Division 44
Environmental Management,
Water, Energy, Transport

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Management of solid and liquid waste at small healthcare facilities in developing countries

Deutsche Gesellschaft für
Technische Zusammenarbeit (GTZ) GmbH

Division 44
Environmental Management, Water, Energy, Transport

GATE – Information Service

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Eschborn 1999

Published by:
Deutsche Gesellschaft für
Technische Zusammenarbeit (GTZ) GmbH
Postfach 5180, 65726 Eschborn, Germany
Internet: http://www.gtz.de

Division 44 – Environmental Management, Water, Energy, Transport
GATE – Information Service
Division 43 – Health, Education, Emergency Aid

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Printed and distributed by:
Universum Verlagsanstalt, 65175 Wiesbaden, Germany

Nominal fee: DM 15,–

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Foreword

The ***gate*** Information Service, the Health Section and Water and Waste Management Section of the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH have in the past noticed an increasing number of requests for information regarding the management of wastes from healthcare facilities. On the other hand only a few publications or handbooks are available on the market of which hardly any is offering an overall approach and practical advice on healthcare waste management in developing countries.

Moreover, substantial experience in the field of healthcare management has been gained through the implementation of health promotion and waste management programmes in which environmental aspects at health facilities are being increasingly taken into consideration. This among others becomes evident by the number project documents available.

As a result of an intensive search and processing of relevant documents, this booklet has been compiled based on the experience of GTZ and individual experts combined with field studies specifically designed for this purpose. It shall contribute towards growing awareness for healthcare waste management among hospital staff and the general public thus to improve the overall environmental conditions at local health facilities.

In close co-operation with the Fachhochschule Giessen, Fachbereich Technisches Gesundheitswesen students were actively involved in the preparation of the publication by carrying out field studies at health facilities in selected developing countries providing a valuable data for the base of information.

We are aware that this publication can only be a first step towards describing and illustrating a rather complex set-up and thus welcome suggestions and additional contributions for a revised edition.

The Editors

Introduction

All waste from hospitals and other health facilities is commonly regarded as hazardous waste, although its infectious potential only originates from less than one quarter of the waste. Improper handling of waste from health facilities could create major health risks for patients and their relatives, hospital staff and neighbouring population. Particular problems associated with healthcare waste could be caused by infections and the spread of diseases resulting from exposure to microbiological pathogens. Apart from these biological risks, additional danger results from the improper disposal of sharps, drugs, chemicals and radioactive substances.

While hospitals and other health facilities in developed countries have developed certain safety standards in order to minimise the risks resulting from healthcare waste, the situation in developing countries is still worrying. A lack of funding, trained personnel, technical equipment, appropriate management structures and awareness is often the reason for unacceptable waste management practice. In particular, rural health facilities are characterised by extremely limited technical and financial resources, difficult logistics and academic isolation. Apart from the prevention of health risks, the protection of the environment in general is another reason for the introduction of proper waste management practices.

When talking about waste from health facilities, different nomenclatures are in use: "healthcare waste" is the new European terminology; in the United States this type of waste is called "medical waste", and in the text of the Basel Convention for Hazardous Wastes it is called "clinical waste". Since this set of booklets will use the term "health(care) facilities" in order to describe the places of waste generation, the waste will be called **healthcare waste**.

The present paper intends to offer theoretical and practical assistance to public health managers, hospital administrators and the staff of health facilities in developing countries in general. It aims to promote a sound managerial approach and the use of appropriate technologies in the waste management of small to medium-scale health facilities, and therefore deal with the frequent lack of knowledge and awareness on the part of local health personnel.

Part 1 offers a more **theoretical look at waste management in general, and the risks and environmental impact of healthcare waste in particular.** The various influences on healthcare waste management resulting from the framework of cultural habits, government legislation, municipal administration, hospital finances and manpower will be described. **Part 2** offers a more **practical and more detailed approach to selected areas of waste management** in health facilities, presented in various **worksheets**.

the authors' intention is to offer advice for health facilities in developing countries world-wide, and therefore there is a certain amount of generalisation. Situations vary according to whether the health facility is small or large, rural or urban, located in Africa, Asia or South or Central America, etc. For the sake of completeness, some waste management practices are also men-

tioned which may not apply, or may not yet apply, to each and every location. While some are minimum requirements for every health facility, others are relevant to the future, taking further technical, social and legal development into account. Waste Management in health facilities is an integral part of general hospital hygiene. It helps to increase the efficiency of medical treatment, and has to protect patients, hospital staff and the neighbouring population against further infections and the propagation of diseases. All waste handling and management practices therefore have to secure a maximum of safety for all persons in contact with the waste.

The establishment of a proper waste management system is costly. Healthcare facilities in developing countries, in particular small units and those in rural areas, often suffer from insufficient funding. Solutions to waste management problems therefore have to be affordable. **The intention of this booklet is to address the requirements of healthcare facilities with limited resources. It aims to offer practical advice leading to maximum waste management improvement while using a minimum of financial resources and technology**. It is obvious that there are always better and more efficient options if more money is spent and more sophisticated technology is applied. But this is beyond the possibilities of the majority of small healthcare facilities in developing countries.

Establishing a proper waste management system for health facilities is an ongoing process which should follow certain steps listed below according to their priority:

- Solving the hygiene problem related to the generation, handling and disposal of healthcare waste.
- Establishing a reliable database of the amount, type and place of generation of healthcare waste.
- Provision of the right equipment for collection, transport and disposal of healthcare waste.
- Developing appropriate techniques, apparatus and plants for the treatment of healthcare waste.

In the long term, the whole process has to be imbedded into a national waste management legislation and infrastructure which gives clear instructions and which offers appropriate facilities for the handling of healthcare waste.

PART 1

Waste management considerations in general

Risks and environmental impact of healthcare waste

■ Definition and characterisation of healthcare waste

Categories of waste

One important characteristic of healthcare wastes is their heterogeneity. Many countries therefore have systematised the disposal of waste in health facilities by introducing categories defining the potential danger and the corresponding disposal method. The number of categories varies from country to country. Depending on the classification system three to eight groups of healthcare waste are defined /1-6/*.

Since proper handling of the daily generated waste is the central and most critical part of any waste management in health facilities, a classification system according to the required handling (with respect to the hazard potential) is chosen to distinguish between the different types of healthcare waste. This results in four categories of waste from health facilities:

Four types of health-care waste

Type A:	General waste and non-infectious healthcare waste, which requires handling similar to that of municipal solid waste;
Type B:	Infectious waste including sharps, which require special precautions during handling and disposal;
Type C:	Pathological waste including body parts, tissues, human foetuses, which require special treatment for reasons of hygiene and particularly for cultural and ethical reasons;
Type D:	Toxic waste such as drugs, chemicals or radioactive substances, which need individual disposal methods;

The majority of waste generated in health facilities belongs to category A.

Waste type A:

General waste

General waste, sometimes also called household or domestic-type waste, which is generated in health facilities, requires the same management and final disposal techniques as are used for municipal solid wastes /7-10/.

This type of waste arises from the hospital administration, general cleaning operations, food preparation, storage facilities, and workshops. It comprises paper, cardboard, plastics, scrap metal, food residues, glass, ash, and swept-up litter. Liquid waste from public toilets and wards (excluding liquid chemicals or drugs) as well as waste water from laundries and kitchens are also often described as general waste.

** numbers in / / refer to articles in the list of references*

Non-infectious waste from medical treatment areas

Non-infectious waste from medical treatment is derived from the general admittance areas, outpatient examination rooms, first aid areas and general wards. Apart from everyday refuse such as wrappings, flowers and magazines, the major part is made up of cotton wool, residues from plastering, empty ampoules and infusion containers and packaging material. Used bandages and clothing and bedding soaked with body fluids or excrement belong to this category too, if they do not originate from patients with infectious diseases /8, 13/.

A number of studies in Europe have proven /22-26/ that waste from general medical treatment areas is not more infectious than normal household waste.

Nevertheless, within health facilities some precautions should always be taken when dealing with waste. Since waste in general represents a route for the dispersal of *pathogens**, there is a latent potential to infect persons whose resistance has been diminished due to illness, advanced age, stress, trauma, etc. Outside the hospital waste from category A can be handled like municipal solid waste.

If there are sufficient facilities for thermal disinfection or incineration of infectious waste from categories B and C the sterilised waste or the ash from incinerators also belongs to waste category A /11-12/.

Waste type B:

Infectious waste

Infectious waste (biological agents of hazard levels 3 and 4**) contains *pathogens* in sufficient concentration or quantity to cause diseases. This category includes cultures and stocks of infectious agents from laboratory work, as well as waste from surgery and autopsies on patients with infectious diseases. In particular, all waste which has been in contact with infected patients in isolation wards or infected patients undergoing *haemodialysis* (not very common in developing countries) belongs to this category. In the case of waste from animals which have been inoculated with an infectious agent or suffering from an infectious disease, the same precautions must be taken /9/.

Since sharps, including needles, syringes, scalpels, blades, broken glass and other cutting or piercing items may cause infected wounds and have been identified as transmitting viral blood infections, they must be handled as infectious waste of type B /1,10/.

Waste type C:

Pathological waste

Pathological or organic waste (sometimes also called wet infectious or biological waste) comprises waste from operating theatres, delivery rooms, morgues, autopsies, etc. It consists of tissues, organs, body parts, human foetuses and animal carcasses, and most blood and body fluids /1, 8, 9/.

As mentioned above, this type of waste requires special treatment not only because

* *italic type: see glossary for explanation*

** *according to the European Union Directive 90/679*

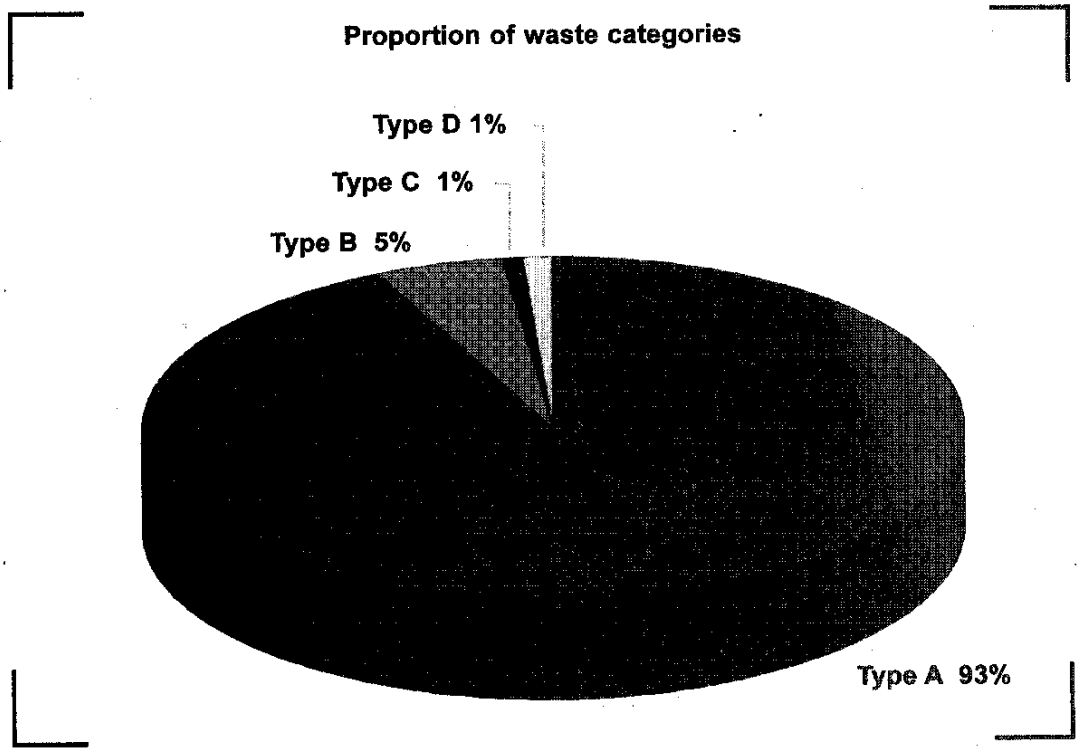
of its content of pathogenic bacteria, viruses or *prions*, but also for cultural and ethical reasons.

Waste type D:

Toxic wastes

Toxic wastes (sometimes also called special waste) necessitates particular treatment because of their special physical or chemical properties, which classify them as hazardous waste /1, 8/.

This type of waste includes radioactive material, solid, liquid or gaseous chemicals which may be toxic, *carcinogenic*, offensive to the skin, corrosive, inflammable or explosive, as well as pharmaceutical waste (in particular *cytotoxic* waste) and drugs whose shelf-life has expired /1/.



■ Quantities of healthcare waste in various countries

Waste quantities

Country	Unit	Total	Type A	Type B	Type C	Type D
Germany /14/	kg/b/d	2.8	2.5	0.3		
	%	100	89	11		
Switzerland /15/	kg/b/d	4.2	3.7	0.35	0.15	
	%	100	88	9	3	
Europe /28/	kg/b/d					
	%	100	59-97	3-41		
Brazil /8/	kg/b/d	1-7				
	%	100	90	10		
Lat. America /16, 21/	kg/b/d	1-4.5				
	%	100	100	10-40		
Botswana /2/	kg/b/d	1.7				
	%	100	72	28		
Tanzania /31/	kg/b/d	0.02-0.14	0.01-0.06	0.01-0.08		
Nepal /6/	kg/b/d	1.27	0.95	0.18	0.13	0.01
	%	100	75	14	10	1
India /17/	kg/b/d			0.25-0.5		
	%					
India /29/	kg/b/d	0.3-2				
	%	100				
Sri Lanka /18/	kg/b/d		0.8-2.5			
	%					
Malaysia /17/	kg/b/d			0.3-0.9		
	%					
Guatemala /27/	kg/b/d	0.3-7.3				
	%	100				
In general /19/	%	100	93	5	1	1

Investigation system

The procedures for estimating the quantity and kind of waste generated vary considerably from country to country and very few details of the respective methodologies are known. At the same time there is a great difference between waste generation between urban and rural, or between big and small health facilities. Even within one health facility the generation of waste varies from section to section. A study carried out in Guatemala /27/ indicated that the treatment of outpatients generates 3 times as much waste than the treatment of inpatients. Therefore, the table on the previous page gives only average figures regarding waste generation (kg/b/d = kg/bed/day) and its composition in different countries; it also demonstrates the wide range depending on the local conditions. In order to put these figures on a more scientific basis further studies will have to be carried out which use a unified methodology to compare the situations in different countries.

The figures above given for waste generation show a wide variation, as does the generation of so-called healthcare risk waste (categories B, C and D). In the literature, the average amount of healthcare risk waste is often given as 5 to 10 % of the total amount of waste. For the vast majority of the cases it will be correct to estimate the generation of healthcare risk waste as less than one quarter of the total amount of waste generated at health facilities.

■ Hygiene and environmental risks due to improper management of healthcare waste

Risk groups

Health and environmental hazards due to improper management of healthcare waste may arise for various groups of people and locations:

- occupational health risks for the personnel of health facilities;
- health risks for patients and visitors to health facilities (in particular children);
- risks to human health and the environment outside the boundaries of health facilities.

Within a health facility, major risks from healthcare waste stem from its handling and storage, while the effects on human health and the environment outside the boundaries of the health facility mainly result from the treatment and the final disposal of the waste.

Main hazards to human health

The main hazards to human health resulting from healthcare waste fall into four broad categories /1/:

- infectious hazards
- toxic hazards
- *genotoxic hazards*
- injury hazards

Routes of disease transmission

The main routes of disease transmission are the following/22/:

- through the skin (e.g. following injury)
- through mucous membranes
- by inhalation
- by ingestion

Animals (e.g. insects, rats, dogs, birds) are very often the main carriers of waste and *pathogens* from health facilities to other locations.

● Infection risks for healthcare personnel

The risk of infection from *biologically activematerial* is classified by the European Union Directive 90/679 in to four levels (hazard levels 1 to 4). It emphasises the protection of workers from risks related to the exposure to biological agents. The staff handling the waste must take precautions appropriate to the different hazard levels /1/.

Injuries from sharps

The major danger of infection results from injuries caused by needle sticks and other sharps. It has been found that the highest number of needle sticks and sharps accidents in health facilities occurs among **nurses**. Nevertheless, there is also a certain risk for **doctors** and **laboratory staff**. The relative frequency of needle sticks and sharps injuries varies according to the degree of training of the person affected /20/. Apart from infections caused by injuries, there is great risk to midwives due to their direct contact with considerable amounts of body fluids.

As well as the medical personnel, the **support staff** (caretakers, hospital cleaners, waste management officers, laundry and kitchen personnel, etc.) are very much at risk. They are often innocent victims of unguarded needles or sharps. When collecting and transporting hospital waste they often receive needle sticks or puncture wounds from objects not discarded properly after use, or handled carelessly by another member of the medical staff, or one of the other health workers or patients.

Handling of infectious waste

Apart from injuries from infected sharps, handling cloth or waste soaked with blood and other body fluids bears an additional risk of *nosocomial* and viral blood infections for **hospital cleaners**, **laundry staff** and **waste handlers**. Dust, aerosols and wet or liquid wastes are the main sources of exposure to infectious agents. A number of diseases are reported to be transmitted via injuries from sharps and the handling of infectious waste, including AIDS and hepatitis /1, 20/.

