large incinerators are ~15m.
Particulate emissions, mg/Nm^3	360	180	These values are significantly higher than required by some overseas countries and may be lowered.
Metal emissions, mg/Nm^3	1	0.5 to 0.05	Typical emissions from health care waste include Cr, Mn, V and Ni.
Gas Combustion Efficiency, %	99.00	99.99	
Emission of Cl (as HCl), mg/Nm^3	<60	<30	
Operating temperature in combustion zone, ^oC	650	Not specified	
Minimum Wall Combustion Temperature, ^oC	Not specified	850	
Secondary combustion zone residence time, s	Not specified	2	Small-scale incinerators do not have well defined combustion zones.
Stack gas exit velocity, m/s	1	10	The greater the stack exit the better the smoke dispersal.

* Note that the amount of waste that can be incinerated in small incinerators has been increased from 10 to 50 kg/week, see text.

Requirements for small-scale incinerators burning less than 50kg/week

As indicated above, the CSIR recently completed a study on behalf of the Department of Health and the WHO [11], into small-scale incinerators that could be appropriate for use at rural primary health care clinics. The specifications proposed by this study for these small-scale incinerators are given in table 3 and compared with the current regulations for large permitted incinerators. As proposed above, the amount of waste that can be incinerated by these small incinerators has been increased from the 10kg/week recommended in the CSIR study to 50kg/week in order to account for the expected higher volumes generated by the small clinics. The exemptions from the requirements of the regulations for the treatment of infectious waste by incineration is motivated on the basis that rural primary health care clinics generate relatively small amounts of waste and have needs and resources that differ significantly from health care centres in urban areas. There is, however, a need to destroy sharps and other potentially contaminated health care wastes in a manner that will sterilise or at least significantly disinfect the waste without a major impact on the environment. The lower combustion efficiency, which would release up to 100 times the amount of hazardous components that a large incinerator is offset by the very small volume destroyed and the ability to incinerate the material in an area that is very sparsely populated. Auditing and inspection of the facilities will be required to ensure compliance with the exemption conditions.

The amount of ash generated from these small-scale incinerators will be very small and approximately 5 to 20% of the actual volume of the waste. Although not tested the ash is almost certainly classifiable as hazardous, since the combustion efficiency is so much lower than that of large incinerators, which generate an ash that is usually classifiable as hazardous. The very small volume means that the load on the environment due to its disposal in a communal landfill or disposal pit will be insignificant.

Chemical Disinfection

Chemical disinfection is routinely used to destroy microorganisms on medical equipment, bench tops and other surfaces can also be used to kill or inactivate pathogens in medical waste. Sterilisation is difficult to achieve by adding chemicals although high-level disinfection that results in the survival of only highly resistant bacterial spores can be obtained. Chemical disinfection can be readily applied to liquid wastes such as blood and urine but is also applied to microbiological cultures and even sharps. There are however some disadvantages:

- Shredding or milling of the wastes is often required to ensure adequate contact of the disinfectant with the solid waste.
- The disinfectants used are potentially a significant hazard both to personnel and to the environment, see table 5, in section 5.3.4.
- The efficiency of disinfection depends on operational conditions and the disinfectant used.

- Only the surface of solid waste may be disinfected.
- The technology is not applicable to human body parts.
- The disposal of the residues, which include an excess of the disinfectant, must be evaluated according to the Minimum Requirements for the Classification, Handling and Disposal of Hazardous Waste [1].

Typical disinfectants that are used to disinfect infectious waste are listed in table 4, together with their hazard ratings and acceptable risk limits (ARL) according to the Minimum Requirements [1].

Clearly, most of the disinfectants in table 4 represent a significant hazard and should only be used by personnel that are trained and equipped with the appropriate personal protective equipment. Sodium metabisuphite appears to be the least hazardous and the generation of small amounts of SO_2 in a sealed container has been demonstrated to disinfect sanitary waste that does not come into direct contact with the liquid. However, the application of sodium metabisulphite to disinfect the infectious waste stream needs to be properly evaluated. Note that only small amounts of these hazardous chemicals are allowed to be disposed in a general waste site in South Africa.

The need to shred waste adds significantly to the cost of the technology and the high cost of the chemicals will add significantly to the overall treatment costs. However, there are circumstances where disinfection can be advantageous, e.g.

- disinfection of infectious waste in the plastic bag or sharps container will minimise potential risk to the staff during handling.
- disinfection can increase the length of time a waste can be stored at room temperature and minimise the need for cold storage facilities.
- infectious waste treated with an organic disinfectant that contains no halogen or sulphur can be incinerated without significant impact on the emissions from an incinerator.
- disinfection prior to landfilling can be used during emergency situations, e.g. during prolonged breakdown of incinerators or other facilities or where such facilities are not readily available.

It is recommended that guidelines be drawn up for the use of selected disinfection methods as appropriate technology for South Africa.

Autoclaving

Autoclaving is widely used for the sterilisation of re-usable medical instruments within South Africa health care facilities and is therefore familiar to most staff members. In the USA, Europe and Australia, in particular, autoclaving has found wide acceptance as an alternative technology to incineration for the sterilisation of infectious waste. The waste is normally shredded or for sharps milled and crushed. This allows the steam ready access to the bulk of the waste and makes the waste aesthetically more acceptable. The process is therefore inappropriate for pathological waste and animal carcasses. The

waste is enclosed in a pressure vessel and subjected to steam up to 6bar pressure and temperatures of up to 160°C. A vacuum is applied and superheated steam added. According to the one supplier, a temperature of 135°C and a contact time of about 30 minutes are usually sufficient to sterilise the waste. The effectiveness of the technique must be checked periodically using bacteria such as *Bacillus thermophilus*. The final volume of the waste is reduced to about 20% and since "dry" steam is used, the product is dry to touch. The process is quite capable of handling waste quantities of up to 500 kg an hour and thus can easily compete with incineration. A comparison of the technology with incineration shows that the capital and operating costs, which include the requirement for disposal of residues to landfill, are similar to incineration provided the incinerator does not have a scrubber. The addition of a scrubber to an incinerator can increase the cost of this technology by more than 30% and therefore the use of autoclaving can result in significant cost savings.

As with incineration the separation of the waste for autoclaving is important. Aerosols, which can explode above 50°C and other pressurised gases, chemical wastes including volatile solvents and some heavy metals such as mercury, should not be autoclaved because of the high temperatures that are used. Shredding will of course lead to destruction of any aerosol cans but it is still prudent to avoid the treatment of these types of waste.

Overseas the sterilised waste can be disposed to General Waste Landfills. However, in South Africa the resulting waste is still regarded as potentially chemically hazardous and therefore must be assessed according to the Minimum Requirements for the Classification, Handling and Disposal of Hazardous Waste [1] before it can be disposed to an H or G landfill. There have been no studies on the leachability of infectious waste after treatment by autoclaving.

Autoclave technology has considerable promise as an acceptable alternative to incineration in South Africa.

Microwave Technology

Most microorganisms are destroyed by microwave technology that rapidly heats the water contained in the waste. Temperatures that are reached are stated to be around 95 °C. The requirements are similar to those for autoclaving since the waste is shredded and humidified before treatment and pathological wastes and certain chemical wastes should not be contained in the waste stream. Note that because of the high temperatures that are attained, the presence of solvents and similar wastes can give rise to fugitive emissions. The technology is however safe and efficient and can treat high volumes of waste, however, it appears to be more expensive than autoclaving.

Needle Destruction

A number of clinics and hospitals have adopted the use of a unit that can electrically melt a needle along a portion of its length thus making it unusable and incapable of producing a needle stick injury. These units are either battery or mains driven and are relatively cheap at ~R1000. It must be noted that only those pathogens within the section of the needle that is destroyed are killed and that the needle must still be

considered a potential risk to health. However, since needles comprise about 95% of the sharps generated, these instruments potentially have a role to play in reducing the number of injuries sustained by sharps. Once the needle has been treated, it can be disposed with the non-sharp infectious waste.

The "needle destroyer" could have a particular role to play in doctor's rooms and rural health care facilities where needles are the main sharps disposal problem.

5.3.3 Infectious Waste Disposal

Introduction

As discussed in section 5.3.1, the preferred approach to the management of infectious waste is treatment by incineration followed by disposal of the residual ash, which is usually hazardous, to a hazardous waste landfill. Disposal to an H or G landfill requires the special permission of the Department of Water Affairs and Forestry and this is normally given only when the required incineration capacity is not available. Alternative technologies such as autoclaving and microwaving followed by disposal of the treated waste to landfill are not yet available in South Africa and approval for the approach would have to be obtained from the Department of Water Affairs and Forestry, subject to a full environmental impact study.

