

Better Health Care Waste Management

An Integral Component of Health Investment



World Health Organization
Regional Office for the Eastern Mediterranean
Regional Centre for Environmental Health
Activities (CEHA)



The World Bank
Middle East and North
Africa Region

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Introduction

Investing in health care improvements is a component of all national development programmes, and often includes support from multilateral institutions. The objectives of such investment in relation to overall national development are simple. Healthy people have a greater opportunity to fulfil their potential and contribute to the economy of a country than those in poor health. A healthy population is also less of a burden on health care systems where public funds are limited. Investing in health is expensive so minimizing the causes of ill-health through prevention should be a regular component to include in investment programmes. The infection risk posed by poorly handled health care waste is obvious for all to see and it is preventable. Up to now, this issue has been too often overlooked.

Health care waste is poorly managed at too many health care facilities worldwide. Identifying the causes and then supporting improvements in the system are key skills that health care facility managers need to develop.

Recent improvements in an increasing number of health care facilities have shown that infection risk does not have to remain unaddressed. Improving waste management from a poor standard of performance is not difficult if the will exists among public officials, health care managers and staff and communities. It is appropriate, and even preferable, to address health care waste management as an extension of infection control in health care establishments. This is the approach taken in this publication.

The overall objective of this publication is to de-mystify the topic of health care waste management and demonstrate that positive improvements are possible in almost every situation with relatively modest levels of effort and investment. It is designed to provide managers and technical staff of health care facilities with the information needed to tackle poor health care waste management as part of their day-to-day work programmes.

The publication has two specific aims: a) to provide managers and advisers in health care establishments with an easy-to-read introduction to the subject; and b) to provide technical staff of such establishments with a reference guide.

Each section follows a standard format providing practical advice and answers under the following headings:

- basic questions to answer
- key points to remember
- general principles
- minimum approach
- desirable enhancements

It is designed to assist those involved in health care projects across the countries common to the World Bank Middle East and North Africa and WHO Eastern Mediterranean regions. More specifically, it is intended to encourage the inclusion of health care waste management activities as a component of new health care investment and promotion programmes in the Region. Reference is made throughout the text to where more detailed information is available for those that seek it. Other health care waste topics are covered in more depth in other publications (see References and bibliography and websites such as www.healthcarewaste.org, www.who.int and www.worldbank.org).

1. Fundamentals of health care waste

1.1 Basic questions to answer

All waste produced in a health care establishment is defined as health care waste. Only the proportion (generally much less than 25% by weight and usually around 10% [1]) that is contaminated with body fluids, chemicals or other components represents an elevated risk as a source of potential infection, injury or other health impact. This is known as hazardous health care waste, and the goal for health care establishments should be to segregate hazardous health care waste so it comprises close to 10% of the total by weight. Most of this waste poses an infection risk. A small fraction (generally less than 1%) may pose a chemical, radiological or physical hazard.

The remainder (75%–90%) is general waste and can be regarded as having no higher risk than ordinary municipal waste, providing it is always kept separate from the potentially hazardous fraction. In particular, if mixed with the potentially infectious waste component it will become contaminated unnecessarily. This causes considerably increased quantities of waste that require special handling and disposal.

A health care manager should be able to answer the following questions.

- How much hazardous and general waste is produced in each medical area?
A simple count of bins or bags filled each day over a week multiplied by the average weight of a bag is helpful if no other data is available. If the segregation is not good, an estimate of hazardous health care waste quantity can be made by estimating the health care waste fraction as between 10% and 25% of the total, with a goal to achieve close to 10%.
- How many medical areas produce health care waste?
Start with a list of medical departments, patient areas and support facilities such as laboratories.
- What is the composition of the health care waste in each place?
Not all areas produce the same types of waste. Identify from medical staff areas producing larger volumes of hazardous health care waste and areas with patients who are most susceptible to secondary infections.
- Could the quantity of health care waste change in the foreseeable future?
Managers and senior medical staff often have some foresight on future demands.
- How much liquid hazardous health care waste is produced?
It is not easy to know exact values but a survey could be made in selected medical areas to produce an estimate.

1.2 Key points to remember

The manager should next consider the characteristics of the establishment's waste. This will make it easier to understand the practical and sustainable changes that can be made. The following are key points to remember.