Exposure to toxic or hazardous chemicals

Just as workers using hazardous chemicals are at risk of exposure, so are those who handle waste chemicals. Unsatisfactory waste management, including improper procedures, container use and storage conditions, can lead to chronic exposure. Acute exposure usually results from a particular incident (such as a spill or fire). The type of illness caused by occupational exposure to toxic or hazardous chemicals depends on the particular chemical and on the level of exposure. Chemicals which are flammable, corrosive or otherwise highly reactive irritate the skin, the eyes and the mucous membranes lining the airways. Reactive chemicals may form sec-

ondary compounds of high toxicity.
Apart from health risks due to the toxicity of chemicals, additional risks may occur from their physical properties or conditions under which they are used or stored. Pressurised containers containing inflammable gases or liquids may cause explosions or fires.

Exposure to genotoxic substances and waste

Radioactive substances or objects, and also some chemicals such as benzene, are recognised as human *carcinogens*. In addition some 30 *antineoplastic drugs* are in use, which create *genotoxic* risks for **all people coming into contact with them** during preparation, injection and disposal /1/. Any *cytotoxic waste* discharged into the environment may have disastrous ecological impacts because of its carcinogenic and *mutagenic properties*.

The main routes of exposure are inhalation of dust or aerosols, absorption through the skin, and ingestion of food which has accidentally been in contact with these *cytotoxic drugs* or with secretions from chemotherapy patients. All discarded items used in chemotherapy should be considered as *cytotoxic waste*. These may be, for example, gloves, masks, connecting tubing, drug vials, vomit, urine or faeces from patients.

● Health risks for patients and visitors to health facilities

Nosocomial infections of patients, visitors and staff

Nosocomial infections (infections acquired in hospital) are a permanent concern of hospital managers, and despite all efforts made, hygiene is far from being adequate in many health facilities located in developing countries. The risk of acquiring such an infection depends on the quantity and virulence (infective potential) of the nosocomial micro-organisms as well as the physiological condition of the individual. Improper healthcare waste management has a negative effect on the hygiene situation of the health facility and therefore contributes in part to *nosocomial infections*.

While healthy persons are less at risk, particular persons with low resistance due to illness, advanced or very young age, surgical treatment, stress etc. may more easily be affected by *nosocomial infections*. In particular children, who often are attracted by waste and medical objects, are a most vulnerable group. Apart from patients and visitors, the staff of health facilities is also endangered.

● Risks for the environment and the neighbouring population due to healthcare waste

Healthcare waste has the potential to cause damage to most aspects of the environment - to soil, water, air, fauna and flora. Despite the fact that unnecessary disposal of waste causes an unnecessary burden on resources, the pollution of air and water, in turn, has a negative impact on public health /2/.

Contamination of soil

The main risk to the soil is caused by depositing sharps and substances which may contaminate the soil. In particular, heavy

metals such as mercury from broken thermometers have to be mentioned. Certain pharmaceuticals and chemicals, if deposited without treatment, may also be a source of contamination.

Pollution of groundwater

Uncontrolled disposal of toxic substances, for instance heavy metals and chemicals, causes toxic agents to leach into water resources. In addition, the leachate generated by the biological degradation of healthcare waste, similar to municipal solid waste, has the potential to cause water contamination.

Chemical residues discharged into the sewerage system may have toxic effects on the operation of biological sewage treatment plants, or on natural ecosystems when drained into surface waters. Particular pharmaceutical residues, some expired drugs, antibiotics, heavy metals, *phenols* and their *derivatives*, some types of *disinfectants* and *antiseptics* represent a high risk if discharged without prior treatment.

Air pollution

The risk of air pollution arises largely from the fact that healthcare wastes are often incinerated or burnt in order to eliminate or reduce infection (or often only to reduce the volume of the waste). Incineration, if carried out in suitable modern equipment operated to the correct standard, causes a negligible amount of air pollution. But many incinerators of health facilities in developing countries pollute the air with:

- **particles**, arising from inefficient combustion;
- **acidic gases**, due to the presence of PVC plastics, pharmaceuticals and chemicals (containing chlorine, sulphur, nitrogen, phosphorus, etc.) in the waste;
- **dioxins**, which are formed from organic substances in combination with chlorine during combustion /30/;
- **heavy metals**, in particular mercury which is volatile when heated.

The majority of the substances emitted are poisonous and *carcinogenic* and therefore create risks to human health. Equally they present risks to fauna and flora, and to biodiversity in general.

Infection risks for landfill workers and waste pickers

As mentioned before, studies in Germany have proven that healthcare waste from category A is not more infectious than ordinary domestic waste /22-26/. Even organic waste from operating theatres presents no higher infection risk /24/. Although these types of waste have to be handled within the hospital with some care, they can be treated (landfilled) outside the health facility together with municipal solid waste.

The situation in health facilities in developing countries often differs from the conditions reported in Europe. Improper waste management and accommodating patients with infectious and non-infectious diseases together in one room, as well as uncontrolled access of the public to all parts of the health facility increase the risk of mixing waste of categories A and B.

Therefore, there is a certain risk for waste workers at normal landfill sites who deal with healthcare waste. Immediate health risks are also apparent for scavengers or those segregating the waste for recycling.

Apart from human health hazards the public is often very sensitive regarding the appearance of recognisable healthcare waste on landfill sites. If possible, such waste should be shredded beyond recognition before landfilling.

Waste management hierarchy

Waste management in health facilities should follow the waste management hierarchy:

- avoidance
- utilisation
- disposal

The basic idea of the waste management hierarchy is to give **priority to waste reduction and recycling** before it comes to the treatment and final disposal of the waste.

This philosophy of a waste management hierarchy was mainly developed in industrialised countries, where the enormous amount of waste and its disposal had become a serious problem. In developing countries, and particularly in health facilities, the priorities have to be set slightly differently.

The danger of spreading *pathogens* and therefore diseases requires solutions which offer a maximum of safety and protection. A secure disposal method is therefore of higher priority than any type of utilisation which cannot provide adequate safety.

The economic pressure under which many health facilities in developing countries suffer forces them to utilise their equipment and supplies as much as possible. Even disposables are used several times. Excessive amounts of waste are therefore not the main problem, but the insufficient hygiene due to poorly disinfected or sterilised equipment.

The lessons learned in industrialised countries can help developing economies to develop preventive measures for coping with the burden of waste expected in the future.

■ Avoidance of healthcare waste

Waste reduction at the source

Modern health facilities tend to use an increasing amount of disposables. Apart from hygienic aspects, these articles minimise cleaning, sterilisation and transport. At the same time, this practice increases the amount of waste generated at the health facility.

To reduce the amount of waste (in particular general waste) at the source, the following aspects should be taken into account:

- use re-usable articles whenever possible,
- use products with a minimum of packaging,
- give preference to products which are made of environmentally friendly materials,
- use less harmful chemicals, if these are available.

In practice, it will not always be easy to decide what material is environmentally friendly or which chemical is less harmful. The relevant expertise must be developed or advice sought.

Segregation of waste

Less than one quarter of healthcare waste is hazardous (categories B, C and D). If this waste is mixed with general waste, it will contaminate the whole batch and its treatment and safe disposal will be excessive. **The hazardous waste in categories B, C and D therefore has to be stored, trans-**

ported, treated and disposed of separately according to its particular characteristics.

■ Utilisation of healthcare waste

Waste, in general, is a source of what is termed secondary raw material. This refers to articles which can be re-used (e.g. bottles, containers, etc.), or materials which can be recycled (e.g. metal, glass, paper). The cleaner and more uniform the separated waste fraction, the easier its re-use and recycling. Therefore, waste should be sorted at the source (by those who know the dangers, e.g. doctors, nurses) before the waste is mixed and contaminated.

Re-use

The re-use of used medical articles or equipment always has to fulfil the hygienic requirements. If all necessary precautions regarding disinfection, cleanness, sterilisation and safety are taken, a number of medical articles are suitable for re-use (e.g. infusion bottles, some sharps, bandages, etc.).

Note: if used bandages and bedding soaked with body fluids are not washed at a sufficiently high temperature (> 80 C) to ensure thermal disinfection, they form a source of further infection of patients and hospital staff.

Typical articles for general re-use within or outside the health facility are:

- glass or plastic bottles and containers;
- cardboard or timber boxes;
- sheets and bags made of paper or plastics;
- plastic or rubber tubes.

In some countries infusion sets, catheters, etc. are collected and repacked, allegedly after cleaning and disinfection. This practice is extremely dangerous and the public should not have access to material of this kind.

Recycling

If articles are broken, dirty or contaminated so that re-use is no longer feasible, it is still possible to use the waste as raw material for processing and manufacturing. Although recycling is not the task of a health facility, collecting and selling recyclable material might generate some additional funds. Recovery of silver from the fixing baths of x-ray film processing is practised in health facilities or centralised facilities world-wide.

If adequate knowledge is available, metals and plastics can be separated by type, while glass is sorted according to colour. The value of the separated material increases with the grade of purity.

In all cases it must be assured that all material leaving the hospital is properly disinfected.

■ Disposal of healthcare waste

Waste is treated prior to the final disposal to lower the hazardous potential of the waste. For infectious waste, which represents the major part of the healthcare risk waste, thermal disinfection is the most common method, and also the safest and most environment friendly. In general, the major treatment methods for solid and liquid wastes are:

biological treatment:
- composting
- aerobic/anaerobic digestion

physical treatment:
- shredding
- sorting
- sedimentation
- liquid-solid separation
- thermal disinfection
- incineration

chemical treatment:
- neutralisation/denaturing
- precipitation
- disinfection

Treatment of healthcare waste

If waste from category A, the major portion of healthcare waste, is properly separated from waste of category B, C, and D, it is not more harmful than municipal solid waste. It can be landfilled untreated.

The hazardous waste fraction (categories B, C and D), which is separated from the main healthcare waste stream, has to be treated prior to any type of disposal. In the case of infectious waste, incineration might be an appropriate method. Chemical waste may need chemical treatment (e.g. neutralisation, denaturing, etc.) while radioactive substances have to be packed and sealed for final disposal.

Final disposal of healthcare waste

The final disposal methods depend on the type of the waste. While waste in category A, incinerator ash and neutralised/denatured chemical waste from health facilities may be landfilled together with the ordinary municipal solid waste, some hazardous waste fractions such as radioactive, *carcinogenic*, *mutagenic* or infectious waste (categories B, C and D) have to be disposed of separately. Appropriate places for hazardous waste disposal are specially designed landfill sites or waste pits or guarded underground places.

In particular pathological waste including body parts, tissues, human foetuses, etc. requires special handling and disposal for reasons of hygiene and particularly for cultural and ethical reasons.

Factors influencing healthcare waste management in developing countries

Just like waste management in general, the management of healthcare waste requires a systematic approach. Successful waste management is not primarily a matter of technical knowledge or particular technologies, but depends largely on the interaction of the awareness of the people involved, the cultural, social and political framework, and on financial and organisational constraints.

Within a health facility, the following factors influence the waste management:

- **awareness, attitude, culture and knowledge of the people** involved (administrative, medical and support staff as well as patients and visitors);
- administrative and management structures;
- system of sanctions and incentives for the staff;
- technical facilities;
- financial resources.

External influencing factors include:

- waste management legislation and its enforcement;
- local municipal waste management structure
- and available technical facilities and financial resources;
- customs and habits **of the local population.**

■ Factors influencing waste management within a health facility

● People's awareness of waste management in health facilities

Waste may be generated at any place at any time by each and every one of us. Successful waste management therefore has to involve everybody. Awareness of the need to protect human health and the environment forms the basis for any responsible waste management activities. Incentives for correct waste management practices and behaviour and sanctions in case of misbehaviour might assist the educational process. The human factor in waste management needs maximum attention in order to establish a functioning waste management system.

Role players in the waste management at health facilities

Within each health facility the following groups of people have to take an active role in waste management:

- management and administrative staff;
- medical and laboratory staff;
- support staff;
- patients and visitors.

Management and administrative staff

It is the task of the management to build up the environmental consciousness in each type of health facility. Environmental protection therefore should be recognised as one important element of the overall managerial approach and should have an influence on each decision and activity within the health facility. Establishing an effective waste management plan as part

of the overall hygiene plan will create the necessary frame for the correct handling of waste.

Medical and laboratory staff
The hygiene standards within the health facility determine to a great extent the success or failure of the medical treatment. Doctors, nurses and the other medical staff must be permanently aware of the important role of hospital hygiene.

To them it must become obvious that proper handling of waste improves the overall standard of hygiene. They should be able to judge the danger to human health and the environment which might arise from the different types of waste. They may still need guidance and training, when it comes to establishing appropriate waste handling practices.

Caretakers and other support staff
Caretakers, kitchen and laundry personnel, cleaners, waste management officers and labourers are the group of people having to deal directly with the waste in health facilities. Although they are the most important part of the waste management chain, they have the least knowledge about possible health risks and appropriate waste handling practices. Often there is a language problem because of lack of formal education or different origin.

In order to establish a successful waste management system, considerable effort is needed to train and motivate the support staff.

Patients and visitors
Due to the permanent fluctuation of patients and visitors, it is virtually impossible to organise systematic education of this group of people on the principles of waste management. Nevertheless, some health facilities offer hygiene and healthcare courses for patients and their relatives during the waiting period, which could be used to incorporate waste management subjects.

A sufficient number of properly marked waste collection bins will advise patients and visitors where to leave waste and residues. Attentive hospital staff might guide patients and visitors from time to time regarding their waste management practice.

In addition, efforts should be made to form linkages with primary education to include waste and general hygiene subjects into the school curricula.

■ Administrative and management structures for successful waste management

Waste management plan
As has already been mentioned, the managers and decision-makers of health facilities have to establish a hygiene plan including an administrative framework within which waste management takes place. This waste management plan or set of guidelines should consist of:

- an investigation of the human resources present with respect to staff knowledge, attitudes and behaviour (KAB) and the social acceptance of waste management;

- an investigation into the amount and type of waste generated on a daily or monthly basis;
- clear and binding advice on how to collect, store, treat, transport and dispose of the various types of waste;
- a list of permanent activities to minimise the generation of waste, including fixed time intervals for assessing the results;
- assignment of responsibilities and duties regarding the handling of waste;
- nomination of a person responsible for waste management;
- integration of hygiene and waste subjects into the supervision system;
- a list of measures for training and motivating the staff of the health facility.

Regular monitoring of waste generation

Generation of the different types of waste (weight and volume) should be monitored on a **regular** basis. These figures will indicate the success or failure of the waste management activities and will encourage people to increase their efforts. At the same time the monitoring results will provide important figures for administration and general planning of waste management activities (e.g. the number of waste bins and other containers required and the related costs of waste management activities, etc.).

Advice on the handling of different waste fractions

The waste management plan for a health facility should give clear and compulsory instructions on how to handle the different waste fractions. The health risks for patients and staff from healthcare waste should be expressed clearly and appropriate protective measures suggested.

Permanent activities to minimise waste generation

Waste minimisation should be a major goal of every waste management plan. Appropriate effort should be made at each place of operation and administrative level. This may incorporate a consistent preference for *low-waste products*, the re-use of certain articles and recycling waste components. Advice should be given as to how to disinfect all articles for re-use to minimise infection risks. Permanent segregation of the waste at the source will minimise the amount of hazardous waste.

Define responsibilities

Who is responsible (e.g. for the separation of sharps, collection, transport and treatment of waste, etc.)? This question should always have a clear answer. Only a chain of interacting responsibilities and duties gives a high degree of security and a clear administrative structure. At the same time, responsibility can be an excellent motivator when it comes to preserving or improving the standard of the waste management system.

Nominate person responsible for waste management

Each health facility should nominate a person responsible for waste (waste man-

agement officer). It will be the duty of this person to implement, supervise and enforce an efficient waste management structure and to give advice to the personnel, patients and visitors.

Integration of hygiene and waste subjects into supervision system

Hygiene and waste management standards have to be monitored and supervised on a **regular** basis. It is an integral part of the quality management of any health facility. Monitoring will be the duty of the waste management officer. The results of monitoring and supervision must lead to appropriate action.

Training and motivation

Training and motivation are both important. All staff, whatever their position in the waste management chain, need to know what is expected of them, and why it is important. Particular attention should be given to staff members who are illiterate or weak in the official language. Motivation can be stimulated by a full discussion of the hazards posed by healthcare waste, so that the staff members understand the significance of the steps that they are asked to take. Permanent supervision must provide feedback for the training activities.

■ Appropriate technical facilities for handling healthcare waste

The most sophisticated waste management strategy and the highest motivation of the staff regarding environmental issues will be insufficient if no appropriate waste handling technologies or equipment are available.

Handling technologies

Appropriate handling technologies are required for:

- collection and separation of waste;
- transport within the health facility;
- intermediate storage;
- on-site treatment;
- on-site disposal;
- transport to centralised waste handling and disposal facilities;

The financial and administrative restrictions at health facilities in developing countries often restrict optimal waste handling procedures. The suggestions below take these circumstances into account.