The above approach represents the "ideal solution" for the majority of the infectious waste generated. However, because hospital incinerators are frequently non-functional and treatment facilities are not available, a significant percent of infectious waste is not pre-treated or incinerated. Also, there are a limited number of hazardous waste disposal facilities in the country. Infectious waste often ends up on the general waste landfills and open dumps throughout the country. Since many unlicensed sites are seldom properly operated, infectious waste is often left exposed, where it poses a major health threat, particularly in the case of children who find it attractive in their play.

Although the Minimum Requirements for Waste Disposal by Landfill [2] do make some provision for the *de facto* disposal of infectious waste on permitted landfills, this is definitely the exception. Consequently, no formalised system, other than the "ideal solution" of treatment by incineration exists. This is why a significant volume of infectious waste continues to be disposed of under completely unacceptable conditions on the majority of the country's landfills and dumps.

Since the "ideal solution" is not always available for the disposal of infectious waste, it is recommended that an alternative "good solution" be developed to ensure that infectious waste can be disposed of in an acceptable manner at landfill sites, and that it is not left exposed to scavengers and children. Since such a solution requires proper research and development, to ensure that it is safe, this is beyond the scope of this project. Nonetheless, having identified the need, it is important to set out the principles involved in selection of the proposed "good solution". Thereafter, steps can be taken to address this situation.

The hierarchy of standards and acceptability for infectious waste disposal

As indicated above, there is an undisputed "ideal solution" for the disposal of infectious waste. However, there is unfortunately also a completely unacceptable *de facto* situation

on the ground, where it is left exposed on the landfills and open dumps throughout the country, posing a major health threat to scavengers, children and the public. It is therefore submitted that somewhere between the two above extremes, there is a "practicable solution", which, although not the ideal, will provide for a significant improvement on the *status quo* at least in the short to medium term while the more acceptable solution is put into place.

In the interests of logically exploring and identifying a possible "practicable solution", a hierarchy of alternatives, together with perceived advantages and disadvantages, is presented in Table 4, for consideration. From Table 4, it is seen that there are four variables:

- Level of treatment (incineration, pre-treatment and raw health care waste).
- Type of landfill (hazardous or general).
- Level of control (with or without proper procedures).
- Quantity of infectious waste

In essence, treatment for example by incineration, and the disposal of the residue to hazardous waste disposal sites provides the safest, but most expensive option, but does not provide the desired coverage, i.e. being available to all generators at an affordable cost. General waste disposal sites are, however, more common and much cheaper, and therefore go a lot further towards providing the desired coverage. However, without the implementation of proper disposal procedures, there are the potential problems of aesthetics, pollution and health risks. Based on this, it is concluded that the use of general waste disposal sites, with the implementation of proper disposal procedures, could well provide a "practicable solution" to supplement the "ideal solution", see the highlighted section of Table 4. These alternatives would be sufficiently low cost to provide the desired coverage, and Alternative 7, "Disposal of untreated infectious waste on a general waste landfill with proper procedures" would be the alternative most under consideration. Note that this disposal method should only be allowed where facilities for the treatment of infectious waste are not available and where practical considerations require a general waste disposal site to be permitted, either *temporarily or permanently*, to accept such waste. There are also occasions where closure of treatment facilities for maintenance or because of an unexpected breakdown, results in waste overwhelming storage facilities and because it can biodegrade disposal is urgently required. Ideally, sufficient incinerators should be available to cope with such emergencies. However, reality is that these are very expensive and unless South Africa is prepared to accept considerably increased costs for treatment of infectious waste, it is unlikely that a large excess incineration capacity will become available. It is proposed that landfilling as detailed in table 4 also can provide an acceptable alternative in emergency situations.

TABLE 4: ALTERNATIVE METHODS OF HEALTH CARE WASTE DISPOSAL

	ALTERNATIVES	ADVANTAGES	DISADVANTAGES
1.	Incineration of infectious waste and disposal of the ash on a hazardous waste landfill with proper procedures.	Disinfection / safety of landfill	Cost / coverage
2.	Sterilisation and disposal of infectious waste on a hazardous waste landfill with proper procedures.	Disinfection / safety of landfill	Cost / coverage. No proof of sterilisation and waste re-usable.
3.	Disposal of untreated infectious waste on a hazardous waste landfill with proper procedures.	Safety of landfill	Coverage. No proof of sterilisation and waste re-usable.
4.	Disposal of any form of infectious waste on a hazardous waste landfill without proper procedures.	Safety of landfill	Aesthetics / coverage. No proof of sterilisation and waste re-usable.
5.	Incineration of infectious waste and disposal of the ash on a general waste landfill with proper procedures.	Lower cost / aesthetics	Hazardous ash pollution
6.	Sterilisation and disposal of infectious waste on a general waste landfill with proper procedures.	Disinfection / lower cost	Aesthetics. No proof of sterilisation and waste re-usable.
7.	Disposal of untreated infectious waste on a general waste landfill with proper procedures.	Lower cost / coverage	Aesthetics. No proof of sterilisation and waste re-usable.
8.	Incineration of infectious waste and disposal of the ash on a general waste landfill without proper procedures.	Lower cost	Hazardous ash pollution
9.	Sterilisation and disposal of infectious waste on a general waste landfill without proper procedures	Lower cost	Aesthetics. No proof of sterilisation and waste re-usable.
10.	Disposal of untreated infectious waste on a general waste landfill without proper procedures, *(status quo)*.	-	Health risk / pollution / aesthetics. No proof of sterilisation and waste re-usable.

Should the disposal of infectious waste on general waste landfills be formalised, three further considerations should be addressed. These are the risk associated with disposing it on general waste disposal sites, the question of what constitutes "proper procedure", and the question of who should and who should not be allowed to use such facilities. Note that the risk can be minimised somewhat by limiting the quantities that can be disposed. These are addressed in the following sections.

Risks associated with disposing of health care waste on general waste disposal sites.

There are two types of risk involved, i.e., those associated with direct exposure and those associated with migration of pollutants or infection.

As indicated earlier in this section, the major problem associated with the *status quo* is that of direct exposure of scavengers, children and even the public to medical waste, which is dumped indiscriminately on both general waste landfills and open dumps. Exposing people to sharps, infected material and tissue, and spent medicines, constitutes a very real and potentially critical health hazard in terms of disease, infection and poisoning. However, this risk effectively disappears when the waste is properly covered and is no longer exposed, (see section on Proper Procedures).

Concern is sometimes raised about infection and / or the migration of pollution that would emanate from disposed infectious waste. However, based on fundamental landfill biochemistry and relative quantities of infectious waste and other waste, this does not appear to represent a significant factor. Biochemical degradation in a landfill is executed by means of soil microorganisms and thus does not differ significantly from that in a cemetery, where human tissue and in many instances, infection, is concentrated. With few exceptions, e.g. *tetanus* and *clostridia*, pathogens would be reduced to their elements and rendered harmless by the waste mass. In the case of the two examples cited, however, these would in all likelihood be present in the leachate from a waste body, regardless of whether or not infectious waste was disposed of.

Regarding the migration of pollutants, this too would be by means of leachate, which regardless of the disposal of infectious waste represents a pollution problem in its own right. The most significant effect on leachate composition may be an increase in ammonia concentrations. This phenomenon has been observed in cases where the SPCA has been permitted to dump large quantities of animal carcasses on a landfill.

Proper Procedures

Since it is not within the scope of this report to address the operational detail of the procedures envisaged, only the principles will be outlined here. In some instances, however, these may require some research to confirm their acceptability. Thereafter, they need to be incorporated into the Third Edition of the Minimum Requirements for Waste Disposal by Landfill [2]. This is important, in order to ensure formalised methods of handling health care waste, when it arrives at the disposal site.

The principles envisaged already appear in the Minimum Requirements and include:

- Education of the landfill staff regarding the risk associated with infectious waste disposal, as well as a sound knowledge of the requisite operating procedures.
- Strict control over the health care waste throughout the whole waste management process, but particularly at the landfill, to minimise the exposure of infectious waste.
- Application of the Sanitary Landfill principles of compaction and cover, but more particularly cover, with special adaptations, as in the case of putrescible waste disposal, to minimise the exposure of health care waste.
- Application of all other appropriate Minimum Requirements

In essence, the most important element is covering or the burial of the infectious waste, as soon as possible, to avoid exposure to the elements and people. This may take place in a special area such as a trench in the completed landfill or in the soil adjacent to the landfill. Infectious waste may also be handled immediately and covered with other waste at the working face. Whichever approach is used, the principle is that the infectious waste is covered as soon as possible with other waste or soil, under informed and strict supervision, to minimise exposure.

One option, for both sharps and other infectious waste, is the addition of a disinfectant. Glutaraldehyde or some other disinfectant could be used (see table 4), although the quantities required must be evaluated. In addition, the potential impact of adding these disinfectants to a General Landfill Site must be assessed, in terms of the Minimum Requirements for the Classification, Handling and Disposal of Hazardous Waste. Another option for needles is to destroy them using a needle destructor, section 5.3.2, and to dispose with the other infectious waste.