Waste collection

Waste has to be collected wherever it is generated. According to the principle of segregation at source, different collection vessels or bins must be available for the various types of waste. They have to be marked, so that they are not mixed up.

Transport within the health facility

The transport of waste (in particular category B) within the health facility requires containers with lids to prevent loss of waste, the spread of disease and injuries caused by sharps.

Intermediate storage

While waste of category A normally is dumped immediately, waste from category B, C and D sometimes need to be accumulated for some time before it is treated on-site or transported to centralised waste handling centres outside the boundaries of the health facility. It therefore has to be stored separately, in a cool place if possible and locked in order to prevent unau-

thorised people from coming in contact with the waste.

On-site treatment

Apart from sorting at source, the main treatment methods for waste of category B, C or D at health facilities are disinfection and incineration. Some liquid chemicals may be neutralised or diluted to lower their hazardous potential. Particular precautions should be taken in the case of radioactive waste, which should never be treated or disposed of on-site. It should be collected and taken to an appropriate treatment site.

On-site disposal

Health facilities at remote places out of reach of any municipal waste management structure have to dispose of their own waste. Normal dumps are sufficient for waste in category A. To avoid any danger of infecting the neighbouring population these landfill sites should be fenced and locked. Organic solid waste may also be composted on-site.

Waste in categories B and C (infectious and pathological waste) requires specially designed waste pits /3/ which guarantee that nobody is able to come into contact with the waste.

Waste in category D (chemical and radioactive waste) should never be disposed of on-site, but transported to authorised collectors.

Transport to centralised waste handling facilities

If healthcare waste is transported to centralised waste handling facilities, it should be transported in a manner preventing the loss of waste during the transport. As a rule specially designed lorries and trailers should be used.

Similar to on-site treatment and depending on the available technology, healthcare waste will be disinfected, incinerated, denatured and/or landfilled at centralised facilities. Particularly in the case of chemical and radioactive wastes only centralised waste management facilities can offer appropriate treatment and disposal opportunities.

■ Financial aspects of healthcare waste management

Waste management costs money!

The establishment and operation of waste management structures in health facilities will require financial resources. Hygienic and environmental protection costs money. Any solution for waste problems in health facilities will involve a compromise between the requirements of health, ecology, technical practicability and financial resources.

Nevertheless, proper waste management also has the potential to save money in some areas. Although some of the opportunities mentioned below still lie in the future for many health facilities in developing countries, costs can be saved by the following means:

- internal re-use or recycling of medical articles;
- selling sorted waste fractions as secondary raw materials to scrap dealers or manufacturers;

- reducing the communal disposal costs through minimising waste, particularly hazardous waste;
- improving the medical standard and thus achieving a higher level of hygiene.

■ Practical advice on waste management at small to medium-scale healthcare facilities

To assist in the implementation of waste management practices at health facilities we are presenting here a number of worksheets with practical advice (see Part 2 of this booklet).

Worksheets No.			
1	Content of a waste management plan	9	Wastewater treatment facilities
2	Monitoring waste generation	10	Basic requirements for landfilling of household type healthcare waste
3	List of ways of reducing and avoiding waste	11	Pit for infectious waste
4	How to segregate waste	12	Soakaway for wastewater
5	Appropriate collection and transportation of healthcare waste	13	Checklist for regular monitoring of waste management
6	Checklist for safe storage of waste	14	Waste management-related cost management
7	Liquid waste and excreta collection and transportation systems	15	Topics in a training manual for waste management
8	Incineration of healthcare waste		

■ External factors influencing waste management

● National waste management legislation

Government responsibility

The national government and its agencies are responsible for establishing a national action plan or waste management guidelines for handling healthcare waste from health facilities /1/. In view of the current status of the health facilities, and their technical, administrative and financial constraints, as well as the health risk arising from healthcare waste, an **appropriate** national waste management legislation should be developed.

It has been suggested that waste management legislation governing healthcare waste should cover the following aspects /1/:

- Definition of waste fractions and their effects on human health and the environment;
- Establishing standards for the control of occupational, health and environmental risks due to healthcare waste;

- Incentives to reduce the quantity of waste produced;
- Standardisation of sound waste handling practices;
- Establishing a pricing system for services provided by third parties;
- Establishing effective surveillance and control of handling healthcare waste and respective sanctions.

Apart from drafting national legislation or guidelines regarding healthcare waste, efficient controlling and enforcement structures have to be developed.

Polluter-pays-principle

A key function of legislation is to define who is responsible for the waste at all stages. The development in industrialised countries has shown that it is important to make people, companies and institutions responsible for the waste they create wherever it is – during storage, transit, processing and disposal. This sense of responsibility, naturally coupled with government legislation and law enforcement, makes people prepared to pay for waste treatment and disposal. Although this still lies in the future in many developing countries, the allocation of responsibility will encourage health facilities to minimise the amount of waste and to check on practices and standards of the contractor they use.

● Necessary infrastructures for effective healthcare waste management

Health facilities in urban areas

Health facilities in some urban areas have a greater chance of benefiting from an existing municipal waste management infrastructure. Not only are they able to drain their liquid waste directly into the local sewage system, they are also often offered solutions for the solid healthcare waste.

If the solid healthcare waste is segregated properly, the waste from category A can be collected and handled together with the municipal solid waste. Depending on technical standards and local infrastructure this waste will be incinerated or landfilled at the local landfill site. In the case of landfilling, precautions should be taken to prevent waste workers and scavengers from having direct contact with the healthcare waste.

Hazardous waste of categories B to D has to be handled separately. In urban areas there are more likely to be centralised facilities for the treatment of hazardous waste, e.g. autoclaves for thermal disinfection or incinerators for infectious, pathological and chemical waste as well as appropriate storage facilities for radioactive residues.

Health facilities in rural areas

Health facilities in rural areas are in a less favourable position. Some might be lucky in using at least municipal landfill sites for their category A waste, or they might be connected to a local sewage system. More often they have to rely totally on themselves.

In this case they have to establish properly managed dump sites for their waste in category A and specially designed pits for their infectious waste (categories B and C). Some of them may even be able to build or purchase and operate their own

autoclaves for thermal disinfection or hospital incinerators.

Special types of hazardous healthcare waste (category D), particular radioactive waste, should be stored within the health facility until a transport opportunity becomes available to transport the waste to authorised collection points.

● Influence of culture and local habits on waste management

Everybody has to play an active role

Everybody in a health facility, regardless of position or profession, must take an active role in waste management, e.g. segregation of waste at its source.

Since this work is regarded as an undesirable task, it might lead to barriers and objections from people who think that the handling of waste is below their social and cultural status. In some cultures the handling of waste is restricted to certain groups of people or castes.

Ethical aspects

There are many cultural restrictions regarding the way that human body parts and foetuses in waste from medical and surgical intervention are handled and disposed of. In some countries shredding anatomic waste is recommended to prior to further treatment or disposal, for basically aesthetic reasons.

In some countries (Asia), local custom requires that body parts are returned to the patients' families inside little coffins, to be buried in cemeteries /1/.

Selected results from case studies in developing countries

During the preparation of this booklet nine case studies (see list of case studies) were analysed regarding waste management practice at the various healthcare facilities. The table below summarises the results of this investigation.

Although a number of the facilities have started waste management activities to a certain extent, the investigation shows that they are in the majority of cases neither adequate nor sufficient to meet the requirements of hygiene and environmental protection.

Since waste management needs a systematic approach to be effective, isolated actions in selected areas are of little use. The complexity of the subject, the need for interaction between the different actors involved and the documented need to increase guidance all indicate that there is an urgent need in waste management at health facilities.

Important waste management aspects	Case Studies								
	I	II	III	IV	V	VI	VII	VIII	IX
Methods of waste collection									
a. Segregation of waste takes place	X	X	X	X	X		X	X	X
b. Availability of appropriate containers for different waste types and appropriate segregation									
c. Special requirements for sharps in practice	X		X	X					X
d. Special handling procedures for infectious/hazardous waste in practice		X	X						
Waste transportation procedures									
a. Transportation equipment if available			X			X	X	X	X
b. Transport procedure, appropriate transport system is adequate									
Waste storage procedures									
a. Storage facilities/equipment exist	X	X	X	X	X			X	X
b. Special requirements for hazardous waste in place		X							
c. Record keeping/responsibilities		X							
Waste treatment									
a. Incineration takes place	X		X	X	X		X	X	X
b. Sewage collection system available		X	X		X				X
c. Septic tank installed			X			X			
d. Special waste water treatment systems in place									
Waste disposal methods									
a. Landfill site in use	X			X	X	X	X	X	X
b. Waste pit in use	X		X	X	X	X	X	X	X
c. Special procedures for hazardous/infectious waste			X						
d. Responsibilities appointed									
Waste reduction									
a. Measures for reduction and avoidance in place									
b. Recycling in practice		X		X			X	X	X
Waste management administration									
a. Waste management plan exists									
b. Activities in monitoring and record keeping		X							
c. Elaboration of statistic data of waste generation									
d. Elaboration of costs of waste management and efforts to reduce them									
e. Information and training of staff takes place	X								
f. Protective measures for healthcare facility staff/personal takes place				X					
g. Political and administrative support exists				X					
h. Legislative aspects concerning waste management				X		X			

X= recorded activities

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Glossary

antineoplastic drugs	drugs which inhibit or prevent the development of neoplasms (e.g. cancer) /1/
antiseptics	substances which inhibit infections, used for disinfection
biologically active material	material containing active microorganisms which might cause infections
carcinogens / carcinogenic	substances which are proven to cause or suspected of causing cancer
cytotoxic	possessing a specific destructive action on certain cells; used in particular in referring to the lysis (disintegration or dissolution) of cells by the immune system and to antineoplastic drugs that selectively kill dividing cells /1/
disinfectants	substances which destroy or disable pathogenic microorganisms
genotoxic	a genotoxic substance is able to impact on the genetic material of the person exposed /1/
haemodialysis	mechanical purification of blood (by osmosis) of patients with renal deficiencies
low-waste products	articles which generate little waste during manufacturing and consumption
mutagenic	substances which are proven to cause or suspected of causing genetic defects
nosocomial infections	infections caused by micro-organisms which occur in the specific environment of hospitals and other health facilities
pathogens	infectious micro-organisms
phenols	weak organic acids combining benzene rings with OH-groups
phenol derivatives	related phenolic compounds
prion	a poorly characterised slow infectious agent /1/; prions are extremely difficult to remove by sterilisation.

PART 2

Practical solutions for healthcare waste management

Introduction

Part 2 aims to give advice on the practical implementation of waste management structures and procedures in small health facilities in developing countries. After this short introduction there follows a series of worksheets giving practical advice suitable for immediate application.

Although the necessity of waste management is accepted in the majority of healthcare facilities, particularly at the level of management and doctors, the success of waste management activities is limited in practice by a lack of finance, knowledge, awareness, infrastructure and technology, in addition to widespread ignorance at the lower staff level.

This section intends to close the gap between the theoretical knowledge about waste management on one side and successful practical implementation of it on the other. The contents of the worksheets have been made as practical and usable as possible. They emphasise the user's perspectives, knowledge and understanding. They are intended to help prepare the basis for establishing a waste management system at healthcare facilities by adapting recommendations given to the local situation.

Experience has shown that no one technical solution can apply throughout the world or even throughout one continent or one country. There is no single way to collect, handle and dispose of wastes, but rather a range of options. However, it is important to outline some appropriate system or solution as a basis for further adaptation.

Although this guide primarily addresses the management staff of healthcare facilities offering advice, working sheets and technical drawings, the worksheets are prepared in such a way that they can be handed on to the respective staff members dealing with waste management activities.

Since it is the intention of this booklet to meet the requirements of healthcare facilities with limited resources, the advice given should lead to a maximum improvement of waste management using a minimum of financial resources and technology. It is obvious that there are always better and more efficient options if more money is spent and more sophisticated technology is applied. But this is beyond the reach of the majority of small healthcare facilities in developing countries.

Worksheet 1

Content of a waste management plan

Objective:

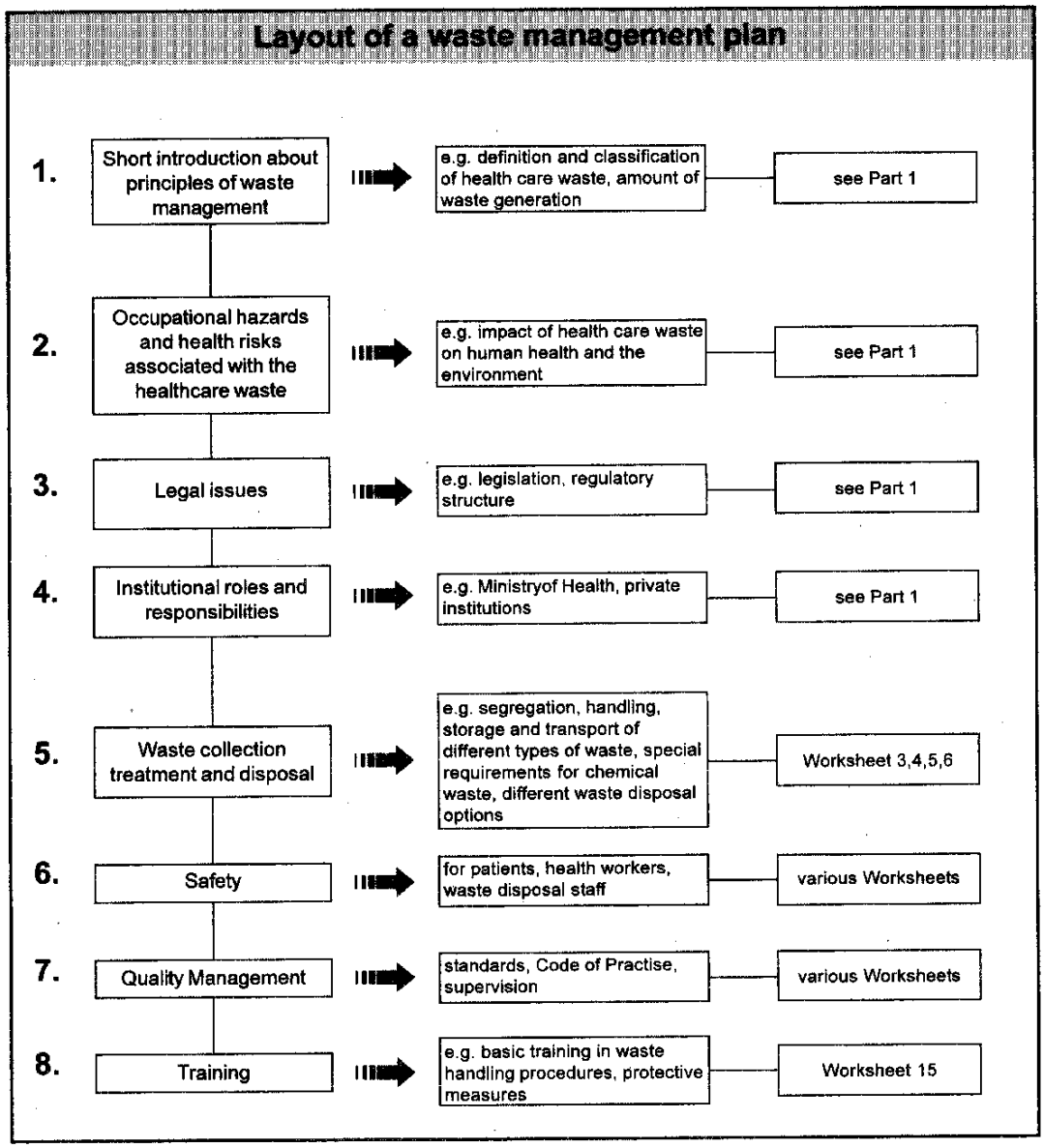
The institutional basis of any waste management at health facilities is the waste management plan - itself part of the hygiene plan. All standards, procedures, regulations and guidelines regarding waste management aspects are fixed and laid down in the waste management plan. For the management, this plan is the instrument for monitoring, supervising and organising all waste management activities. The staff will find advice and guidance for their waste management practice.

To guarantee that waste management will work properly, it has to be in line with the overall aspects of quality management. Only then will waste management play its role most effectively by contributing to a sustainable improvement of standards and quality at the health facility.

This worksheet gives advice about the contents of a waste management plan, how to establish it and how to set short to long-term goals in waste management.

The table on the next page shows the general structure of a waste management plan. When formulating the respective sections, please refer to the theoretical background in the booklet "Introduction to the waste management of healthcare facilities" and to the advice and recommendations given in the various worksheets of this booklet. It is obvious that due to the different situation at each healthcare facility a standard waste management plan cannot exist. A waste management plan has to be drawn up that meets the local situation, through dialogue between management and staff.

Knowledge, attitude and behaviour of the people involved are the most important factors influencing the success or failure of any waste management activity and should not be underestimated. Therefore, before designing and establishing a waste management plan, the awareness and social acceptance of waste management should be thoroughly investigated. Depending on the results of this investigation appropriate action in the field of training, awareness creation and motivation should be taken. A system of incentives and sanctions to promote good behaviour and discourage bad, can encourage people to act in the desired manner.



Establishing a waste management plan at the healthcare facility does not mean that all problems can be solved immediately. It will take time to put all recommendations and regulations into practice. Therefore, it is important to define short-term, medium-term and long-term improvements to be achieved (goals).

Short-term improvements

Short-term improvements are developments that can be carried out in a reasonably short period of time (2-3 months) and which aim to minimise the risks of an outbreak of infectious disease.

Medium-term improvements

These improvements fall between short-term and long-term measures. Medium-term activities integrate the essence of the work carried out in the short-term and prepare the basis for the strategic planning of activities to achieve long-term improvements.

Long-term improvements

Long term improvements require long term actions, which normally base on strategies and policies pursued by the healthcare facility itself or general policies of the health and sanitation sector.

A selection of short-term, medium-term and long-term activities for an individual healthcare facility is listed below:

Short-term activities

- Developing methods for quantifying waste generation at the health facility. For further planning it is important to know the composition and generation rate of waste including excreta. Hazardous fractions of the waste have to be identified.

- Developing appropriate waste handling and treatment guidelines (code of practice) including excreta disposal and wastewater treatment. The guidelines should be based on the present waste situation and define waste categories, the segregation of waste streams, and the special care required for hazardous components, as well as appropriate treatment and disposal methods.

- Assessing (e.g. by questionnaire) of the awareness of the personnel and patients (knowledge, attitude, practices). The staff of the healthcare facility, patients and visitors are the groups affected by the waste management system. They all have access to different types of waste. This is why they should be aware of the dangers to human health and the environment.

Medium-term activities

- Implementing hygienically and environmentally sound waste handling and treatment practice according to the guidelines developed.

- Upgrading waste handling and treatment facilities including those for excreta disposal and wastewater treatment.

- Developing a decentralised monitoring & evaluation (M&E) system, based on good supervision practices.

- Developing waste minimisation and avoidance strategies.

- Developing appropriate training programmes/manuals for personnel generating and handling the wastes.

Long-term activities

- Implementing a quality management system (monitoring, evaluation and supervision).

- Permanent monitoring of waste flows within the facility from generation as raw materials to disposal as (hazardous) waste. This may involve usual practices of mixed accumulation, separation or conditioning at the source, as well as transport, storage, treatment and final disposal of the waste.

- Establishing a database on waste streams and fractions. This can help in pinpoint-

ing large waste streams and in documenting achievements through efforts aimed at avoidance, minimisation and re-use.

- Executing training programmes for all staff members who may generate or handle waste, especially hazardous material. All personnel affected should be provided with detailed waste operating manuals or instructions, according to their specific role in waste management.

- Participation in the design and implementation of a national long-term education campaign for health personnel in the field of waste and hygiene.

Additional information is available in:

Christen, J.:
Health Care Waste Management in District Health Facilities – Situational Analysis and System Development;
Dar es Salaam Urban Health Project,
Dar es Salaam City Council/SKAT, August 1996

Worksheet 2

Monitoring of waste generation

Objective:

The generation of the different types of waste should be monitored on a regular basis. These figures will indicate the success or failure of the waste management activities and will encourage people to increase their efforts. At the same time monitoring results will give important data for administration and general planning of waste management activities.

The following questionnaires should assist the collection and recording of relevant data on waste generation in the various sections of healthcare facilities.

● Monitoring intervals:

If waste generation at the health facility has never been investigated, it is important to produce an initial database for planning further activities in waste management. The data on waste generation has to be recorded for each section of the healthcare facility **on a daily basis over a period of one month (minimum)**. The figures for each section are summarised in a record sheet for the whole health facility.

Once the general data basis has been established, it is sufficient to monitor the development of waste generation **once a month**. Again, the monthly results for each section are recorded in the general data sheets of the health facility.

Questionnaire 1 is used for recording waste generation in each section of the health facility.

Questionnaire 2 can be used to summarise the data from each section, giving an overview of the total waste generation at the entire health facility.

Questionnaire 3 records the amount of waste to be stored, treated, disposed of or transported to places outside the health facility. This questionnaire should help to design and dimension appropriate handling facilities for the different waste and indicate the whereabouts of the waste (waste route) after collection and segregation.

Additional information is available in:

Christen, J.:
Health Care Waste Management in District Health Facilities – Situational Analysis and System Development;
Dar es Salaam Urban Health Project,
Dar es Salaam City Council/SKAT, August 1996

Questionnaire 1

Generation of waste in section

Place of Generation: (e.g. ward) _____

Person in charge: _____

WASTE TYPE	Quantity [kg]	Reporting Period from: [dd/mm/yy] to: [dd/mm/yy]	"Immediate" Handling e.g. collected in plastic bags, fed to pigs,...
Type A			
General Waste			
Food / Kitchen Waste			
Packaging			
Total [kg]			
Type B			
Infectious Waste			
Sharps			
Total [kg]			
Type C			
Pathological Waste			
Total [kg]			
Type D			
Chemical Waste / Drugs			
Radioactive Waste			
Total [kg or l]			

Note: If weight is unknown the number of bags or containers should be noted and the typical weight for a bag or container should be determined

Questionnaire 2

Generation of waste in health facility

Reporting Period: **from:** [dd/mm/yy] **to:** [dd/mm/yy]

Person in charge: _____

PLACE OF GENERATION / WASTE TYPE	Maternity	Operation Theatre	Surgical Ward	Medical Ward	Kitchen	Orthopedic Departement	Laboratory	others	Total waste [kg or l]
Type A									
General Waste									
Food / Kitchen Waste									
Packaging									
Total [kg]									
Type B									
Infectious Waste									
Sharps									
Total [kg]									
Type C									
Pathological Waste									
Total [kg]									
Type D									
Chemical Waste / Drugs									
Radioactive Waste									
Total [kg or l]									

Note: If weight is unknown the number of bags or containers should be noted and the typical weight for a bag or container should be determined

Questionnaire 3

Handling of waste at health facility

Person in charge: _____

WASTE TYPE	Total waste [kg or l]	Reporting Period from: [dd/mm/yy] to: [dd/mm/yy]	Intermediate Storage [kg or l]	Incineration [kg or l]	Disposal		Inside-Transport (shipment to centralised facilities)	Remarks
					Waste Pit [kg or l]	Landfill [kg or l]		
Type A								
General Waste								
Food / Kitchen Waste								
Packaging								
Total [kg]								
Type B								
Infectious Waste								
Sharps								
Total [kg]								
Type C								
Pathological Waste								
Total [kg]								
Type D								
Chemical Waste / Drugs								
Radioactive Waste								
Total [kg or l]								

Note: If weight is unknown the number of bags or containers should be noted and the typical weight for a bag or container should be determined

Worksheet 3

List of possibilities to reduce and avoid waste

Objective:

Avoidance and reduction of waste generation minimise the necessary effort for waste treatment and disposal at healthcare facilities. With less waste to be collected, transported, stored, treated and disposed of, less money, time and technology are needed to meet the required standards of hygiene.

This worksheet gives advice on how to reduce and avoid waste generation.

1. Avoidance and reduction of waste through product selection

- use re-usable articles whenever possible;*
- use products with less packaging;
- give preference to products which are made of environmentally friendly materials;
- use less harmful chemicals, if these are available.

2. Avoidance and reduction of waste through re-use

Typical articles for re-use or recycling within or outside the health facility may be:

- glass or plastic bottles and containers;*
- cardboard or timber boxes;*
- sheets and bags made of paper or plastics;*
- plastic or rubber tubes;*
- lead batteries.*

3. Reduction of infectious waste by segregation

When infectious waste is mixed with general waste, it will contaminate the whole batch and the effort required for treatment and safe disposal will be excessive. Therefore, the segregation of general waste from infectious material at the source minimises the amount of waste which needs special treatment and precaution.

4. Avoidance and reduction of waste chemicals, drugs and radioactive substances through efficient use of materials and products

Through administrative measures:

- Monitoring of drug and chemical flows within the facility from receipt on the site to disposal as hazardous waste.
- Establishing a centralised system for purchasing and dispensing drugs and other hazardous chemicals.
- Improving the inventory control for chemicals and drugs.
- Implementing an institution-wide waste reduction programme.
- Establishing an internal recycling/re-

** Only those articles not contaminated by hazardous chemicals, radioactive substances or infectious pathogens are suitable for re-use or recycling.*

using programme. Waste produced in one department can be useful in another (e.g. dextrose bottles for urine).
- Accounting of waste management costs to the department that generates the waste, if applicable.
- Providing employee training in hazardous materials management and in waste minimisation.
- Returning outdated drugs to the manufacturer, if applicable.

Through better operational practices:
- Ordering hazardous chemicals only when needed and in minimal quantities to avoid outdated stock.
- Purchasing drug volumes according to needs.
- Using up old stock before ordering new stocks.
- New materials that may result in hazardous waste generation after use should be tested in small quantities before being purchased in bulk, if applicable. This can avoid needing to dispose of unused material that does not perform as expected.

5. Methods of reducing and avoiding selected chemicals and drugs

Chemotherapy and Antineoplastics
- reduce volumes used,
- optimise drug container sizes when purchasing,
- return outdated drugs to manufacturer,
- centralise chemotherapy compounding,
- minimise waste from compounding equipment cleaning.
- provide cleanup kits for spillage,
- segregate hazardous from non-hazardous waste.

Formaldehyde
- minimise strength of formaldehyde solutions,
- collect used formaldehyde and return to collection point,
- investigate possible re-use in pathology, autopsy and other laboratories.
- consider alternatives.

Photographic chemicals
- return used developer to manufacturer,
- cover developer and fixer tanks to reduce evaporation and oxidation,
- recover silver from photographic baths if possible.

Radionuclides
- use less hazardous isotopes whenever possible,
- segregate and label radioactive wastes properly,
- store short-lived radioactive wastes in isolation on-site until the degree of decay permits disposal with ordinary waste,
- return radioactive waste with long half-life to suppliers.

Solvents
- substitute less hazardous cleaning agents and methods,
- reduce the analysis volume, if possible
- use pre-mixed kits for tests where solvents are a fixed component,
- use calibrated solvent dispensers for routine tests,
- segregate solvent wastes,
- recover/re-use solvents by distillation.

Mercury

- Substitute mercury-containing devices with electronic sensing instruments using other measurement principles,
- provide mercury spill cleaning kits and train personnel how to handle it.

Toxins, corrosives and miscellaneous chemicals

- Inspect and maintain equipment for ethylene oxide sterilisers on a regular basis,
- use less toxic compounds and cleaning agents,
- use physical instead of chemical cleaning methods (see formaldehyde),
- return empty containers for re-use or refilling,
- use recyclable drums,
- neutralise acid waste with appropriate basic residues,
- precipitate metal iron and impurities from aqueous solutions.
- Collect batteries and return to suppliers.

Worksheet 4

How to segregate waste

Objective:

The segregation of waste at the source offers the opportunity

- to separate hazardous from non-hazardous waste,
- to recover material for re-use or recycling,
- secure the correct handling for each type of waste.

If waste is properly segregated at the source before it gets mixed up, special precaution in waste handling is only necessary for the hazardous fraction of the waste e.g. infectious materials, pathological waste, chemicals, drugs and radioactive substances. The bulk of the material (the general waste) can be disposed of like ordinary municipal solid waste.

This worksheet gives advice on how to distinguish between the different waste types generated at healthcare facilities.

Here again are the four types of healthcare waste:

Type A: General waste and non-infectious healthcare waste, which requires handling similar to that of municipal solid waste.

Type B: Infectious waste including sharps, which require special precautions during handling and disposal.

Type C: Pathological waste including body parts, tissues, and human foetuses, requiring special treatment because of reasons of hygiene and particularly for cultural and ethical reasons.

Type D: Toxic waste such as drugs, chemicals or radioactive sub stances, which needsindividual disposal methods.

Less than 10 % of healthcare waste is hazardous (categories B, C and D). If this waste is mixed with general waste (category A), it will contaminate the whole batch and the effort needed to treat and safe dispose of it safely will be excessive. This will increase the cost of waste management.

To assist the identification of the different types of waste, a list of common items, materials and substances with their respective waste categories is given below. Please note that this list is not exhaustive and additions should be made according to the specific local conditions.

Examples of waste articles, materials and substances	Waste category
newspapers, magazines, books	A
packaging material	A
food residues	A
syringes, needles, scalpels	B
blood-soaked bandages	A
cultures and stocks of infectious agents	B
body tissue	C
body parts, human foetuses	C
organs	C
formaldehyde	D
radioactive material	D
drugs	D

The various types of waste should be segregated and held in colour-coded containers. Colour coding varies from nation to nation. To prevent waste being mixed up the colour coding should be standardised at national level. At the very least, there should be a standardised colour-coding system within each healthcare facility. In addition to colour-coding, a description should be placed on the containers (labelling). All staff should be able to recognise the appropriate container for each particular type of waste.

Usually **plastic bags, containers or bins** are used for waste collection, transport and storage. They have to be strong and leak-proof to avoid spillage and loss of waste during handling. **Sharps** must be kept in special containers which can be firmly closed and which are strong enough to resist puncturing by their contents (see Worksheet 5).

Colour-coding system				
	Type of waste	**Colour of container***	**Type of container**	**Volume of approp. container**
A	General waste and non-infectious healthcare waste requiring handling similar to that of municipal solid waste;	plastic bag. container, bins	e.g. black	50-150 l
B	Infectious waste including sharps, which require special precautions during handling and disposal;	puncture-proof container	e.g. red	5–20 l
C	Pathological waste including body parts, tissues and human foetuses, requiring special treatment for reasons of hygiene and particularly for cultural and ethical reasons;	strong plastic bag or container	e.g. green	10-30 l
D	Toxic waste such as drugs, chemicals or radioactive substances, which needs special disposal methods.	puncture-proof containers, lead box, abelled with the respective symbol	e.g. yellow	5-10 l

* has to be defined

Worksheet 5

Appropriate collection and transportation for healthcare waste

Objective:

Containers for collection and transportation of healthcare waste have to meet several requirements:

- they must be available throughout the facility in sufficient numbers and size to be within the reach of any patient, visitor and staff member;
- they have to be appropriate for the segregation of waste into the different categories;
- they must protect against leakage and loss;
- they must allow easy and safe transport within and outside the health facility.

This worksheet shows designs of simple but safe collection and transport containers.

In general, only bins with a reliable lid should be used, to ensure safety and hygiene.

In waiting rooms, general wards or corridors open to the public, no infectious, chemical or radioactive waste should be present. If this type of waste is ever generated, it has to be removed immediately by the staff. Therefore only waste containers for general waste are necessary in these areas.

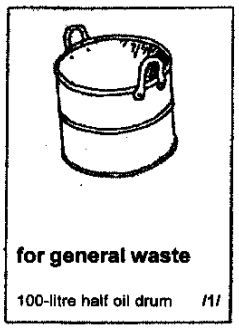
In doctors' rooms, operating theatres, laboratories and pathology departments, separate waste containers for the different types of waste should be available, e.g. containers for general waste, for sharps, for soft infectious waste, body parts and for certain kinds of chemicals. They have to be colour-coded to avoid confusion.

Note: In order to minimise the retention time of the waste before removal, he containers should not be oversized. To avoid unhygienic and smelly residues starting to rot in the containers, if possible each container should be lined with a colour-coded plastic bag. The waste will be removed in the bag, which is tied for transport and disposal, at least once a day.

Within the health facility, transport of waste is only allowed in sealed plastic sacks, closed containers or transport trolleys with a lid or hood.

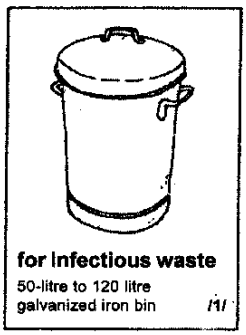
Outside the health facility, infectious, chemical or radioactive waste should only be transported in locked vans or lorries. General waste can be transported in open trucks or carts, if there is no better option.