It is submitted that although the above procedures may not represent the ideal, they do provide a practicable solution, which will bring about a significant improvement in the *status quo,* without excessive risk. Further investigation of these options is required.

The "Proper Procedures" outlined in this section, are based on principles, which already appear in the Minimum Requirements, and form the basis for part of the Guideline on the disposal of Healthcare waste.

General waste disposal sites should only be used for health care waste disposal:

- where incineration or pre-treatment facilities do not exist and there is no coverage, because small quantities of waste do not justify them, e.g. in rural areas, or where they are too expensive.
- where local authorities have identified, assessed and registered *bona fide* cases of generators for whom incineration or pre-treatment are not realistic options.
- where the authorities (Department of Water Affairs and Forestry and Department of Environmental Affairs and Tourism) have given their permission.

Emergencies at the Landfill

As indicated in the above sections, a significant percent of infectious waste is not pre-treated or incinerated and ends up on the landfills and open dumps throughout the country. Because it is left exposed, it poses a major health threat, particularly in the case of children. This situation is considered to represent an "emergency" in itself. However, it only seems to be accorded emergency status, when there are reports in the media of children injecting one another with discarded syringes.

Solutions to the above situation include controlling the health care waste generators to ensure that they segregate their waste and assigning it to the correct streams. Most important, however, is the development of formalised methods of handling health care waste, when it arrives at the disposal site, (see section on Proper Procedures). In essence, the procedure involves the burial or covering of health care waste with waste or soil, as soon as possible, to avoid exposure to the elements and people.

5.3.4 Chemical Waste Treatment and Disposal

Chemical waste, which includes pharmaceutical waste and heavy metals, e.g. mercury from thermometers, must be segregated as far as possible from infectious and other wastes. This is particularly important since the treatment and disposal technologies used are often quite different. For example, as pointed out in section 1.2.1, a pyrolytic incinerator constructed for the treatment of infectious waste cannot dissipate the high heat generated by the combustion of chemicals and thus considerable damage can occur. There will always be small quantities of pharmaceuticals ending up in the infectious waste stream, but this will amount to less than 1% of the total mass. Options for the treatment of chemical waste include:

- Physical treatment
- Chemical treatment
- Thermal treatment
- Biological treatment and
- Stabilisation, Immobilisation and cementation

The main objective of any treatment process for chemical waste is to minimise or even eliminate any of its hazardous characteristics including its toxicity. The residues from the above procedures are usually landfilled at a hazardous waste site. However, some wastes can be delisted in terms of the Minimum Requirements for the Classification, Handling and Disposal of Hazardous Waste and disposed at a permitted General Waste, GLB^+ site, i.e. one that has a leachate management system.

Thermal treatment, usually by incineration, is used internationally for the destruction of chemical hazardous waste including pharmaceuticals. In the USA, it is considered the best developed available technology (BDAT). However in South Africa, although there are incinerators that are destroying hazardous waste these are normally end of pipe facilities that handle a single waste stream. No general hazardous waste incinerators are

available that can be used to treat chemical wastes from the health care facilities. Unfortunately, this has lead to the abuse of infectious waste incinerators that are not constructed to accept such waste. Most of the chemical hazardous waste is still disposed to landfill and for waste designated as hazard group 1, extremely toxic; this may require encapsulation in concrete, which is extremely expensive.

Since the amount of chemical waste generated by medical facilities is usually low, the best option is to use a professional waste management company to treat and correctly dispose of the waste. However, it must be remembered that the generator of the waste has a "duty of care" to ensure that the waste is only handled by companies that are permitted to transport and dispose of hazardous waste.

Some chemical waste can be disposed to sewer, for example, small quantities of water miscible solvents such as acetone and ethanol can be discharged with lots of water since they are readily biodegradable and will not impact adversely on the municipal biological treatment plant. However, the disposal of large quantities of heavy metals, water insoluble chlorinated solvents such as chloroform and flammable wastes such as ether are not allowed. Municipal sewer plants in different regions may have very different standards for the discharge of chemical waste, because of the size and construction of the sewage works and reticulation system. Each health care facility must discuss this with their local or regional officer and obtain written permission for discharge in terms of the by-laws.

In table 5, a number of examples of the chemical waste commonly found at health care facilities are listed. Particularly for the cytotoxic and pharmaceutical wastes, those listed in table 5 are illustrative only. Where possible, the hazard rating and acceptable risk concentrations are given, according to the Minimum Requirements for the Classification, Handling and Disposal of Hazardous Waste [1]. Some indication of possible treatment and disposal options are also presented, however, these are only a guide and it is the responsibility of the generator to ensure that the waste is being disposed according to the current legislation and local by laws.

Cytotoxic wastes must be considered an extreme hazard, HG1, to human health and the environment. Very small amounts will contaminate tissue, syringes and needles and potentially blood products and thus will enter the infectious waste stream and be incinerated. Because of the very low concentration, this practice is not expected to constitute a hazard to health and the environment. However, larger amounts including redundant stock must be managed as a hazardous chemical waste

Mercury from broken thermometers, thermostats, specialised apparatus and laboratories and cadmium that can occur in batteries should never be disposed with the infectious waste stream, as they are volatile in an incinerator and without an appropriate scrubber will pollute the atmosphere. They must be collected separately from other wastes and disposed to an appropriate landfill.

Pressurised containers such as gas bottles should be returned to the supplier. According to the Minimum Requirements, compressed gases should never be disposed to landfill. Aerosols should be emptied before disposal to landfill and should never be discarded

with the infectious waste stream and incinerated. A hazardous waste management company should be consulted, if there is any doubt on the procedures to be followed for disposal.

Table 5: Examples of Chemical Hazardous Waste Commonly Found in Hospitals

Source and Name		Hazard Rating	ARL, ppm	Chronic Toxicity	Comment	Possible Treatment/Disposal Options
Cytotoxic/Genotoxic						
	Azathioprine	1	-	Usually carcinogenic	No aquatic toxicity data available for these compounds. They are extremely toxic and therefore are assigned to HG1	Chemical incineration, the preferred option. Otherwise, dispose to an H site according to the Minimum Requirements.
	Chlorambucil	1	-			
	Thiotepa	1	-			
Pharmaceuticals						
	Aspirin	2/3	<1			Chemical incineration, the preferred option. Otherwise, dispose to an H site according to the Minimum Requirements.
	Paracetamol	3	81.4			
Disinfectants						
	Ethylene Oxide			A Group A Carcinogen	An extreme hazard. A gas at room temperature and a significant health hazard.	Chemical treatment, Small quantities can be discharged to atmosphere via an efficient fume cupboard.
	Formaldehyde	2	0.9	A Group B Carcinogen and a Teratogen	A high hazard and volatile.	Small quantities can be discharged to sewer. Chemical incineration, the preferred option. Otherwise, dispose to an H site according to the Minimum Requirements.
	Glutaraldehyde	2	0.35		A high hazard and volatile, 2% aqueous solution used.	Small quantities can be discharged to sewer. Landfill and ash blend at an H site. Chemical incinerator if available.
	Sodium Hypochlorite	1	0.007	A Group C/D carcinogen	An extreme hazard. High impact on fish and other water borne species	Small quantities can be discharged to sewer. Chemical reduction and residues to sewer or landfill.

Source and Name	Hazard Rating	ARL, ppm	Chronic Toxicity	Comment	Possible Treatment/Disposal Options
Sodium Metabisulphite	4	10		A low hazard solid that has been shown effective against a wide range of species for the treatment of sanitary waste. Gives off a low level of SO_2.	Small quantities can be discharged to sewer. Chemical reduction and residues to sewer or landfill.
Photographic Chemicals					
Hydroquinone	2	4.2		A high hazard waste.	Preferred option to chemical incinerator if available – otherwise, H landfill.
Silver Nitrate	1	0.0007		Extremely toxic to most aquatic organisms	Recovery. Very dilute solutions can be discharged to sewer.
Potassium Hydroxide	3	8		Corrosive	Neutralise. Small quantities can be discharged to sewer after neutralisation, pH >6.
Sodium Hydroxide	3	3.3		Corrosive	Neutralise. Small quantities can be discharged to sewer after neutralisation, pH <12.
Source and Name	**Hazard Rating**	**ARL, ppm**	**Chronic Toxicity**	**Comment**	**Possible Treatment/Disposal Options**
Solvents					
Halogenated					
Chloroform	1	0.1	A Group B Carcinogen, Teratogen		Preferred option to avoid the use of chlorinated solvents. Unavoidable waste to chemical incinerator, if available – otherwise H landfill.
Methylene Chloride	4	14	A Group B Carcinogen		
Trichloroethylene	1	0.1	A Group B Carcinogen		
Non-Halogenated					

Source and Name	Hazard Rating	ARL, ppm	Chronic Toxicity	Comment	Possible Treatment/Disposal Options
Acetonitrile	4/NT	100	Teratogen		Preferred option to chemical incinerator if available – otherwise dispose to H landfill. Small quantities of ethanol and other water miscible solvents can be discharged to sewer.
Benzene	1/2	2.2	A Group A Carcinogen		
Ethanol	NT	700			
Ethyl acetate	3	21.2			
Isopropanol	NT	505			
Petroleum Ethers	3	1.1			
Xylene	3	1.1			
Heavy Metal Wastes					
Cadmium	1	0.031	A Group A Carcinogen		Treatment to stabilise element followed by disposal to H landfill.
Mercury (I/II)	1	0.0009	A Group C/D Carcinogen		
Mercury Metal	1	0.022	A Group C/D Carcinogen		
Acids	-	-		Mineral acids sulphuric and hydrochloric are corrosive.	Neutralise. Small quantities can be discharged to sewer after neutralisation, pH >6.
Alkalis	3	-		Caustic soda and potassium hydroxide are corrosive.	Neutralise. Small quantities can be discharged to sewer after neutralisation, pH <12.
Ammonia Solutions	1	0.0024			Neutralise to pH ~7. Small amounts can be discharged to sewer
Phenols	3	2.3			Dispose to H landfill.
Chromic compounds	1	0.02	A Group A Carcinogen		Recovery otherwise reduce to Cr(III) and add lime to pH 9 and landfill to H site.