Appropriate containers for waste



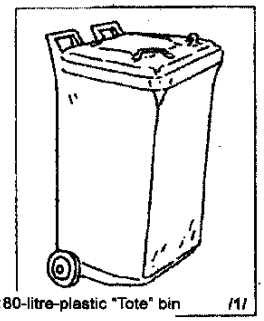
for general waste

100-litre half oil drum /1/

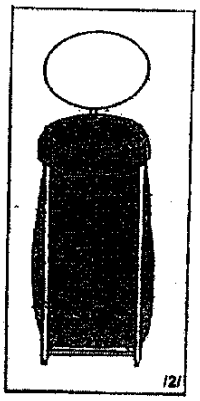


for infectious waste

50-litre to 120 litre galvanized iron bin /1/



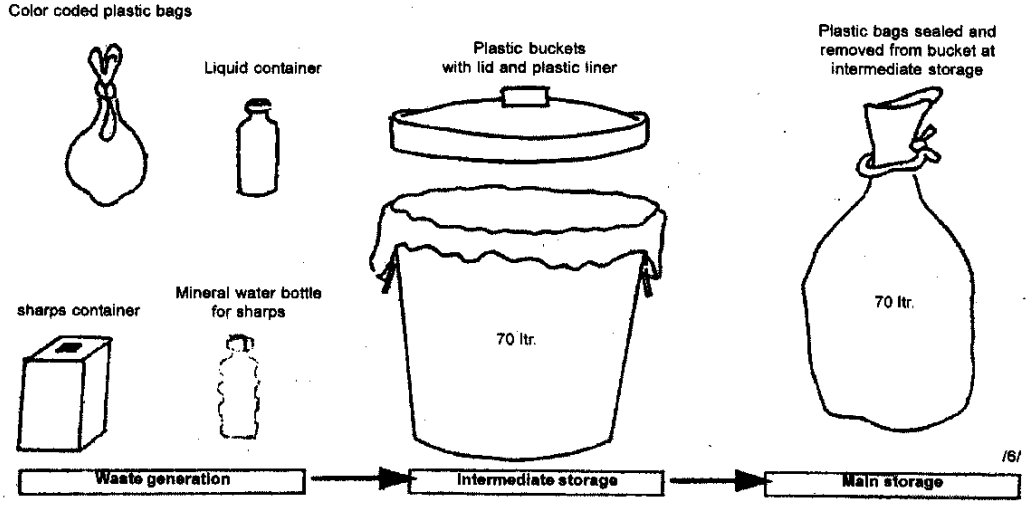
180-litre-plastic "Tote" bin /1/



/2/

for general and infectious waste

Handling equipment for hazardous waste



/6/

Waste collection containers for healthcare facilities should have the following properties:

- design securing minimum contact of the personnel with the waste,
- no access for vectors (for example: should be covered with a tight fitting lid to stop attracting flies, rodents, and other vermin),
- convenient operation during loading and unloading (selection of correct size and material, handles for carrying, etc.),
- not too heavy when full, so that they can be handled by one person (maximum size of 100 litres for dry wastes, maximum size of 50 litres for wet wastes),
- robust, durable, stable, distinctive colour, correct labelling,
- easy to clean,
- outdoor container for waste of type A may have holes in the bottom to avoid stagnant rainwater in the bins and to let decomposition liquids out,
- plastic bags should never be more than 3/4 full, so that they can be closed by tying the neck.

Sharps such as needles, scalpels, broken glass, ampoules etc. should be placed into a suitable container at the site of use incorporating the following features:

- It should be puncture-resistant, leak-proof, shatter-proof and able to withstand rough handling.
- It should display the universal biohazard label (if available) and be clearly labelled indicating the nature of the contents.
- It should have an opening which is accessible, safe to use, and designed so that it can easily and safely be determined when the container is full.
- The container should be sealed when ready for disposal and capable of being handled with no danger of contents spilling or falling out.
- Besides industrially produced sharp containers, alternatives such as empty plastic canisters or plastic mineral water bottles may be a suitable option*.

* The container should in any case not be valuable in order to avoid theft!

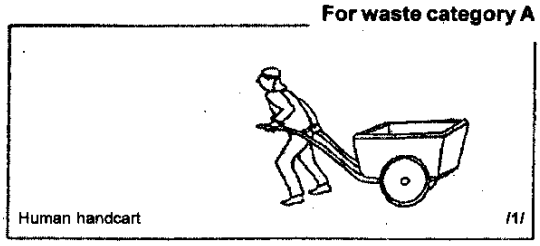
Note: The disposal of sharps should not incorporate cutting, bending or any other manipulation that could generate aerosol splatter of contaminated fluids, or cause injuries.

The containers, carts and vehicles used for collection and transport of waste must be cleaned and disinfected regularly (at least once a week).

Appropriate transport for waste

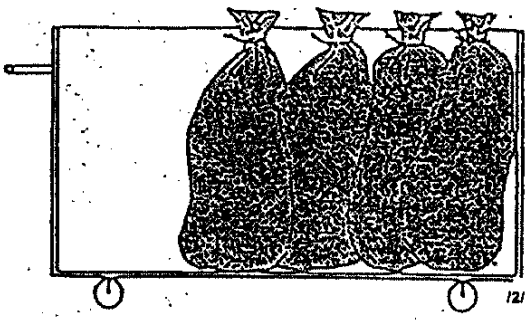
Inside the health facility

For waste category A



Human handcart /1/

For waste category A, B



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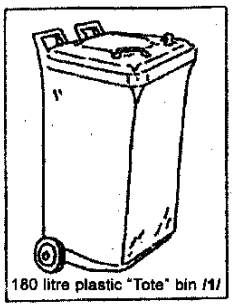
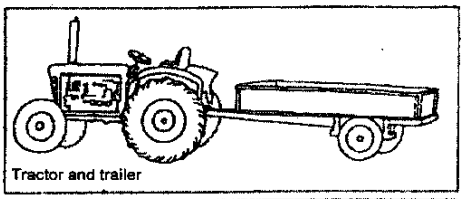
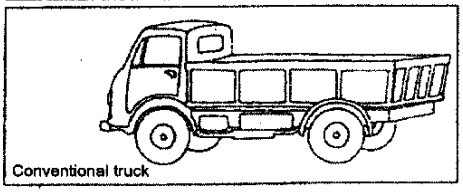


180 litre plastic "Tote" bin /1/

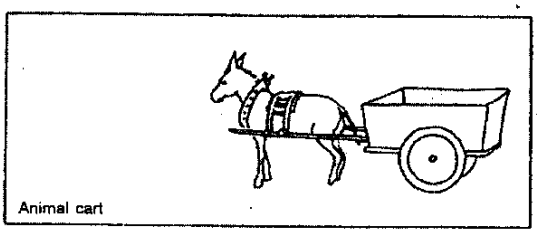
Outside the health facility for waste category A



Tractor and trailer



Conventional truck



Animal cart /1/

A cover (net, plastic foil, etc.) is advivible

Worksheet 6

Checklist for safe storage of waste

Objective:

The waste storage period should be as short as possible and the amount of waste stored should be as little as possible. There is always the risk of attracting scavenging animals and other vermin, thus spreading germs and diseases.

Nevertheless, general waste might only be collected by the municipality once or twice a week and has to be stored until the next collection, and hazardous waste for which no on-site disposal opportunity exists has to be stored before it can be transported to centralised treatment or disposal facilities, and thus accumulates.

This worksheet gives advice on how to store waste properly.

Waste storage at health facilities is practised in two ways:

- while accumulating at the point of collection,
- at a central point awaiting transport to landfill site or treatment facility.

In practice, most health facilities store their waste at the place of collection. This is not recommended for reasons of hygiene. Waste should be moved to a central storage point as frequently as possible.

Note: Waste should be removed from the points of collection as frequently as possible.

Different storage facilities are recommended depending on the type and hazardous potential of the waste:

Solid waste of category A can be deposited in the usual containers used for general waste. To protect the waste from weather and scavengers, these collection points should be fenced, roofed and protected from the wind. There should be sufficient space for waste handling operations and good access to public roads.

Infectious and other types of hazardous waste should be contained in a manner which presents no threat to health, safety or the environment. Therefore, **waste of categories B, C and D** requires special waste storage areas/facilities with the following characteristics:

- The storage room/area should be locked to prevent access by unauthorised persons.
- The room/area must be of an adequate size for the quantity of waste and frequency of collection. It should be large enough to allow easy handling of the carts and other vehicles used for transport to and from the storage site.
- There should be good lighting and sufficient ventilation. The temperature inside should be as low as possible. Therefore, it should be protected from direct sun, and if possible should be air-conditioned to maintain a temperature below 15°C.

- The design of the walls and floors of the depot must be waterproof, smooth, rustproof and well drained. They should be easy to clean and disinfect.
- The storage area must be located well away from fresh food stores and food preparation areas.
- Chemicals and radioactive agents should be kept separate from the other (infectious) waste, preferably in a separate room or locked in a cupboard.

Special precautions for waste storage:

- In general, the maximum storage time in warm climate if there is no air conditioning should be 48 hours during the cool season and 24 hours during the hot season. Waste should be picked up at least twice a week and the depot area must be cleaned afterwards each time.
- Sanitary facilities should be available nearby where the personnel can wash and disinfect their hands. Staff handling chemicals and radioactive substances should wear protective clothing.
- Absorbent material such as sand and disinfectant should be within reach in case of emergency or spillage. Alternative containers should be at hand in case of leakage.
- Any spillages or violations of the security of the storage area must be reported immediately to the person in charge of the storage facilities.

Worksheet 7

Liquid waste and excreta collection and transportation systems

Objective:

Liquid waste at health facilities is not much different from liquid waste at other institutions such as schools, factories or government office blocks, where a large number of people come together. It always has to be guaranteed that the waste is collected hygienically, drained properly and treated adequately in appropriate wastewater treatment facilities.

In health facilities some additional precautions should be taken to prevent chemicals, certain types of drugs and radioactive substances from being discarded into the wastewater system. To meet the hygienic standards of health facilities, a properly managed system of liquid waste collection, treatment and disposal is of major importance.

This worksheet gives some advice on how to install a hygienically sound system for liquid waste at health facilities.

Liquid waste or wastewater at health facilities is generated at various places and is of varying composition and consistency.

Place of generation	Type of liquid waste
Toilets	human excreta, partly infectious
Washing rooms	wastewater from washing polluted with soap and detergents
Laundries	wastewater from laundry operations polluted with detergents; partly infectious
Kitchens	wastewater from cleaning food, dishes, pots, polluted with fat, food residues and detergents
Operating theatres, pathology departments	wastewater from washing contaminated with soap, detergents and disinfectants; body fluids, body tissue; partly infectious
Laboratories	wastewater from washing polluted with soap, detergents and disinfectants; acids, bases, solvents, chemicals, drugs
Rainwater drains	rain and surface water carrying mud, sand and other solids; large variations in quantity and quality

Depending on infrastructure and technical standard of the health facility, either a centralised or decentralised sewage system is available. In urban areas the sewage system of the health facility may be directly connected to the municipal sewer.

In principle it has to be distinguished between liquid waste containing excreta, infectious material, body fluids or tissue and the different types of wastewater coming from kitchens, laundries, washing rooms or arising as surface water. The first category of liquid waste should not come into contact with anybody. Therefore it has to be drained in closed pipes, not in open drains. The waste is normally led into a septic tank were it is decomposed by bacteria. Germs and pathogens are destroyed here to a large extent as well. The solids settle in the tank while the water will leave the septic tank. Excessive quantities of chemicals should be avoided, so as not to poison the bacteria.

Septic tanks for discharge of wastewater must be emptied periodically (for instance, once every three years) and the sludge disposed of hygienically. As this is usually done with a vacuum tanker, there should be good access to public roads. If such vehicles are not available, the tanks have to be emptied by hand using buckets or scoops. A septic tank should be designed to hold three times the volume of wastewater flowing into it every day. This allows the solid material to settle. It is best to build a septic tank with two compartments, the first compartment being twice the size of the second. The outlet of the septic tank should carry the liquid part of the wastewater to a soakpit or a drainfield.

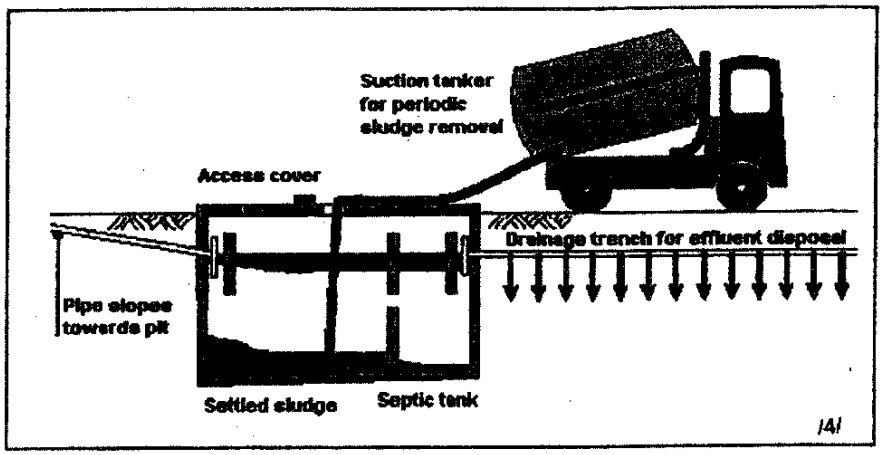
The soakaway should be downhill from the health facility and at a safe distance of 30 meters from any drinking water source. The distance between soakaway and septic tank should be at least 3 metres. The liquid from the septic tank outlet can also be disposed of in drainfields. These are long lines of pipes with open spills buried in a trench filled with stones or gravel just below the surface of the ground. The spill should not be drained into streams or any other open water.

Sullage resulting from washing clothes and kitchen utensils, showers or bath water does normally not contain excreta. It can be disposed of in a septic tank, or it can be used for watering garden crops or discharged into stormwater drains.

The drainage of rain-water is an important factor because it prevents the breeding of flies and mosquitoes in stagnant pools, and removes floodwater. Poor drainage at public sites can lead to unpleasant and unsanitary conditions. Drains should be inspected regularly (once a month) and any debris blocking them removed.

The following drawings show how to build and operate a septic tank.

Liquid waste and excreta collection and transportation systems



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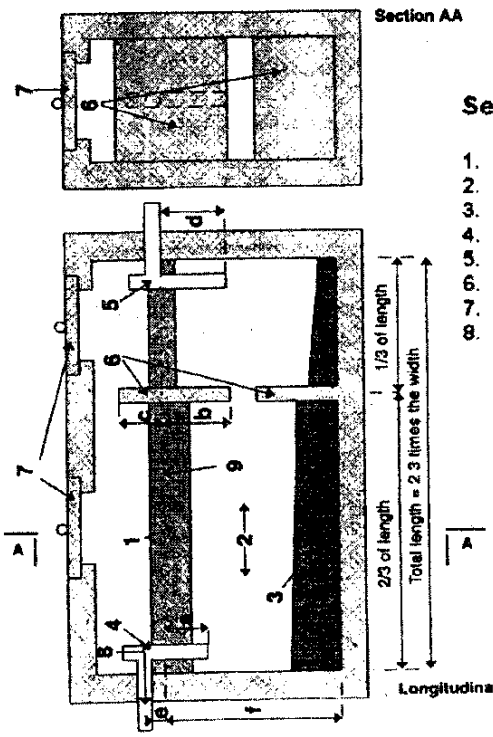


Septic tank

1. Floating material (oils, fats)
2. Clarified liquid
3. Settled solids
4. Inlet tee
5. Outlet tee
6. Partition to retain solids and floating material
7. Access holes with covers
8. Ventilation
   a: 20% of effective depth
   b: 40% of effective depth
   c: 20% of effective depth
   d: 40% of effective depth
   e: at least 75cm
   f: effective depth of water (minimum 1m)

/3/

Pit latrine

Toilets in developing countries often do not have water flushing systems. More common are what are called pit or VIP-latrines, where the excreta falls into a pit (approximately 2-3 m deep) below the toilet. They are normally not connected to any type of sewage system. Since there is no danger of access to the excreta, this type of latrine can also be used to dispose of infectious material or used needles/ sharps, on condition that the pit latrine not excavated once it is full As the excreta and other waste decompose, their volume is reduced and the latrine can continue to be used. To avoid the spread of germs and pathogens via the percolating water, such toilets should be well away (at least 30 m) from any drinking water source (see drawing on page 55).

All faeces (particularly those of young children and babies, and of sick people), should be safely disposed of so that it cannot infect the environment. There must be a handwashing basin with clean water and soap close to the toilet facilities. When the contents of a pit reaches 0.5 metres below the top, the pit should be excavated or filled with earth and a new pit should be dug.

If local materials are used, the simple pit latrine has the advantage of being easy and cheap to construct, the slab and shelter can be re-used, and the excreta are inaccessible. To avoid odours and flies, the squat hole must be kept clean and closed by a lid (usually made of wood) when not in actual use. The facilities should be cleaned a least once every day with water and soap or disinfectant. Instead of pit latrines, VIP-Latrines are recommended, which have a number of advantages.

Ventilated improved pit (VIP) latrine

When building a VIP-latrine the following points should be considered:

The ventilation pipe should have a minimum diameter of 100 millimetres, and it should extend at least 0.5 metres above the roof. The end of the vent pipe above the shelter roof should be fitted with a fly screen (of mesh not smaller than 1.2 x 1.5 millimetres so that air flow is not blocked). The facility should be away from tall buildings and trees to ensure that ventilation works efficiently. The door of the latrine should face into the prevailing wind. The VIP should not have a lid over the squat-hole, which must be left open to allow air to flow into the pit. The shelter of the latrine should be kept semi-dark so that the principal source of light into the pit comes from the vent pipe. Flies in the pit are attracted to the light from the vent pipe, but as the vent pipe has a fly-screen at the top they cannot escape, will be caught and die. If possible, provide lighting for night use.

The drawings on page 61 show how to built VIP-latrines.

The process of composting waste in pit latrines and septic tanks is supported by bacteria. Wastewater contaminated with chemicals, drugs, acids, alkaline solutions or heavy metals may destroy the bacterial population. The digestion of the organic waste, the destruction of germs and pathogens as well as the purification of

the wastewater will be affected. Not only will the soil and groundwater be contaminated by the chemicals, but also the danger of spreading diseases will increase. The following list of substances should not be disposed of in pit latrines or into the sewage system.

Substance not to be disposed of in pit latrines or into the sewage system

- organic solvents
- motor oil
- disinfectants
- mercury
- radioactive solutions
- salts
- insecticides
- batteries
- toxic, corrosive or other miscellaneous chemicals
- photographic chemicals, etc.
- drugs

Additional information is available in:

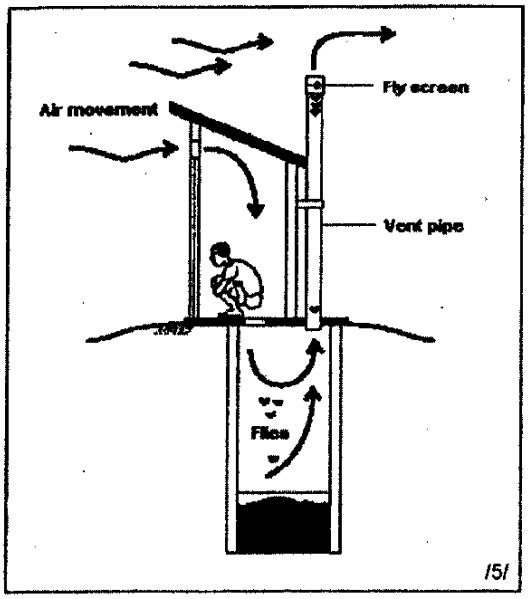
Sasse, L.:
DEWATS - Decentralised Wastewater Treatment in Developing Countries;
Bremen Overseas Research and Development Association (BORDA), Bremen, 1998

Baumann, W., H. J. Karpe.:
Wastewater Treatment and Excreta Disposal in Developing Countries;
gate, Eschborn, 1980

Wagner, E.G., J.N. Lanoix:
Excreta Disposal for Rural Areas and Small Communities;
WHO, Geneva, 1958

Liquid waste and excreta collection and transportation systems

VIP Latrine



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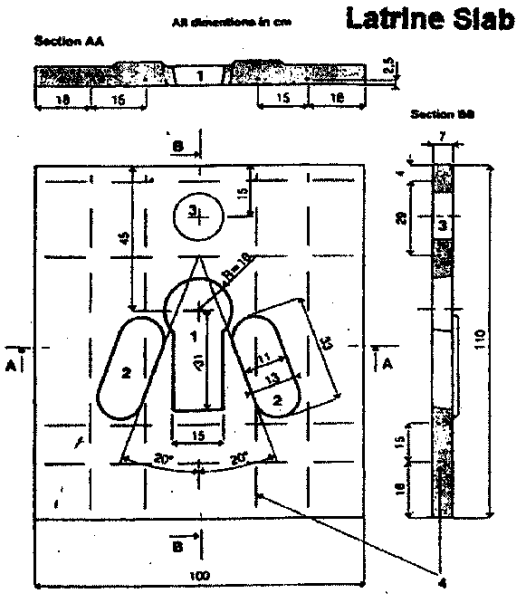
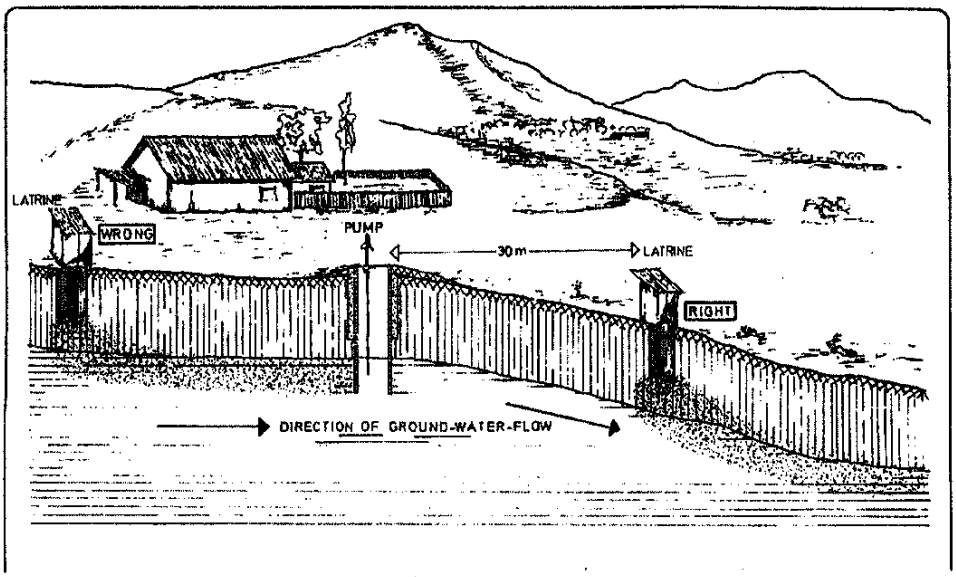
Latrine Slab



1. Defecation hole
2. Footrests (optional)
3. Ventilation pipe hole
4. 8 mm reinforcing steel bars

/3/

Liquid waste and excreta collection and transportation systems



/10/

GROUND-WATER-FLOW AS CRITERION FOR LATRINE POSITION

Note:
In the majority of the cases the ground water flows in a 90° angle to the surface contour lines (= down the hill). Since this is not always true it is advisable to consult the geological service of your country or other hydrogeology experts.

Worksheet 8

Incineration of healthcare waste

Objective:

One of the most effective methods of treating infectious waste is by incineration. The high-temperature combustion destroys harmful germs and pathogens on syringes, needles and used bandages. At the same time, both the volume and weight of the waste substantially reduced. Aesthetically offensive waste components such as blood and materials soaked with body fluids or body parts are destroyed beyond recognition.

These positive effects can only be achieved if the incinerator is working properly. High temperature and good ventilation are essential for optimal combustion.

This worksheet shows different designs of low cost incinerators and will give advice how to operate them.

Modern hospitals in industrialised countries use highly sophisticated incinerators to meet all requirements of hygiene and environmental protection. Many health facilities in developing countries cannot afford the expensive investment and subsequent running costs of such devices. They often have poorly functioning home-made incinerators, which do not achieve the desired results. In any case the bad habit of open burning by adding petroleum, diesel, petrol or oil to a heap of waste should be avoided. Because combustion is often incomplete, the residue may still be infectious and the air pollution due to the emission of particles and the bad smell are unacceptable.

For infectious hospital wastes, a major objective of the incineration process is the destruction of infectious organisms (pathogens) that may exist in the waste. The pathogens are destroyed by the high temperatures within the incinerator. Another aspect of incineration of hospital wastes is an aesthetic one, because it destroys organic components of waste that the community often finds objectionable when disposed of in landfills.

The following pages show some incinerator designs for small health facilities. Although the combustion properties of these simple incinerators cannot be expected to compete with the highly sophisticated industrial incinerators of modern design, they will do their job, if certain technical aspects are considered.

The desired complete combustion will be achieved if the temperature with the furnace is high and sufficient air for combustion is available. The following points should therefore be observed:

- use enough additional fuel (firewood, oil or gas), if the waste does not burn properly by itself. It is a good idea to collect waste motor oil for this purpose. Waste oil can be added to the incinerator on oil-soaked cloth, bandages, paper, sawdust, etc. Do not pour waste oil directly into an incinerator in operation;

- ensure good ventilation using enough air inlets and a sufficiently high chimney (at least 6 m high to achieve good suction), made of stainless steel;
- do not add too much waste at one time; it is better to add it in small portions, e.g. one plastic bag at a time, and wait until it has burned away before adding the next;
- install a preheating chamber in your incinerator where wet waste can dry out prior to combustion;
- ensure a good mix of combustible and non-combustible material during charging;
- since simple incinerators have limited hygiene and environmental protection, some safety measures for the operating personnel and the neighbouring environment should be considered.

Regarding the operating personnel:

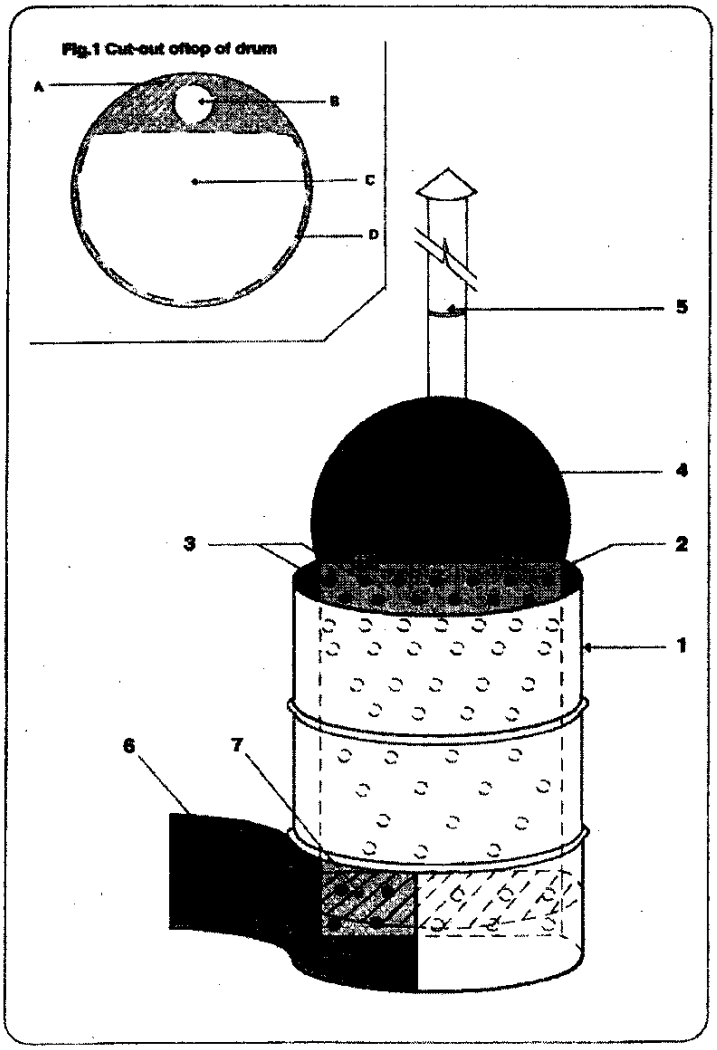
- create awareness of the importance and risks of the job.
- provide protective clothing and gloves for the personnel.
- ensure that the safety equipment provided, such as gloves, protective clothing, masks and impermeable footwear, are used.
- The operators of the incinerator must not open waste bags (black plastic bags), which often contain hazardous waste, or otherwise handle the waste. Direct skin contact with wastes must be avoided at all times.
- To avoid eye injuries, never open observation doors or charging doors to peer into the incinerator during operation. Collect the ash in a covered metal container, and construct a pit for the ash removed. While the ash from a properly operated incinerator is not likely to be infectious or otherwise hazardous, caution still should be exercised to avoid skin contact or inhalation.
- Always be aware that parts of the residues of the incinerator may still be infectious due to incomplete combustion. Therefore handle them with care and landfill them so that they are inaccessible to the public.

Regarding the neighbouring population and the environment:

- When building the incinerator consider the prevailing wind direction. The smoke should not pollute the area of the health facility or neighbouring settlements.

The incineration of waste is a hygienic method of reducing its volume and weight, along with its potential to pollute. However, not all wastes are suitable for combustion. Be aware that some plastic materials, in particular PVC, will produce toxic gases including dioxins in the simple incinerators presented on the following pages. Therefore separate PVC from the waste if possible. Residues from incineration processes must still be land filled, as must the non-combustible waste. Therefore incineration alone cannot provide a complete waste disposal solution.

Incineration of healthcare waste



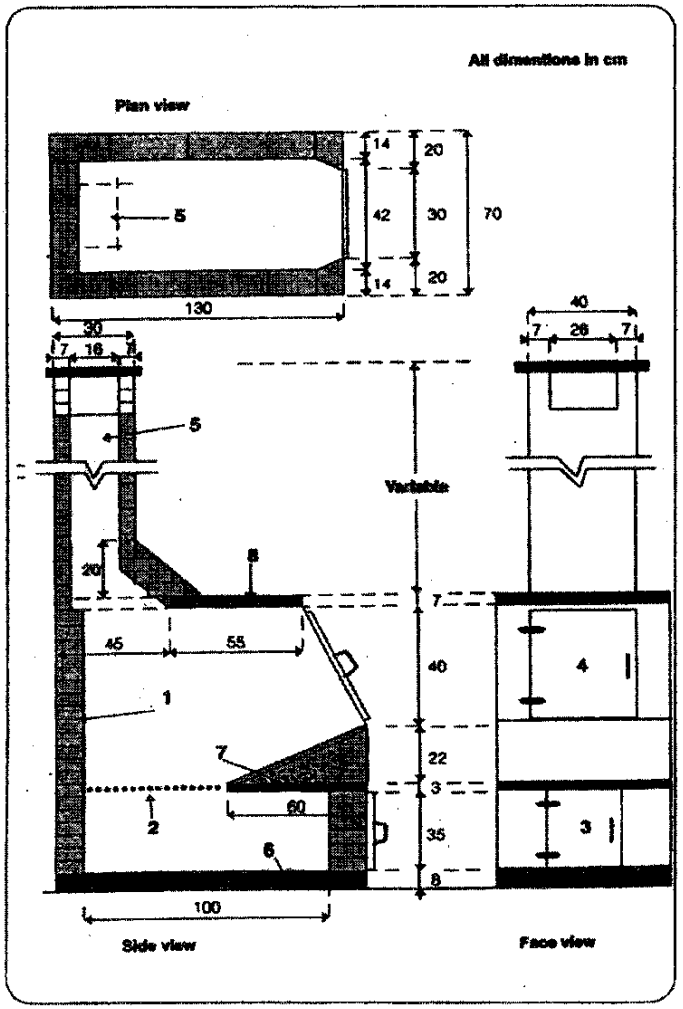
Operating instructions:

- preheat the waste incinerator using wood, charcoal, mineral coal, paraffin, oil, etc.;
- charge only one plastic sack of waste at one time;
- do not charge waste which is too wet;
- ensure good ventilation;
- leave the cover closed until most of the waste has burned away;
- add additional fuel if combustion is insufficient;
- never add liquid fuel to the fire; do not add whole bottles filled with liquid fuel (danger of explosion).

1. **Metal drum, 200l**
2. **Perforated metal plate**
3. **Perforations in the metal plate for draught**
4. **Movable cover**
5. **Chimney, min 3m**
6. **Fire chamber door (used to regulate the draught)**
7. **Metal grating (or heavy mesh) to separate the refuse from the fire chamber**

Note: This method is a better option than open burning, though the lifetime of the device is fairly limited. /3/

Incineration of healthcare waste



Operating instructions:

- preheat the waste incinerator using wood, charcoal, mineral coal, paraffin, oil etc.;
- charge only a few plastic sacks of waste at one time;
- do not charge waste which is too wet;
- ensure good ventilation;
- leave the door closed until most of the waste has burned away;
- add additional fuel if combustion is insufficient;
- never add liquid fuel to the open fire; do not add whole bottles filled with liquid fuel (danger of explosion).

1. **Brick walls (7x14x28cm)**
2. **Fire bars (3cm spacing)**
3. **Door of fire chamber**
4. **Door for loading refuse**
5. **Chimney, extension (5m to 8m) made of stainless steel pipe**
6. **Base (reinforced concrete: 130x70x8cm)**
7. **Fire chamber slab (reinforced concrete: 70x60x3cm)**
8. **Top slab (reinforced concrete: 100x70x7cm)**

Note: **A second grate in the centre of the incinerator would improve the drying of waste prior to combustion**

/3/

Worksheet 9

Wastewater treatment facilities

Objective:

Untreated or inadequately treated sewage is a major source of surface and groundwater pollution throughout the developing world. Sewage carries microbial pathogens and faecal coliform levels may be very high in sewage-contaminated rivers. The sewage of healthcare facilities can be a particularly rich source of infectious pathogens, thus creating substantial health risks for the surrounding environment.

Oxygen is needed for the decomposition of organic matter by bacteria. Municipal sewage discharged into watercourses decomposes, requiring substantial amounts of oxygen (called the biochemical oxygen demand) and upsetting the ecological balance of rivers and lakes.

This worksheet gives advice on how to establish low-cost wastewater treatment facilities.

Wastewater treatment facilities decompose organic matter under controlled conditions. Oxygen is either injected into the wastewater or made available via large surface areas which allow it to enter the water more easily. During the decomposition process carbon dioxide is produced.

A completely different decomposition process for organic matter is anaerobic digestion by bacteria which do not need oxygen to survive. These bacteria generate methane gas while decomposing the organic material. This effect is utilised in biogas plants where the methane generated during digestion is collected for further use.

Methane and carbon dioxide affect the climate. In comparison to carbon dioxide, methane has a much greater global warming effect, so the generation of methane should be avoided unless it is collected as biogas for heating or cooking purposes.

Some low cost wastewater treatment facilities are described on the following pages. A general layout of wastewater treatment facilities is also given:

Waste stabilisation ponds

A waste stabilisation pond is a large shallow pond that can be used for treating wastewater. The method is very effective in sunny climates and where land is cheap and offers simple, low-cost operation. Various types of waste stabilisation ponds exist and they can be broadly categorised as anaerobic lagoons, facultative lagoons, maturation ponds and wetlands.