5.3.5 Radioactive Waste Treatment and Disposal

The safe management of radioactive waste within health care facilities is a responsibility of the Directorate of Health Technology, Department of Health in Cape Town [5]. Disposal procedures for sealed sources differ from those for unsealed radioactive material. Each time a sealed source is to be disposed of, written permission must be obtained from the Department. Sealed sources are usually disposed of at the Atomic Energy Corporation's waste site at Pelindaba or as is the case with some imported sources, are re-exported to the country of origin. Sealed sources may not be treated at incinerators or disposed to landfill sites.

The treatment and disposal of low-level radioactive waste uses somewhat different management principles to those used for infectious or chemical wastes. Radioactive wastes cannot be destroyed, they can only be contained or stored, e.g. in a landfill, and allowed to degrade without causing harm to man and the environment, or they can be dispersed into the environment in such a way that they become so diluted that they no longer pose any danger. The discharge to sewer or the incineration of selected low level radioactive wastes with the infectious waste stream lead to significant dilution. An example is the incineration of C^{14} containing low level waste; the C^{14} burns to give $C^{14}O_2$ (C-14 carbon dioxide), which is diluted with the enormous quantities of carbon dioxide generated by the burning of the infectious waste and any fuel used to maintain the high temperatures required.

Clearly, the Department of Health carefully controls the incineration of low-level radioactive waste. The incinerator operator must have an authorisation to accept such waste and the Department undertakes regular monitoring of the radioactivity levels of incinerator ash. For radioactive waste under his control, the holder of an authority must at all times ensure [5] that:

(a) Disposal or radioactive waste to incinerators is restricted to suitable waste, which includes flammable solid waste (excluding sealed sources), animal carcasses, vials containing organic solvents and bulk solvent;

(b) G1ass vials with closed metal caps are not disposed of because of the risk of an explosion and the possibility of radioactive glass residue in the slag; the contents of these should be transferred to plastic containers for incineration. However, glass vials with plastic caps can usually be safely disposed of in limited numbers. Plastic vials containing organic solvents are perfectly acceptable provided the smoke emitted from the incinerator stack does not contravene the standards laid down by air pollution control legislation applicable to the area. The same restriction applies to the incineration of bulk solvents,

(c) The activity per waste package and the total activity disposed of per month do not exceed the specified limits;

(d) Short-lived materials not meeting the activity and/or surface dose-rate limits for packages are stored until they have decayed to below the specified limits;

(e) Accurate records are kept of the nuclides and total activity disposed of per month to the incinerator;

(f) When disposing of radioactive waste at an incinerator, the holder of the authority or his agent shall liase with incinerator operators to develop mutually convenient procedures for the receipt and disposal of the waste, which will minimise health hazards:

(g) When a package is sent to an incinerator, it carries the following markings:

- the warning sign for ionising radiation, information as to the sender,
- information regarding the mechanism of disposal (i.e. "for incineration"),
- information as to the radionuclide content and activity,
- a statement that the surface dose rate does not exceed 5 microsievert per hour (0.5 mR per hour),

Note that an incinerator designed for infectious waste treatment cannot normally accept some of the waste listed above, such as bulk solvents.

For discharge to sewer of the low-level radioactive waste under his control, the holder of an authority must at all times ensure that:

(a) Radioactive waste for disposal to the sewer is restricted to aqueous solutions of radioactive materials and macerated biological material where this is acceptable to the waste water authorities;

(b) The activity per release and the total activity per month do not exceed the limits specified in the code.

(c) Accurate records are kept of the nuclides and total activity disposed of per month via the sewer;

(d) Release of radioactive waste is confined to one release point for each laboratory;

(e) At each release point there shall be a visible sign stating that radioactive waste may be released into the sewage system;

(f) Water to dilute the discharge is flushed before and for at least one minute after the discharge;

(g) Plumbing personnel are warned of the possible hazard prior to performing maintenance;

(h) Liquid scintillation counting vials containing chemically toxic organic compounds (e.g. toluene, xylene, etc.) are not disposed of via the sewer.

5.4 Handling, Collection, Storage and Packaging of Health Care Waste

The handling storage and packaging of health care waste has been defined for South Africa by the introduction of SABS 0248, Code of Practice: Handling and Disposal of Waste Materials within Health Care Facilities [6], for chemicals including chemical waste by SABS 0229 [13] and for radioactive wastes by the Codes of Practice published

by the Directorate of Health Technology, Department of Health [5]. While there are some important issues that need attention, these codes of practice, which are in line with international standards, form a strong base for consolidated guidelines and regulations on the handling, collection, storage and packaging of health care waste. The basic proposals are given in Appendix 2 sections A to F.

The survey conducted during this study (Appendix 1) identified considerable problems with the handling, storage and packaging of infectious waste in the health care facilities visited. These included the use of unacceptable containers, overloading of sharps containers, incorrect colour coding, etc. A revision and expansion of SABS 0248 is urgently required together with the implementation of the guidelines. Regular training programmes plus inspections and audits are required in order to ensure that the guidelines and regulations are properly adhered to.

It has been proposed in the "Proposed Regulations for the Control of Environmental Conditions constituting a Danger to Health or a Nuisance"[10] and in SABS 0228 [5] that infectious waste should be stored at 4°C or even frozen. The major problem arises from the decomposition of human and animal tissue, particularly placentas, which lead to the generation of odours. However, if these wastes are collected within about 12 hours and then treated by incineration, odour is generally not a problem provided the waste is stored in a cool place that is disinfected and maintained on a regular basis. Also for other infectious wastes collection within 24 hours or even longer is adequate. Most hospital staff and waste management companies that were consulted on the issue of refrigeration were against the proposal. The provision of refrigerated storage facilities was considered an unnecessary cost that hospitals cannot afford and it was pointed out that for most clinics and hospitals waste was collected at least daily and for the larger facilities two or three times a day. The Chris Hani/Baragwanath Hospital generates about 180 boxes a day and these are collected from various points around the hospital a about three times a day. Clearly, "on-time" service must be available and those health care facilities that cannot demonstrate that decomposition is not a problem should be required to install appropriate cold storage facilities for infectious waste. *Thus, it recommended that the provision of refrigeration facilities for infectious waste should not be made a general requirement.*

One other requirement is *the need for specifications for sharps and other containers* that are acceptable for use in SA. Currently, the BS 7320:1990, Specification for Sharps Container, has been used to determine the requirements for sharps in South Africa. Of particular importance are the specifications for: *resistance to penetration*. However, there are a number of sharps containers on sale in South Africa that are not up to standard as they are not puncture proof and therefore constitute a danger to the user.

5.5 Transportation of Health Care Waste

The transportation of health care waste is considered in detail in Appendix 2, section G and the Emergency Response requirements are outlined in section H. Discussions with a waste contractor have indicated that because of the relatively high value of infectious waste to the disposer and because of the paucity of treatment facilities it is sometimes transported over considerable distances, e.g. between Johannesburg and Durban. According to their records, there have been vehicle accidents in the past 10 years but none have resulted in infectious waste being spilled on the public highways, because the

vehicles are enclosed. There does not appear to be a need for refrigerated vehicles for the transport of infectious waste, see section 5.4, although they should be required if the transporter cannot demonstrate that decomposition of the waste and the generation of odours is not a problem.

Codes of practice for the transportation of "Dangerous Goods" that cover the hazardous materials including chemical hazardous wastes classified in terms of SABS 0228 [12] have been published by the SABS [13-20]. These are very comprehensive, of international standard and according to the SABS Internet Site many are being reviewed.

The Directorate of Health technology, Department of Health has also published guidelines for the Safe Transport of Radioactive Material [5]. Packaging requirements depend clearly on the physical form of the waste and whether it is to be transported by road and rail or by air. Radiation warning signs have to be visible on road and rail transport vehicles for a number of waste categories. Since, only a few facilities generate radioactive waste the transport requirements will not be elaborated any further in this document and the reader is referred to reference 5.

5.6 Training and Awareness Programmes

The importance of training of staff of health care facilities, for the proper management of waste, cannot be over emphasised. It is proposed that standardised training programmes be developed for South Africa. It has been noted that many of the waste management companies and hospitals have instituted training programmes for infectious waste but they usually omit other wastes such as chemical including pharmaceutical waste and radioactive waste from the programme. The proper segregation of health care waste will be impossible to achieve without informative training programmes that include retraining at regular intervals. It is outside the terms of reference of this study to develop training and awareness programmes.

5.7 Opportunities for Job Creation

The total market potential for the infectious waste market in this the country is 160 000 hospital beds, generating waste of some 40 000 tonnes per year. This translates to a revenue ~R150 million per annum for the management of the infectious waste stream of which about 50% is currently held by existing waste management companies. Opportunities also exist for waste services in the management of chemical including pharmaceutical waste, which currently is badly neglected in our health care facilities and the provision of training programmes. It is proposed that health care facilities should be subject to annual external waste management audits, which can be carried out by SMME's.

The potential for SMME's to get a sizeable amount of this market is high since initial entry into the market can be via operating collection and transport services to incineration facilities operated or owned by local councils such as that it Johannesburg. Thus, the capital cost of entry can be low. Many large players in the industry do not view small clinics and small doctor's rooms as important clients because they are volume driven.

Recently, the Gauteng Provincial Tender for infectious waste services was awarded to four small companies some being black owned.

5.8 Role of Public Private Partnerships

Public/Private partnerships are essential for the proper management of health care waste. The development of shared facilities or the identification of the need for regional facilities by Provincial and Local Government, that are put out to tender to industry to build and operate should be encouraged. Public involvement in the siting and management of health care waste treatment facilities will be ensured by the requirement of the Department of Environmental Affairs and Tourism for an EIA. A representative stakeholder committee should be in place that will monitor the environmental performance of the facility.

6. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions can be drawn from the current limited study:

- It is clear from the brief survey carried out at hospitals and with the authorities and waste managers that there are considerable problems with the management of healthcare waste in South Africa.
- Disposal of health care waste to inappropriate landfills and informal dumps is fairly common in South Africa.
- A lack of training and awareness, limited funds, particularly at the Provincial health care facilities, plus a lack of capacity at the authority level have contributed to the poor state of health care waste management in South Africa.
- While some institutions are managing infectious waste in an acceptable manner, almost none have acceptable procedures and management systems in place for chemical, including pharmaceutical waste, and low level radioactive waste.
- Codes of practice are available in South Africa for the management of infectious and radioactive health care waste and the Minimum Requirements documents published by the Department of Water Affairs and Forestry provide acceptable procedures for chemical waste, but these are not implemented correctly within health care facilities. These only need to be adapted, modernised in parts and integrated in order to provide an acceptable total approach to health care waste management.
- The separation of health care waste into the correct categories followed by implementation of the appropriate treatment and disposal procedures will reduce the exposure of staff of health care facilities, the general public and the environment to the dangers posed by these wastes.
- South Africa requires a network of regional or even local modern treatment facilities for infectious health care waste in order to be able to implement a "best practice" solution.
- In the short to medium term, an interim solution is required that can more safely dispose of infectious waste until a "best practice" solution is implemented.

Recommendations are that:

- An integrated guideline covering the whole management process for all types of health care waste should be developed. A draft starter document has been produced as part of this study.
- The starter documents produced in this study should be used a basis for a programme of wide consultation with all I&APs.
- Provincial Governments need to undertake a survey to determine the quantities, types and location of all types health care waste within their areas

as well as the status of the available treatment and disposal facilities.

- Training and awareness programmes must be developed based on the guidelines and run within all health care facilities.
- Sufficient funding must be made available in order to undertake the required studies and implement the training and awareness programmes.
- An interim, short to medium term solution, to the problem of treating and disposing of infectious health care waste must be developed. It is recommended that the authorities allow disposal onto landfills under well-defined guidelines – see the text and the proposed guidelines in the framework document.

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APPENDIX 1:

Report On Management Of Health Care Waste In Hospitals, Clinics And Doctor's Rooms In The Gauteng Province

1. INTRODUCTION

1.1 Background

In terms of the DEAT NWMS Action Plan for Waste Treatment and Disposal (See Version C DEAT Sept. 1999), this project was launched to fast track the Implementation Program for the Management of Health Care Waste. The Terms of Reference required that in depth discussions with hospital superintendents, heads of Clinics and doctors at surgeries were held in order to:

a) assess the *status quo* of health care waste management at "ground level",

b) identify and define any problems, and

c) identify feasible solutions.

1.2 Scope of investigation

Although, in the Terms of Reference the Department of Environmental Affairs and Tourism requested a wide coverage of urban and rural health care facilities, throughout the country, the budget and the time available limited the study considerably. It was thus agreed that the survey should cover a representative cross section of health care facilities in and around the Greater Pretoria region.

2. METHODOLOGY

In order to execute the project in an efficient and professional way, the following steps were taken:

- A set of definitions of health care waste was developed for the survey, see section 5.1 of the main text.
- A questionnaire was developed for the survey. It was based on the WHO, SE Asia Questionnaire, which was adapted to meet the perceived needs of the survey. (See Annexure 1). In retrospect, it is conceded that this questionnaire could have been simpler, however, it served its purpose. It also means that there is additional information available in some instances.
- A letter authorising the survey and investigations was obtained from the Department of Environmental Affairs and Tourism. As a first step, this, together with a covering letter, was faxed to the Director of Provincial Hospitals and to the Director of Primary Health Care (Region 4), requesting permission to visit health care facilities. Thereafter, appointments were made

and permission obtained to visit the various facilities. (Often permission was not granted in time and various alternatives had to be resorted to).

- When the facilities were contacted, an explanation was provided regarding the purpose of the survey and the questionnaire. Many facilities requested time to peruse the questionnaire before the appointment, while others were concerned with anonymity, which was duly promised.
- Each visit lasted about three hours, excluding travel time and normally included a consultation with the responsible person(s) that included Medical Superintendents, Doctors, Matrons, Nursing Sisters, Dentists and Pharmacists, followed by a site inspection of the premises. Where appropriate the observed problems and solutions were discussed with the responsible person(s). All the relevant information was then noted on the questionnaire.
- The data from the questionnaires was then processed and is summarized in Table 1, which indicates the type of facilities visited and the level of training, awareness and health care waste management standards and the conditions encountered.

3. FINDINGS

This section provides some background on the elements of health care waste management at health care facilities. It then elaborates on the information provided in Table 1, which summarises the findings of the investigation.

3.1 Background

From direct observation and from the literature, health care waste management comprises several components such as waste segregation and storage, which should be carried out in accordance with an appropriate policy or a code of practice. Other related components include collection, transport and disposal. The correct practices are discussed in the main text and extensively outlined in appendix 2.

3.1.1 Waste Segregation

This is the first step in the handling of health care waste, which must be separated or segregated into clearly identifiable colour coded classes. Those classes and colour codes observed during the study were:

- *Sharps,* which are placed into special puncture proof, sealable containers. These were red or yellow.
- *Pathological and infectious wastes,* which are usually placed in heavy-duty red bags, but in some instances, infectious wastes were also stored in heavy-duty yellow bags or opaque white bags and marked.
- *Chemical and Pharmaceutical wastes* were normally flushed to sluice or included with the infectious waste.
- *General wastes,* which were placed in heavy-duty black bags.

3.1.2 Waste Storage:

Health care waste must not be compacted because frequently it has a high moisture content. Furthermore, it should not be allowed to accumulate in wards or corridors. Special storage facilities are therefore required. These should be strategically placed close to generation and / or collection points, but away from food, patients and the public. They should have sufficient capacity, sheltered from the weather if outside, be well drained, easy to clean, well ventilated and lit, secure with self-closing lockable doors and well marked with signs. Where putrescible waste, such as tissue is involved, refrigeration is required except when the waste is remove frequently. Packaging must be in accordance with the above and where private sector contractors are used to remove health care waste, their specified containers must be used. These must be properly packed, sealed and stored, so that they do not rupture or leak.

3.1.3 On-site Incineration / Disposal

The larger hospitals frequently have on site incinerators. In the smaller facilities, however, this is not the case, although there are instances of burning of health care waste. Since many of the hospital incinerators do not function properly, on site incineration now tends to be the exception. Disposal is therefore undertaken by private contractors, who collect the waste and incinerate it prior to disposal of the residue to landfill. Where waste is neither incinerated on site, nor managed by a contractor, there will be the potential for problems, as this waste will inevitably enter the general waste stream.