- ***Anaerobic lagoon***
  A deep pond where most of the solids in the sewage settle out at the bottom, where they form sludge. As oxygen cannot penetrate to the bottom of the

pond, the sludge breaks down without oxygen, anaerobically.

- ***Facultative lagoon***
  A shallow pond, larger than an anaerobic lagoon, which allows the remaining solid part of the sewage to settle out, while air and sunlight kill harmful germs and render the liquid part of the sewage less dangerous to plants and fish.

- ***Maturation pond***
  Usually two or three ponds in a line which allow oxygen and sunlight to kill more harmful germs and to make the liquid safe for discharge into a river or irrigation of crops. Solid sediments have already been removed in preceding ponds. Often the maturation ponds are used for breeding fish. The more maturation ponds are used, the cleaner the effluent becomes.

Lagoon systems are usually built in pairs (in parallel) so that the anaerobic and facultative ponds can be drained and the sludge dug out every few years. The sludge may be used as a fertiliser or soil conditioner. The more lagoons in line are used, the better the quality of wastewater purification becomes.

- ***Wetlands***
  Wetlands (seatbed purification system) are shallow pans with an impermeable bottom layer in which wetland plants are growing. The wastewater will flow through the wetland and the organic material is decomposed by bacteria populating the roots of the plants. While purifying the water the plants live on the nutrients generated by the decomposition process. The water leaving the wetland is fit for irrigation or can be discharged into the river. Some danger may result from mosquitoes and other insects breeding in the wetlands and lagoons. It may help to keep some fish in the lagoons if the water quality is sufficiently high. Depending on the type of plants grown in the wetlands, they can be used as animal feed, for composting or as green fertiliser.

Mechanised wastewater treatment facilities

- ***Aerobic lagoon***
  In an aerated lagoon oxygen is supplied by electrically powered floating surface aerators, diffusers or submerged air pipes. Settlement in the lagoon is achieved by switching off the aeration device for a short period, which allows the suspended solids to settle. The pure water then runs off near the surface. The lagoon is formed by a hole or depression in the ground, 1 to 3 m deep, with an impermeable lining at the base. If land area is not a problem, the aerobic lagoon represents a cost-effective method of wastewater purification.

Additional information is available in:

Sasse, L.:
DEWATS - Decentralised Wastewater Treatment in Developing Countries;
Bremen Overseas Research and Development Association (BORDA), Bremen, 1998

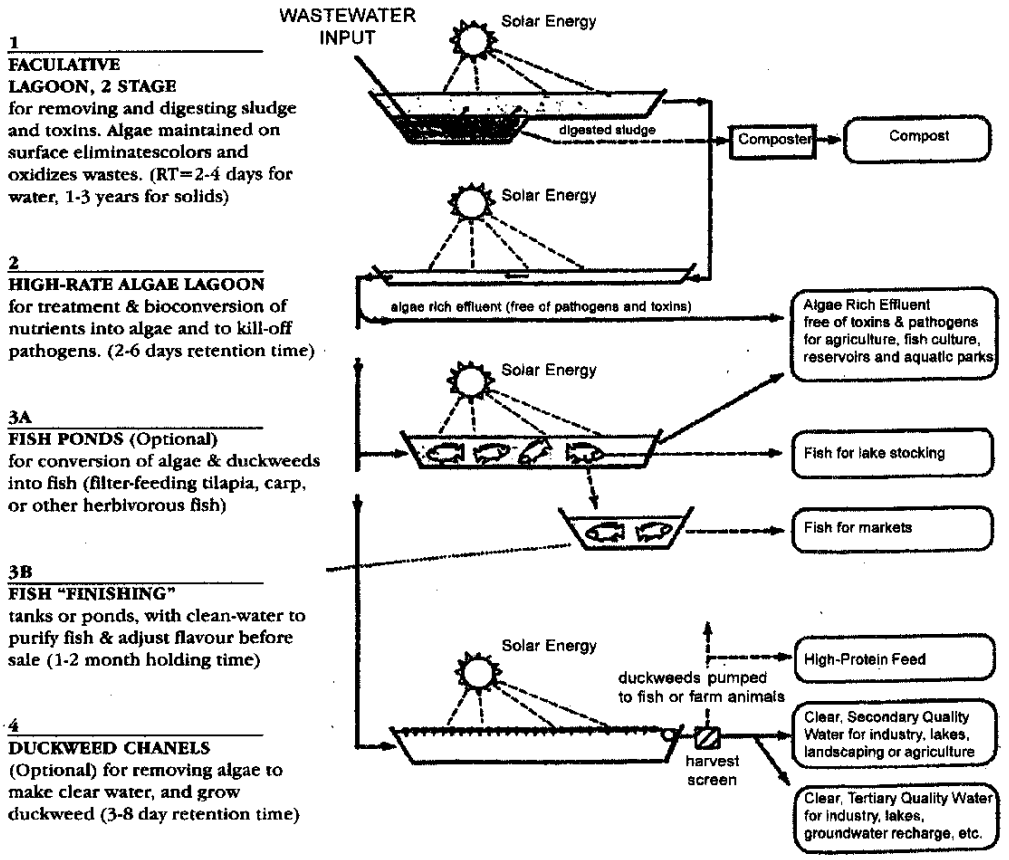
Baumann, W., H. J. Karpe.:
Wastewater Treatment and Excreta Disposal in Developing Countries;
gate, Eschborn, 1980

Wagner, E.G., J.N. Lanoix:
Excreta Disposal for Rural Areas and Small Communities;
WHO, Geneva, 1958

Rural Industrial Innovation Centre (RIIC):
Introduction and information paper on wetland treatment systems;
Kanye, Botswana,

A Low Cost, Low Technology Sunwater System for Small Flows and Rural Villages

Section View of components and processes for simple, low-cost wastewater treatment for rural villages. The process can produce water free of toxins and disease organisms, safe for agriculture, aquaculture, and other reuses, with no mechanical equipment or chemicals. The Faculative Cell removes and digests toxin and sludge. The High-Rate Algae Cell oxidizes wastes, kills all pathogens, and grows high volumes of algae. This water is then safe for any reuse. The algae make an exellent organic fertilizer for agriculture, or food for fish. If clear water is desired, a spezial pond covered with duckweeds will function to settle and covert algae into high protein feed.



1
FACULATIVE LAGOON, 2 STAGE
for removing and digesting sludge and toxins. Algae maintained on surface eliminatescolors and oxidizes wastes. (RT=2-4 days for water, 1-3 years for solids)

2
HIGH-RATE ALGAE LAGOON
for treatment & bioconversion of nutrients into algae and to kill-off pathogens. (2-6 days retention time)

3A
FISH PONDS (Optional)
for conversion of algae & duckweeds into fish (filter-feeding tilapia, carp, or other herbivorous fish)

3B
FISH "FINISHING"
tanks or ponds, with clean-water to purify fish & adjust flavour before sale (1-2 month holding time)

4
DUCKWEED CHANELS
(Optional) for removing algae to make clear water, and grow duckweed (3-8 day retention time)

Worksheet 10

Basic requirement for landfilling of household type of healthcare waste

Objective:

Isolated health facilities are forced to dump the majority of their waste. Often this is done without any planning or design of a proper landfill site. Even infectious waste is dumped in this way without any protective measures.

To minimise the major negative impacts of landfilling of healthcare waste, some basic requirements must be fulfilled.

This worksheet gives advice on how to install a proper landfill site for healthcare waste.

When installing a small landfill site the following aspects are of importance:

Site selection

A landfill should **not** be developed in the following unsuitable areas:

- within 1 km of an airport or airfield boundary (because of the attraction of birds)
- below or within 100 m of the level of the most severe flood in the last 50 years; this includes dry riverbeds, wetlands, swamps, flood plains, etc.
- areas within 100 m of the highest known level of significant surface water bodies, e.g. swamps, river courses, dams
- unstable areas such as fault zones, seismic zones, sinkholes, etc.
- sensitive ecological or historical areas
- catchment areas for water resources, e.g. a village water supply
- areas where there is emerging ground water, e.g. swamps, pans, springs
- areas with a flat gradient as this does not allow for water runoff
- areas of groundwater recharge, e.g. highly permeable soils
- areas overlying or adjacent to aquifers
- areas where there is shallow bedrock with little soil cover
- areas in close proximity to communities (buffer zones are required, usually 500m)
- any area directly upwind of a residential area
- areas of public access, e.g. paths of electrical cables, roads

Areas where economic issues make the development impractical should also be avoided. Obviously, a general topographical observation of the area is important and naturally common sense should be used when deciding where to position a landfill. Even when no equipment is to be used on site, an understanding of the geology (sub-surface features) is important before a location is selected.

Design

In the case of small landfills where no equipment is to be used, the trench method will be the most appropriate. This involves digging trenches, 2 m or 3 m wide by about 2 m deep (these sizes are

dependent on volumes, gradients, etc.). It is important to have the base of the trench dug with a slope so that water will not form ponds near the refuse. Ideally, if a site can be positioned where a slope exists, the trench should start at ground level at the lowest point and be dug into the slope but still retaining a gradient on the base. This means that there will be no water in the trench at all. Some form of compaction on the base layer would be ideal. Do not dig vertical trench walls where the soils are unstable as the walls could collapse and injure or kill someone. Also remember that these open trenches pose a safety hazard for people and animals.

In order to prevent unauthorised access, the landfill site should be fenced and the entrance gate locked. Regular inspections of the fence and gate should be carried out to ensure that they are intact.

Operations (manual operation)

Waste deposition should start at the highest point of the trench. If there are no restricting factors it is possible to burn the refuse to reduce the volumes, avoid rodents and flies, reduce smells and limit water pollution. However, burning should only take place where volumes of refuse are very small as this creates air pollution and is usually a nuisance. There are also health and environmental risks associated with burning refuse. If refuse is to be burned before landfilling, ensure that there is no risk of setting the adjacent bush alight.

Note: Only general waste should be burned openly - no waste of categories B, C and D.

Avoid having more than one tipping area as this creates a messy and untidy operation and requires the double handling of refuse. The soil, which is stockpiled on the side of the trench when it is dug, should be used to cover the refuse after it is burned and deposited in the trench. Common sense should be used as to how often the refuse should be covered with soil, but intervals should not be longer than one week. If refuse is not burned, it should be covered daily. Do not pile up waste above ground level.

Closure

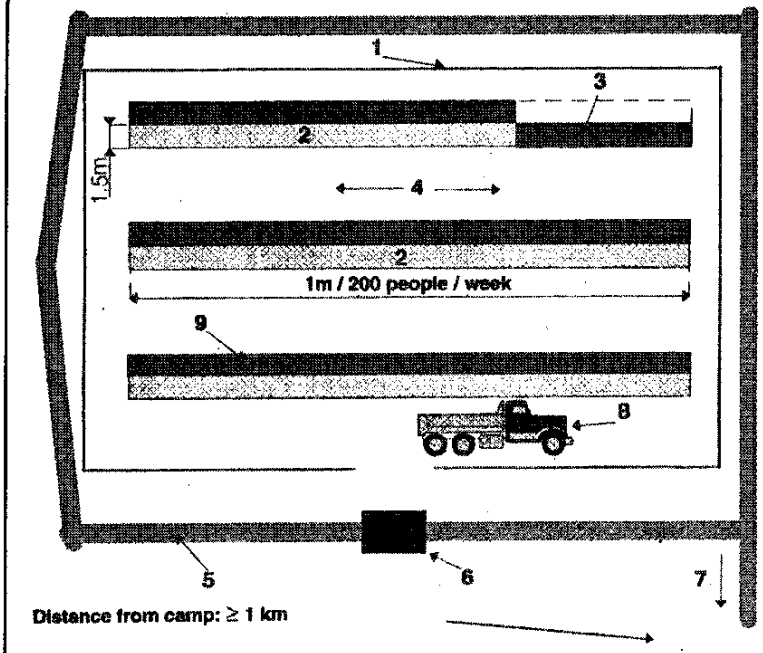
There will usually be cover soil remaining when the refuse reaches the top of the trench. In general waste should always remain about 500 mm below the top of the trench and should then be covered with a layer of at least 500 mm of soil. The remaining soil can be domed up over the waste. During digestion of the waste, both waste and soil will settle. The dome of cover soil over the entire trench will assist water runoff. A general rehabilitation of the area should take place after some time (~ 1-2 years of settling).

Monitoring

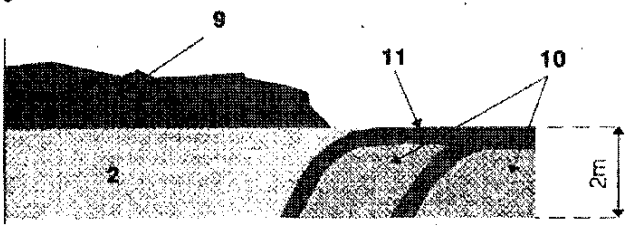
For small landfill sites regular monitoring is not necessary. Nevertheless, records of the position of the trenches and general operating criteria should be kept.

Design of a landfill site

CONTROLLED TIP



Trench in longditudival section



Key

1. Fence
2. Trench waiting for use
3. Part of trench already full
4. Alley (wide enough for the passage of the refuse collection vehicle)
5. Drainage ditch
6. Crossing point of ditch
7. Lowest corner: towards soakaway pit
8. Lorry bringing refuse
9. Excavated earth used progressively for covering
10. Refuse
11. Layer of backfilled earth

Inputs
(construction)

- Land
- Mechanical shovel or numerous workers
- Stakes and fencing material
- Poles or tree trunks to build the bridge crossing the drainage ditch

(operation)

- Lorry or cart for transporting refuse
- Trained personel, permanently at the tip
- Shovels for covering refuse
- Boots and gloves for personel
- Broom and 0.05%chlorine solution (or lysol) for daily cleaning of the cart or lorry.

Important

- This technique needs a lot of land and sophisticated equipment for its implementation, which can entail heavy costs.
- Important: the bottom of the trenches must be more than 1.5 m from the water table to avoid pollution by leachafes.
- The compuslory distance from dwelling demands the use of a lorry or cart
- The staff should be trained for their task and should wear prtective clothes; washing facilities (water ans soap at least) should be available at the site.
- If the tip is designed to have a lifespan of more than 6 month, it is possible, when the end is reached, to redig the start of the first trench filled, to reopen the tip. Otherwise it is necessary to open a second tip during the time it takes for the first one to stabilize.
- The fence is essential to avoid scavenging and accidents at the tip.

Worksheet 11

Waste pit for infectious waste

Objective:

Many small healthcare facilities do not have an incinerator for infectious healthcare waste. Some of them burn infectious waste openly or dump this waste together with the general waste on public landfill sites. This practice is unacceptable since it creates health hazards and pollutes the environment.

An easy, cheap and effective method of infectious waste disposal is a waste pit. The waste pit has to be specially designed to protect people and the environment.

This worksheet gives advice on how to design and build a proper waste pit for infectious healthcare waste.

In contrast to open dumpsites, a properly designed waste pit protects people from coming into contact with infectious waste. The drawing on the following page shows the design of a waste pit for infectious waste.

In some countries it might not be possible to dispose of placentas and body parts together with other infectious waste due to cultural restrictions. In this case a separate pit or another acceptable disposal or burying methods for body parts must be used.

Instead of digging separate waste pits, some health facilities use their pit-latrines as a disposal place for sharps and infectious waste. This practice is acceptable if enough space is available, if the pit-latrines are not emptied manually and if it is ensured that people do not come into contact with the waste.