3.2 Filling in the Questionnaire

The health care facility staff gave an honest appraisal of health care waste management at their facilities. The majority of people interviewed acknowledged that what sometimes looked good and was supposed to be happening on paper, wasn't really happening on the ground.

3.3 Health care Facilities Visited

From Table 1, it is seen that 29 facilities were included in the survey. Not all these were, visited however. In the case of the General Practitioners (GP), some of the doctors (and some dentists) interviewed, acted in the capacity of *locum* for several practices and were thus able to provide comments on more than one health care facility.

What follows is an overview of the health care facilities visited, which highlights some of the main findings. These and other findings will however be included in subsequent sections, which deal with the different aspects of health care waste management.

Table 1: Comparative Study Of Facilities Taking Part In The Survey

No	Survey Questionnaire	Provincial Hospital		Private Hospital		Private Clinic		GP Practices	
	Total No. Of patients per day	4500	1600	355	100	550	30	30	30
1	Number of facilities in Survey	2		2		2		23	
2	Location of Facility	Rural	Urban	Urban	Mine*	Urban	Urban	Urban *	Urban
3	Infection Control Policy	Not located	Not located	yes	yes	Yes	No	no	No
4	Does it relate to HCWM	no	yes	yes	no	Yes	No	no	no
5	Understanding of HCWM	vague	fair	good	fair	excel.	good	poor	excel.
6	Implementation of HCWM	no	partial	yes	partial	yes	partial	no	yes
7	"Trained" Team for HCWM	yes	yes	yes	no	yes	no	no	no
8	Team Representation (Key I)	N & C	MNCO	MNCO	no	MC	M	D	D
9	Job Description i.e. HCWM	no	no	no	no	no	no	no	no
10	Training related to HCWM	yes	yes	yes	no	yes	yes	no	yes
11	Sufficient training to HCWM	no	no	no	no	no	no	no	no
12	Was documentation supplied?	no	no	no	no	yes	no	no	no
13	Aware of Human Tissue Act	yes	yes	yes	yes	yes	yes	yes	yes
14	SABS Code 0248	no	no	yes	no	yes	no	yes	yes
15	Type of Waste segregated (Key II)	a, b, c, d, e	a, b, c, d, e	a, b, c, d, e	a, b, c, d, e	a, b, c, d, e	a, b, c, d, e	a	a, b, c, d, e
16	Cytotoxic drugs	no	yes	yes	no	no	no	no	no
17	Method of Disposal	unknown	Container waste company	Container waste company	Container	unknown	unknown	unknown	unknown
18	Formaldehyde	yes	no	no	no	no	no	no	no
19	Method of Disposal	Sluice	unknown	unknown	unknown	unknown	unknown	unknown	unknown
20	Solvents (Sluice, Waste Company, Incinerator)	Incin.	Waste Comp.	Waste Comp.	Bigger Mine Hospital	Waste Comp.	Waste Comp.	Sluice & Mun. Dump	Waste Comp.
21	Final Waste Disposal	Incin.	Waste Comp.	Waste Comp.	Bigger Mine Hospital	Waste Comp.	Waste Comp.	Waste Comp. Mun. Dump	Waste Comp.
22	Weak Links in Chain of Disposal (Key III)	all	all	S & C	S & C	OSSAD	Appar. None	all	Appar. None
23	Failure at Manager Level	yes	yes	no	no	no	no	yes	no
24	Failure at Team Level	yes	yes	yes	no	Yes	No	yes	N/A
25	Pharmaceutical down Sluice	no	no	no	no	no	no	yes	yes
26	Honest Appraisal	yes	yes	yes	yes	yes	yes	yes	yes

Key I Definition of Health Care Waste Team	KeyII Types of waste	Key III Links in health care waste chain
M = Management	a) = Sharps	S = Segregation at place of generation
D = Doctors	b) = Pathological	ST = Storage at place of generation
N = Nurses	c) = Infections	C = Collection from place of generation
C = Cleaning staff	d) = Chemical	TR = Transport to Disposal Site
O = Others	e) = Pharmaceutical	I = Incinerator
	NB: See definitions in questionnaire	OSSAD = Outside Storage Site awaiting Disposal

Some of these facilities could be classified as either urban or rural.

3.3.1 Provincial Hospitals

Two provincial hospitals, a large rural and a smaller urban hospital were visited.

As seen from Table 1, the large rural hospital had very little in the way of health care waste management practices in place and rated the worst of the facilities visited, except for some of the GP Practices. However, this hospital did have some staff with health care waste management training in place. All health care waste, including sharps was incinerated on the hospital property at supposedly 800°C. However, the operator told the interviewer that he had only found out from a health inspector the previous week, "where the arrow should point on the dial, which had all the small lines on it".

The smaller urban hospital provincial visited, was a little better than the rural hospital, in that it had slightly better health care waste management practices in place and used a private contractor to collect and dispose of the health care waste.

3.3.2 Private Hospitals

Two private hospitals, a small private urban hospital, and a smaller mine hospital, which could be considered as rural, were included in the survey.

As seen from Table 1, the small private urban hospital had many elements of a health care waste management programme in place and used a private contractor to collect and dispose of the health care waste and rated as the best facility visited. This may be attributed to the fact that as a private facility, there were more resources available to invest in proper health care waste management. There was also more management commitment and awareness.

The small mine hospital on the other hand was comparable in standards to the rural provincial hospital in Section 3.3.1. However, health care waste was taken to a larger mine hospital where it was incinerated. The acceptability of the procedures at the larger hospital is unknown.

3.3.3 Private Clinics

Two private urban clinics were included in the survey, a larger and a smaller one.

As with the small *private* urban hospital, the large *private* urban clinic (which was larger than the hospital) also had many health care waste management elements in place and used a private contractor to collect and dispose of the waste. Consequently, it too rated as one of the best facilities visited. This is again attributed to the fact that as it was a private facility, there were more resources available to invest in proper health care waste management, as well as an awareness of the need.

Notwithstanding the above, however, the smaller private clinic exhibited health care waste management standards that were comparable to the smaller hospitals visited.

3.3.4 GP Practices

The twenty-three practices surveyed exhibited a very large range of attitudes on health care waste management and the segregation of health care waste and, therefore, the standards varied considerably. All practices segregated sharps with some using proper sharps boxes, while others saw fit to use open cardboard boxes. All the remaining waste as defined in the survey were sorted by the sisters in charge or assistants and disposed of in bags. Where private contractors were used, these were the proper colour-coded opaque bags, but in many instances, ordinary black or transparent bags were used.

Since not all the practices use private contractors to remove their waste, the question to be asked, is what happens to the health care waste generated? At the smaller practices, often the rural ones, health care waste was burned in a 200*l* drum, sometimes with the addition of diesel, or were disposed into black bags that eventually ended up at the municipal disposal site.

3.4 Health Care Waste Management Awareness

In general, there was a lack of awareness at most of the facilities interviewed. As will be seen in Section 3.6, this is manifested in the low standards observed at the various facilities relative to SABS Code 0248. A common example reported was that casual labourers simply emptied all the segregated health care waste from the red bags into black municipal bags while doing their cleaning rounds so that health care waste ended up in the general waste stream.

In the survey, various aspects of health care waste management awareness and means of promoting it were considered. These are addressed below.

3.4.1 Policy

Although the two provincial hospitals claimed to have a formal Infection Control Policy, these could not be located. However, both the private hospitals and the large private clinic did have policies, while the small private clinic and the GP Practices did not. As seen from Table 1, not all the policies addressed health care waste and not all facilities were aware of SABS 0248. Consequently, these policies are not considered very meaningful in promoting health care waste management awareness.

3.4.2 Documentation

Of all facilities in the survey, only one was able to furnish documentation relating to health care waste management. When the responsible people at the other facilities were questioned in this regard, typical responses were:

a) "We do not have a management plan".

b) "Perhaps we have a management plan, I've not seen it".

c) "It is probably outdated and definitely misplaced".

d) "We do not have time to take care of all these problems. No one cares".

The above indicates a lack of planning and a lack of interest, which contributes to poor health care waste management. Also, there were no posters making people aware of risks associated with health care waste and the principles of proper health care waste management.

3.5 Training and Job Descriptions

From Table 1, it is seen that all the larger facilities apparently have a "trained team for health care waste management". It is also true that four staff members encountered had attended courses on infection control, which included management of health care waste, one person had attended a one-day Seminar at Pretoria Academic Hospital, and two facilities evidently had plans in this regard. Notwithstanding this, the interviews revealed understanding of health care waste management ranging from vague in most cases to excellent in a single case. It was thus concluded that, in general, there was insufficient training and hence awareness in health care waste management at the facilities surveyed.

None of the facilities had job descriptions, which included health care waste management. This almost certainly contributes to the observed discrepancy between training and understanding. It also indicates why there is an evident lack of awareness and no one appears to be interested or prepared to take responsibility.