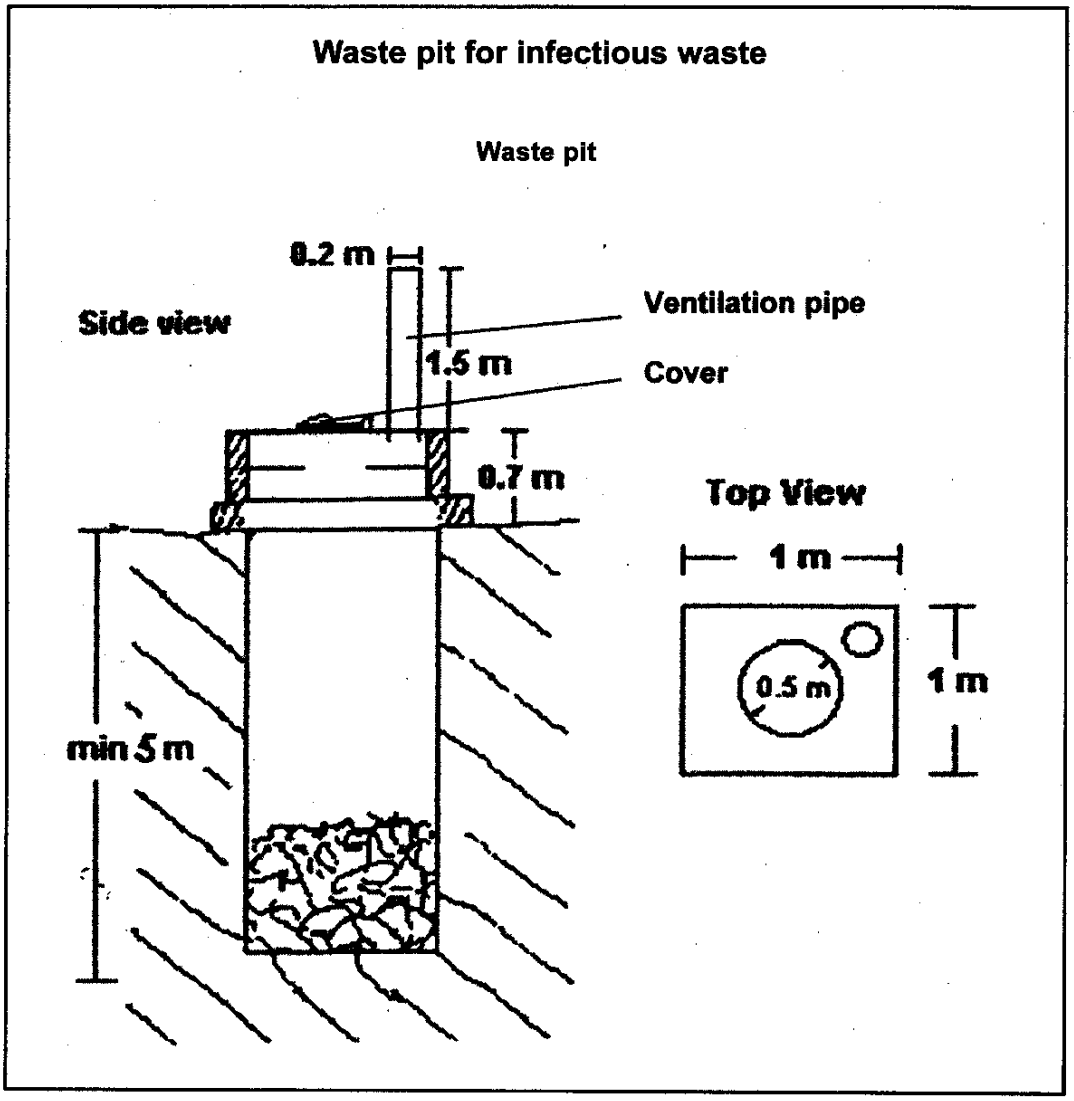
When selecting the right place for a waste pit, similar aspects to those for pit-latrines or landfill sites must be considered. In particular, contamination of the underground water and soil must be avoided. During operation it has to be ensured that nobody comes into contact with the waste and in particular that no child or adult is able to fall into the pit. Therefore it is necessary that the pit can be covered with a hood and locked.

After the pit is filled it has to be sealed (e.g. by a concrete cover). The position should be recorded in the site plan of the health facility or any other relevant document.

For some small healthcare facilities with minor quantities of waste, the waste pit might described even be used to dispose of all waste (except waste of category D) generated at the facilities. Sharps are normally buried together with the other infectious waste in the waste pit. If this is undesirable for any reason, **encapsulation** might be an alternative method of safe disposal of sharps.

Sharps are collected for encapsulation in puncture-proof and leak-proof containers such as metallic drums or barrels, or boxes

made of high-density polyethylene. When the container is three quarters full, a medium such as fluid cement mortar, asphalt or plastic foam is poured into the container until it is full. After the medium has dried and solidified, the containers are sealed and may be buried at normal landfill sites or on the hospital premises.



Worksheet 12

Soakaway for wastewater

Objective:

After the treatment of wastewater in a septic tank, aeration pond or biogas plant, it can be discharged into a soakpit. There the water will penetrate slowly into the ground. Further purification takes place as the water passes through the gravel and sand.

As always when liquid waste or partly purified wastewater is discharged into the ground care has to be taken to avoid the transmission of germs and pathogens into the groundwater resource. The soakpit therefore should be at least 30 m away from any well or borehole.

This worksheet gives some advice on how to construct a soakpit for wastewater disposal.

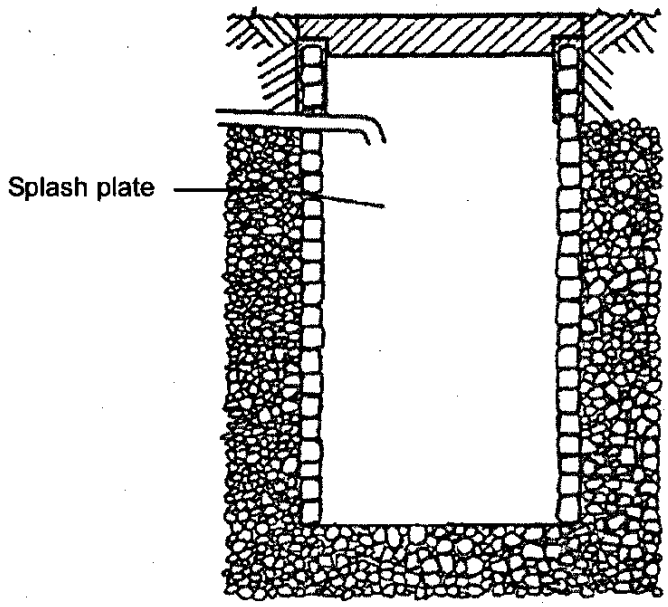
Two possible designs of soakpits are shown on the following page. When constructing these pits certain aspects have to be taken into account:

- A soakaway for a small septic tank should be about one metre in diameter, or square, and 2.5 metres deep.
- The soakaway can be lined with unmortared brick or stones. A splash plate should be added to prevent cavitation in the soakaway, as well as to distribute the flow.
- Alternatively, the pit can be unlined and back-filled with rocks or stones. The soakpit should be covered with a concrete lid, or with well-compacted clay or soil, to stop flies getting into the pit. The outlet from the septic tank enters the soakpit close to the top.

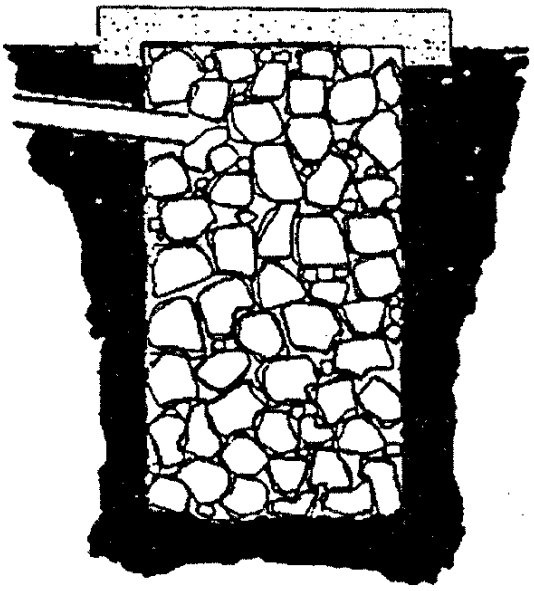
Note: It should be mentioned that where soils are very permeable, however, there is a risk of groundwater contamination from soakaways, particularly where the water table is high.

Soakaway for wastewater

Lined soakaway



Unlined, back-filled soakaway



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Worksheet 13

Checklist for the regular monitoring of waste management

Objective:

Waste management is an continual task demanding a permanent effort from each and every person at the healthcare facility. During the upgrading phase the progress in waste management must be investigated and recorded. Once the required level is reached regular monitoring should secure that the standard is maintained. The monitoring of waste management is part of the overall quality management system.

Regular monitoring is able to document the progress towards short, medium or long-terms targets, to pinpoint deficits and weaknesses, to motivate people not to cut down their effort and to demonstrate success and failure in waste management.

These worksheets are intended to assist in establishing a regular monitoring system.

Responsibilities:

The introduction of waste management is part of the overall management activity at health facilities. By formulating and establishing a waste management plan the management sets a frame within which waste management takes place. The waste management plan defines short, medium and long-term goals or targets, giving the major outlines for all waste management activities. The progress towards the achievement of these goals has to be monitored and recorded on a regular basis.

Again it is the responsibility of the management to establish an appropriate monitoring system and to analyse and utilise the monitoring results. In this context the management should assign one person to be responsible for monitoring and evaluating waste management.

Monitoring intervals:

In order to reveal the current developments, the time intervals between the individual monitoring events should not be too long. Therefore recording all data regarding waste management at the health facility once a month is recommended.

Monitoring subjects:

Waste management structure

- progress towards short, medium and long-term goals
- reduction of waste, avoidance of waste
- increase in efficiency, quality management, standard of hygiene
- awareness of staff and patients

etc.

- statistical data on waste generation, results from the various sections (see worksheet 2)
- costs of waste management and efforts to reduce them
- functioning of responsibilities
- activities in training and awareness creation
- activities in monitoring and recording

Waste handling procedures

collection

- sufficient and appropriate collection bins/bags (colour-coded), sharp containers in use and in stock
- efficiency of waste segregation
- frequency of waste removal
- functioning of latrines, sinks and other liquid waste collection facilities, no blockages in pipes and drains
- environmentally friendly handling of chemical and radioactive waste, outdated drugs, disinfectants and detergents
- responsibilities

transportation and storage

- cleanliness and functioning of transportation equipment
- execution of recommended transport procedure
- status of storage facilities
- cleanliness
- separate storage of hazardous items
- emergency equipment
- locks and safety measures
- responsibilities

waste treatment

- incinerator for infectious waste
- proper functioning of incinerator
- maintenance procedure
- safety regulations for operation
- safe disposal of ash
- responsibilities
- sewage system
- functioning of septic tanks, aeration ponds, biogas plant, seedbed purification, etc.
- maintenance procedure
- no blockages in any pipes or drains
- quality of wastewater outlet
- use and disposal of solid residues from wastewater treatment
- responsibilities

waste disposal

- proper operation of landfill site
- proper operation of waste pit for infectious waste
- functioning and condition of soak pits and drainfields
- transport of chemical and radioactive waste to authorised collectors
- responsibilities

general cleanliness of the facility and the premises

- bins not overfull
- no used sharps outside or protruding from sharp containers
- no foul-smelling waste in facility or on premises
- no litter in facility or on premises
- no faeces on premises
- waste pits not overfull

Additional information is available in:

Christen, J.:
Health Care Waste Management in District Health Facilities – Situational Analysis and System Development;
Dar es Salaam Urban Health Project, Dar es Salaam City Council/SKAT, August 1996

Worksheet 14

Waste management related cost management

Objective:

The establishment and operation of waste management structures in health facilities will require financial resources. Hygienic and environmental protection is not given free of charge. This is likely to create a conflict of interest for the management in view of the limited financial resources of the health facility and the needs for hygienic and environmental protection. Any solution for waste problem in health facilities therefore will involve a compromise between the requirements of health, ecology, technical practicability and financial resources.

Nevertheless, proper waste management also has the potential to save money in some areas. Although some of the possibilities mentioned below still lie in the future for many health facilities in developing countries, some costs can still be saved.

This worksheet is intended to point out the major areas where waste management in health facilities can cut costs or generate funds.

The upgrading of the waste management at health facilities requires funds for:

- initial capital investment
- amortisation of the plant and equipment over the effective lifetime
- maintenance and repair costs
- labour and material costs
- energy requirements
- external contractual costs.

To minimise costs, the following points have to be considered:

The technology must not be too expensive for the user. Promoting local production of the necessary equipment and material should be encouraged. The use of materials not locally available may lead to major costs, which cannot be justified even with the best waste management staff and procedures. Good maintenance of equipment and infrastructure will ensure long life and low operating costs.

Waste management must be efficient. The administrative structure and the handling of waste should be logical, straightforward and understandable. That will limit unnecessary friction, misunderstanding and duplication of work. Cost-effectiveness therefore is an essential factor in any healthcare waste management plan or programme.

As mentioned before there are some ways of saving money by installing a good waste management structure. Thus funds can be saved/better used by:

- internal re-use or recycling of medical articles,
- selling sorted waste fractions as secondary raw materials to scrap dealers or manufacturers,

- saving energy costs using biogas from the anaerobic treatment of liquid and solid organic wastes,
- reducing the municipal disposal costs through minimisation of waste, particularly hazardous waste,
- improving the medical standard, in order to achieve a higher level of hygiene.

Waste management will affect the standard of hygiene at healthcare facilities and thus has a strong influence on the effectiveness of curative measures. In addition, a bad reputation due to low standards of hygiene will deter people from coming. A fall in patient numbers, combined with ineffective treatment consuming both time and money (due to re-infections), has a negative impact on the economics of the health facility. Qualified staff will not want to work at such a place and the government might not offer subsidies and assistance.

Waste management revolving fund

In some developing countries and economies one option of cost-management may be to create a waste management revolving fund. The income generated by recycling or re-using waste, or simply reducing the amount of waste for disposal could be used as a revolving fund to buy and replenish spare parts, personal protection and articles of consumption necessary for running the waste management.

It is important that this revolving fund is not seen as a way of lowering the overall costs of the health facility. To motivate the staff involved in income generating activities, the management should publish the purchases and improvements in waste management funded by the incoming money annually. The staff must get the feeling that the money earned is not seen as a source of income for the administration, but as a source of income for the environment.

Worksheet 15

Topics of a training manual for waste management

Objective:

The correct attitude in waste management is based on knowledge and awareness regarding the potential risks of healthcare waste and the technical and administrative procedures for handling the waste.

Apart from a general understanding of the requirements of waste management, each group of people (doctors, nurses, caretakers, administrative staff) working at the health facility has to acquire its individual waste management skills. Staff cannot be assumed to have the theoretical knowledge and practical skills, but must be taught and trained. For the training to be successful the right attitude is important, which can only be created if the participants are aware of the risks arising from healthcare waste.

This worksheet assists in selecting the most important topics of a training course and a manual on waste management at health facilities.

When talking about the target groups at health facilities we have to distinguish between primary and secondary target groups:

Primary target group	Secondary target group
Management and administrative staff Medical and laboratory staff Caretakers and support staff	Patients and visitors

Training and supervision should apply to all personnel at the health facility, not only to those at senior level. It might also be necessary to train external personnel, e.g. from transport or maintenance firms who are involved in waste handling. Waste management training in general should be part of any formal training of healthcare personnel. Apart from training, good supervision and incentives are of major importance in maintaining efficient and safe waste management.

Management and administrative staff

It is the task of the management to build up the awareness of waste management in each type of health facility. However, often the management itself is not totally aware of all the risks resulting from healthcare waste, and in many cases does not know about appropriate waste management technologies and procedures. Some guidance is needed before the management staff of health facilities is able to install proper waste management structures. The present two booklets may assist in informing the management staff about the major aspects of waste management at health facilities.

Medical and laboratory staff
Due to their professional training, doctors, nurses and the other medical staff have the broadest knowledge about health risks resulting from healthcare waste. They should create awareness among the other members of staff of the health facility. Although they should be aware of the health risks, doctors, nurses and other medical staff may need training in proper waste management and handling technologies and procedures.

Caretakers and other support staff
Caretakers, kitchen and laundry personnel, cleaners and labourers are the group of people having to deal directly with waste. However, this group will have the least knowledge about health risks or waste management practices. Therefore they need extensive training and regular supervision to ensure the desired improvement in waste management.

Patients and visitors
Due to the permanent fluctuation of patients and visitors, it is virtually impossible to teach this group of people systematically about the principles of waste management. One possibility may be to offer advice on basic waste management subjects during the waiting periods. Patients and visitors should be made aware of the proper use of waste containers to dispose of their waste. Attentive hospital staff might guide patients and visitors from time to time regarding their waste management practice. Relevant posters may often provide the public with additional information.

Training subject	In particular relevant for			
	Ma	**Me**	**C**	**P**
Basic knowledge about healthcare waste:				
- waste categories	X	X	X	
- hazardous potential of certain waste categories	X	X	X	X
- transmission of nosocomial (hospital acquired) infection	X	X		
- health risk for healthcare personel	X	X	X	
Proper behaviour of waste generators:				
- environmental sound handling residues	X	X	X	X
- waste avoidance and reduction possibilities	X	X		X
- identification of waste categories	X	X		

Training subject	In particular relevant for			
	Ma	Me	C	P
- separation of waste categories	X	X		
- knowledge about appropriate waste containers/bins	X	X	X	
Proper handling of waste:				
- adequate waste removal frequency	X		X	
- safe transport containers and procedures	X		X	
- recycling and re-use of waste components	X	X	X	
- safe storage of waste	X		X	
- cleaning and maintenance of collection, transportation and storage facilities	X		X	
- cleaning and maintenance of sanitation facilities, drains and piping	X		X	
- handling of infectious laundra	X		X	
- handling of chemical and radioactive waste, outdated drugs	X	X	X	
- maintenance of septic tanks and other sewage treatment facilities	X		X	
- maintenance and operation of the incinerator for infectious waste	X		X	
- maintenance and operation of waste pit and landfill site	X		X	
- safety regulation in waste management, protective clothing	X	X	X	
- emergency regulations in waste management	X	X	X	
Establishment of a waste management system:				
- establishment and implementation of a waste management plan	X			
- sampling on waste quantities, monitoring and data collection	X	X	X	
- monitoring and supervision of waste management practises	X			
- cost monitoring of waste management	X	X		
- establishment of a chain of responsibilities	X			
- set-up of occupational safety and emergency regulation	X			
- Interaction with communal or private sector waste handling structures	X			
- public relation and interaction with local community	X			

Ma = Management staff · Me = Medical and laboratory staff

C = Caretakers and other support staff · P = Patients

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