3.6 Standards of Health Care Waste Management

Because the factors indicated in the preceding sections, the standard of health care waste management in the facilities under consideration is unlikely to be very high. This section looks at the components of health care waste management and elaborates on the findings during the site inspections.

3.6.1 Waste handling and segregation

All facility representatives interviewed said that health care waste handling was done by General Assistants or Domestics, who were reportedly trained by a Supervisor. Although some of the workers did wear protection clothing, these were the exception, as most did not. All those interviewed had little knowledge of the risks associated with health care waste and the principles of its management.

It is noted that whether done correctly or incorrectly, health care waste segregation in some form did take place at the place of generation, at all facilities visited. With two notable exceptions, however, the waste was not segregated correctly. Typical situations were as follows:

- In all instances, sharps were segregated into sharps containers. Although these were mostly the proper container, there were instances where they were makeshift and inappropriate, such as cardboard boxes. The containers were often overfilled.
- Even where colour-coded bags were in use, they were used "haphazardly", negating the whole purpose of the system.
- General waste bins e.g. waste paper baskets contained urine bags and tubing from intravenous therapy. (This was often blamed on medical students).
- As noted earlier, casual labourers often tipped health care waste from the red bags into black municipal bags while doing their cleaning rounds. Again, this negated the whole purpose of the system and resulted in health care waste entering the general waste stream.

3.6.2 Waste storage

Site inspections revealed that most waste was stored close to the place of origin, e.g. on the ward. On one ward, health care waste was stored in the clean linen room, in other instances in passages, kitchens and storerooms were used. In some cases, health care waste was transported by trolley to an outside depot, which were covered but usually not locked.

The following situations were observed at the majority of facilities visited.

a) With two exceptions, excessive waste was observed lying around the precincts of the facilities.

b) "Sealed" boxes had burst open, disgorging hazardous waste.

c) Boxes were squashed or had not been taped sufficiently, and were oozing.

d) Sharps bins were overloaded – lids not present or not secured properly.

e) Underwater drains, urine bags and tubing from intravenous therapy were disposed incorrectly.

At one of the clinics, the sister said that "people" just dumped loose health care waste, including syringes and needles, next to the stacked or stored boxes, awaiting removal. At another facility, black bags overloaded with placentas and severely macerated foetuses had to be stored over the weekend, without refrigeration, awaiting incineration on a Monday.

3.6.3 Waste collection

In most instances where a private contractor collected the waste, there were no serious problems. However, two facilities said collection was not always done on request or that the company after hours (after 4pm) when there was no one around to provide access.

The problem, however, is not the health care waste that is collected and taken away by the private contractors, rather it is the health care waste that ends up in the black bags and enters the general waste stream.

3.6.4 On-site Waste disposal

As noted above in Section 3.1.4, properly functioning incinerators at health care facilities are rare. Where possible therefore, the smaller facilities use private contractors to collect and incinerate their health care waste before disposal. This section deals with various health care wastes, which are sometimes disposed at the facility.

Cytotoxic Drugs. Five pharmacists and two hospitals with oncology units were interviewed. In all cases, it was reported that these drugs were disposed of in plastic bins, which were collected and disposed of by the company.

Formaldehyde. It could not be established how formaldehyde is disposed. No one seemed to know about it. However, several doctors were of the opinion that it is sluiced away.

Solvents. Solvents are disposed of in plastic drums and sharps bins. Two people said they would open the vials and flush the solvent down the sluice.

Flushing of Pharmaceutical Waste. This occurred in two facilities, both Doctors' practices. It is believed that flushing and sluicing are far more prevalent that reported.

4. PROBLEMS

As is evident from the findings of the survey, there are numerous problems relating to health care waste management. Many of these are interrelated and are set out below

4.1 Lack of Motivation and Awareness

Based on the survey, it can generally be stated that there is an acute apathy and lack of awareness amongst the professionals regarding health care waste management. This of course does not serve to motivate the majority of staff who must handle the health care waste. This lack of motivation and awareness at professional level also results in a failure to promote awareness and training programs to improve the situation, as well as the development of proper job descriptions for the people doing the work. At this level, most felt overwhelmed by the enormity of the task and were apathetic.

4.2 Insufficient adequate training

Of the four people encountered, who had had some training, only one was aware of the risks associated with health care waste and the principles of its management. On

investigation it was found that the training received was a "once off" training day comprising several lectures. Although there are Infection Control Committees in hospitals and clinics, there was insufficient emphasis on training in the management of health care waste. Since health care waste management training is not a priority, it follows that the standard of its management leaves much to be desired. Cleaners and casual labourers, who empty colour-coded bags into black bags, had apparently never been trained or instructed regarding health care waste.

4.3 Lack of Time and Accountability

Many people interviewed used "lack of time" as an excuse for the low standard of health care waste management observed. This simply means it is not a priority, however, most people claimed that there wasn't time to do health care waste management within the time framework of their daily tasks. The reason for this is that, with one exception health care waste management was not an integral part of anyone's job description. Consequently, no one was accountable for health care waste management and tended to pass the responsibility to others. For example, doctors said they relied on nursing staff to clear up after them. One said it is an "inborn culture." The nurses on the other hand said that the medical students and doctors were totally unaware of health care waste management.

5. CONCLUSIONS

Based on the objectives, methodology and findings of this project it is concluded that:

- Within the time and budgetary constraints associated with this project, it has been possible to assess the *status quo* of health care waste management at "ground level" for a reasonably representative group of 29 health care facilities.
- In general, the survey indicated poor standards of health care waste management, with a few exceptions. It appears that the larger private facilities have better standards of health care waste management, possibly because greater resource bases. The General Practitioners (GP) Practices were, however, of a lower standard than expected.
- The main problem associated with the *status quo* is the generally poor standards of health care waste management indicated above and elaborated on in the text. These are the result of a lack guidelines, legislation and enforcement, poor motivation and awareness on the part of management, insufficient training at the lower levels and a general lack of accountability.
- Health care waste enters the general municipal waste stream and ends up on the landfills and dumps because practices do not have proper disposal facilities and deliberately use black municipal bags, or because wastes are not properly segregated, or because segregated wastes are placed in black bags by untrained staff.

Finally, it is concluded that it is of prime importance that this area of waste management should receive priority attention at a National Level and Provincial levels as soon as possible.

6. RECOMMENDATIONS

The following recommendations are based on the experience of the consultants and the views of the people interviewed in the survey. These should be integrated into the solutions developed from the main report and are as follows:

a) Management Involvement

b) Standardised Policy

c) Documentation

d) Training and Motivation

e) Development of Teams

f) Quality Assurance and Monitoring

6.1 Management Involvement in Health Care Waste Management.

If standards in health care waste management are to be improved, it is imperative that it receives appropriate recognition (based on the risks involved) and hence commensurate priority. This recognition and priority must start at top management level, as the management of any facility is responsible for initiating all the solutions to the problems and for giving "the go ahead" for all planning involved.

Based on the above, legislation must force Management to recognise the problem of health care waste management as a priority and to take responsibility for maintaining set standards, in their facilities. This can be achieved by setting up standard policies and training programs and motivating staff to improve standards.

6.2 Standardised Policy

A standardised policy must be developed by government to ensure all health care facilities manage their health care waste in a standard and acceptable manner. Health care waste management, which is partially dealt with in the infection control policy and SABS 0248, must ensure that health care wastes are properly segregated, stored and disposed of. To ensure that this is achieved, health care waste must be clearly defined and explained. Also a "safety chain of health care waste management" should be established, (see later). The policy must be user friendly and easily understandable to all members of the health care waste management safety chain.

6.3 Documentation

There must be appropriate documentation to support the policy, at all levels in the hierarchy, starting with top management and continuing down to where health care waste management takes place on the ground, at the point of generation. Desirable characteristics of the documents would be that:

- They are readily available to all members of the team.
- They are user friendly and understandable – the education standard of all persons in the chain must be considered.
- The chain of health care waste management should be displayed at each point of generation of health care waste, by means of Bright Bold Posters depicting all types of waste, types of containers used, colour coding etc.
- Posters should be kept as simple as possible. Bold print should be used and questions such as: "Are you the weak link in the chain?" should be asked.

6.4 Training

As indicated in the findings of the survey, there is a significant lack of training in health care waste management, and often where training exists, it is not manifested in the workplace. This is believed to be a direct cause of the low standards of health care waste management observed in the field, so that the following is presented as part of the solution.

- It is fundamental and therefore imperative to ensure proper training at all levels, if a health care waste management policy is to be implemented.
- Health care waste management should therefore be included in all basic training for staff (Nurses, Health Care Workers, Domestics and Pharmacists). In the light of the problems observed, training of cleaners and general labourers is particularly important.
- Training in health care waste management must be included in all Orientation Programs for any Health Workers entering the health care environment.
- Regular information campaigns should be held regarding health care waste management, not only at health care facilities but also in public places, such as at shopping centres. This would raise the awareness of the public in general. Often visitors to health care facilities are unaware of health care waste.
- In-service training should be held regularly at all health care facilities. Each member of the team could present a lecture regarding some aspect of health care waste management. Regular meetings should be held to pin point and discuss problems and come up with solutions. This would help to maintain vigilance regarding health care waste management.

6.5 The Health Care Waste Management Team

Each facility must set up appropriate health care waste management teams to ensure that health care waste is properly managed. Teams must comprise a health care waste chain

of responsibility from Top Management down to General Assistant and Cleaning Staff. In this way, it would not be "your" waste and "their" waste, but "OUR" waste, and everyone would be accountable. To achieve this, job descriptions must be provided for each team member and goals should be set.

6.6 Monitoring and Quality Assurance

In order to ensure the sustainability of any improved health care waste management standards, monitoring and quality assurance are essential. What follows are some basic ideas in this regard.

- There should be regular daily monitoring of the health care waste management chain, by a designated monitor, using a simple checklist. The monitor should have the authority to check and correct any member of staff not complying with the written policy, and to address any problem immediately.
- All Disposal containers should be clearly marked, indicating the type of health care waste and the Department of Generation.
- The person sealing the Sharps bin or box should check the contents of the colour-coded bag. If not properly segregated etc, any problems should be addressed with staff so that any further occurrence should be minimised.
- The representative of the contractor collecting the waste must sign his or her name, along with the time of collection, as part of a manifest system. The contractor is then responsible and accountable for proper transportation and disposal of the health care waste.
- Each department must have a designated storage area, where segregated health care waste awaits collection. The health care waste should also be monitored at this point as a follow up procedure to check standards for each unit.
- Unless monitoring of each link of the health care waste management chain is maintained, any health care waste policies, planning and training will fail, as is currently happening at facilities visited. Continual monitoring of the health care waste management chain by auditing, both internally and externally, is therefore essential to ensure the desired management standards.
- Sufficient trained staff should be available to cater for persons on leave, are sick or absent for any reason. Untrained staff and particularly casual labourers must not be used for the management of health care waste.

Annexure

NATIONAL WASTE MANAGEMENT STRATEGY

Survey questionnaire on HEALTH CARE WASTE

SURVEY QUESTIONNAIRE FOR HOSPITAL CLINIC AND DOCTOR'S WASTE MANAGEMENT

Type of solid waste produced and estimated quantity. (Consult classification and mark X where waste is produced.)

N.B. Estimated quantity per day = average 1.7 kg. Per patient per day. (Hospital) (Ref. Lars Mikkel Johannson.)

	Waste Category							
Sources	**General**	**Pathological**	**Chemical**	**Infectious**	**Sharps**	**Pharmaceutical**	**Pressurised containers**	**Est. quantity (kg/day)**
Patient services								
Medical								
Surgical								
Operating Theatre								
Intensive Care Unit								
Isolation Ward								
Dialysis Unit								
Oncology Unit								
Emergency								
Outpatient Clinic								
Autopsy Room								
Radiology								
Labour Ward								
Laboratories								
Biochemistry								
Microbiology								

SURVEY QUESTIONNAIRE FOR HOSPITAL CLINIC AND DOCTOR'S WASTE MANAGEMENT Continued/…

	Waste category							
Sources	**General**	**Pathological**	**Chemical**	**Infectious**	**Sharps**	**Pharmaceutical**	**Pressurised containers**	**Est. quantity (kg/day)**
Haematology								
Research								
Pathology								
Nuclear Medicine								
Support Services								
Blood Bank								
Pharmacy								
Central Sterile Supply								
Laundry								
Kitchen								
Engineering								
Administration								
Public Areas								
Long-term Health Care								

WASTE SEGREGATION, COLLECTION, STORAGE AND HANDLING.

Describe briefly what happens between segregation (if any) and final disposal of :

Sharps_____
_____
_____
_____

Pathological waste_____
_____
_____
_____

Infectious waste_____
_____
_____
_____

Chemical waste_____
_____
_____
_____

Pharmaceutical waste_____
_____

_____
_____

(Formaldehyde, Cytotoxic drugs and solvents)_____
_____
_____

Is any pharmaceutical waste ever flushed down a sluice or toilet ?

If so, what and what type?_____

_____

_____

_____

_____

_____

_____

SURVEY QUESTIONNAIRE FOR HOSPITAL, CLINIC, AND DOCTOR'S PRACTICE WASTE MANAGEMENT

Waste segregation, collection, labelling, transport and disposal

Handling of Segregated Waste	Sharps	Pathological Waste	Infectious Waste	Chemical Waste	Pharmaceutical Waste	Pressurised Containers
Indicate by X the type of waste (if any) that is segregated from the general waste stream.						
Where is the segregation taking place (i.e. operating room, laboratory, etc.)?						
What type of containers/bags (primary containment vessels) are used to segregate waste (bags, cardboard boxes, plastic containers, metal containers, etc)? Describe accurately.						
What type of labelling, colour coding (if any) is used for marking segregated waste? Describe.						
1. Who handles (removes) the segregated waste (designation of the staff member)? 2. Is the waste handler using any protective clothing (gloves, etc.) during waste handling? Yes/No.						
What types of containers (e.g. plastic bins, bags, cardboard boxes, trolleys, wheelbarrows, etc.) are used for collection and internal transport of the waste? Describe.						
Where is the segregated waste stored while awaiting removal from the hospital of disposal? Describe.						
Describe briefly the final disposal of segregated waste (e.g. taken to municipal landfill, buried on hospital grounds, incinerated, open burned, etc.)						

HEALTH-CARE WASTE MANAGEMENT PLANNING

SURVEY QUESTIONNAIRE FOR HOSPITAL, CLINIC, AND DOCTOR'S PRACTICE WASTE MANAGEMENT

Personnel involved in the management of hospital, clinical and Doctor's practice solid waste.

1. (a)Designation of person(s) responsible for organisation and management of waste collection, handling, storage and disposal at administration level.

(b) General qualification and level of education of designated person.

(c) Has he/she received any training on Waste Management? ☐ Yes ☐ No

If yes, what type of training and of what duration?

_____
_____
_____
_____

_____
_____
_____
_____

2. Indicate the number of persons involved in the collection, handling and storage of waste, their designation, their training in solid waste handling and management and the number of years of experience of this type of work.

Number	Designation	Training	Experience
1. 2. 3.			

5 Do the Waste Management Staff have job descriptions detailing their tasks? ☐ Yes ☐ No

4.Are instructions/training given to newly hired Waste Management Staff? ☐ Yes ☐ No

HEALTH-CARE WASTE MANAGEMENT PLANNING

SURVEY QUESTIONNAIRE FOR HOSPITAL, CLINIC, AND DOCTOR'S PRACTICE WASTE MANAGEMENT

_____
_____
_____
_____

Waste Management Policy

1.Are you aware of any legislation applicable to Waste Management? ☐ Yes ☐ No

If yes, please list the legislative acts :

_____
_____
_____
_____

_____
_____
_____
_____

2.Are you aware of a document outlining the Waste Management Policy? ☐ Yes ☐ No

If yes, give title of document (and attach a copy, if possible):

_____
_____
_____
_____

Is there a manual/guideline document on management of health care waste at the hospital, clinic and Doctor's practice available:

(a) In the Ministry of Health?

☐ Yes ☐ No

If yes, give title of document (and attach a copy if possible.):_____
_____
_____
_____

(b) In your hospital, clinic, Doctor's practice

☐ Yes ☐ No

If yes, give title of document:_____
_____
_____
_____

4.

Does your hospital, clinic, Dr.'s practice have a Waste Management Plan? ☐ Yes ☐No

If yes, please attach a copy.

(b) Are there Waste Management responsibilities included in the job descriptions of hospital supervisory staff (Head of Hospital, Departmental Heads, Matron / Senior Nursing Officer, Hospital Engineer, Infection Control Officer, Pharmacist, Laboratory Supervisor, etc.)?

If yes please provide sample copies

☐ Yes ☐ No

HEALTH-CARE WASTE MANAGEMENT PLANNING

SURVEY QUESTIONNAIRE FOR HOSPITAL, CLINIC, AND DOCTOR'S PRACTICE WASTE MANAGEMENT

_____
_____
_____
_____

Does your hospital, clinic, Doctor's practice have a Waste Management Team (or Teams)?

If yes, please list the members by designation:

☐ Yes ☐ No

Designation

No of people:

Team Leader_____
_____
_____

Team Members_____
_____
_____

Waste Handling Staff_____
_____
_____

5. Are there clearly defined procedures for collection and handling of wastes from specified units in the hospital, clinic, Doctor's practice?

☐ Yes ☐ No

6. How are the present waste collection, handling and disposal responsibilities defined in the job descriptions of the staff involved? (Please cite appropriate statement or provide copies.)

7. What do you see as the problems associated with the management of Health care waste? (Indicate at which level.)

8. What solutions would you recommend for the above problem?

COMMENT