- An item does not become waste until the person producing it decides it should be discarded. Before that point it is still a useable resource or piece of equipment.
- Most health care waste is not contaminated with pathogens or chemicals and can be handled as normal municipal solid waste; often over 80% of the total. One exception is general waste produced by patients with highly contagious diseases (such as cholera, typhoid fever and SARS) and usually kept in isolation. As a precaution this waste should be treated as hazardous.
- Waste items contaminated with body fluids and tissues harbour human pathogens and are the major potential sources of infection.
- Potentially infectious waste and sharps are the waste components that most commonly need to be safeguarded against in order to improve infection control.
- Other potentially hazardous health care waste components (i.e. chemicals such as mercury in thermometers, pharmaceuticals such as cytotoxic drugs or materials contaminated with cytotoxics, radioactive waste and pressurised containers and gas cylinders) comprise a very small fraction of the total waste quantity and are only a potential concern in large regional or teaching establishments. These waste components, although small in quantity, should be managed separately to avoid causing harm to staff and the public through injury or environmental damage.
- Anatomical remains should not enter the waste stream. In the Eastern Mediterranean and Middle East and North Africa countries, they are usually taken to cemeteries for burial in accordance with religious customs.

1.3 General principles

The underlying principle before initiating safer health care waste practices is to understand the problem, i.e. the composition, infection potential and approximate quantities of waste involved.

a) Health care waste composition

Health care waste comprises two general components (derived from [1]): a) general waste or municipal solid waste, e.g. packaging materials, food scraps, newspapers, bottles; and b) hazardous health care waste which has seven distinct types, as follows.

- Used sharps are the most clearly identifiable type of hazardous health care waste, e.g. needle and syringe assemblies, lancets, blades;
- Potentially infectious waste accounts for the largest fraction of risk among health care wastes, e.g. swabs, bandages, gloves, IV lines, catheters;
- Pathological waste, including anatomical remains, should be treated as potentially infectious. In many countries identifiable human remains are not regarded as waste and go to burial sites instead.
- Chemical waste, including heavy metal-bearing wastes, usually accounts for only a small proportion of health care waste unless chemotherapy is undertaken or where chemical solutions are treated for silver recovery, e.g. spent X-ray developer, mercury from thermometers, chemical disinfectants, pesticides. Chemical wastes are often not identified at smaller health care establishments.
- Pharmaceutical waste is comprised of unused medicines although it is often not a problem where drugs are in short supply. Sometimes misdirected aid can result in local accumulations of inappropriate medicines. Cytotoxic waste is generated at specialist and teaching hospitals that provide cancer treatments.
- Radioactive waste is only produced by nuclear medicine departments, for cancer therapy, diagnosis and research purposes at major hospitals or research facilities. Usually distinct national controls are well understood and used. Short half-life radionuclides are normally left to decay naturally before leaving the medical treatment area. Very few places produce long half-life radionuclides.
- Pressurised containers and gas cylinders, such as used aerosol cans pose a potential risk of explosion if a gas cylinder valve corrodes and the remaining cylinder pressure is unknown.

b) Infection potential

Many human pathogens can be found in health care waste items [3], e.g. *Staphylococcus* sp., HIV, hepatitis B and C in blood, *Salmonella*, *Shigella* sp. in faeces and vomit and *Streptococcus* sp. in pus. The transmission routes for these infection sources from waste to a patient or health care worker are still uncertain. Only puncture injuries from sharps have demonstrated a clear infection pathway. For other waste items, if not by direct contact, the potential pathways are presumed to be airborne (e.g. spores or aerosols) or vector-borne (e.g. flies) transmission. Therefore, good health care waste segregation means that:

- Wastes should be placed in containers (e.g. bins, boxes, strong disposable bags) to prevent direct contact.
- Containers should be kept covered to prevent contact with the open air.

- Sharps and potentially infectious waste should be kept in separate containers in each medical area and located well away from patients, such as behind the nurses' station or in a treatment room. Sharps containers should be clearly labelled.
- A colour coding system should be established or clear signs placed on containers and bags to differentiate between general and hazardous health care waste (see Section 5)

It is helpful to note that the largest demonstrable cause of secondary infection (also known as nosocomial or hospital-acquired infection) is poor hand hygiene by medical staff, followed by poor disinfection of surfaces and medical equipment. Improving health care waste management in health care establishments will make a contribution to improving infection control but it is not a substitute for improvements to other aspects of infection control, especially hand and equipment hygiene (see Section 8).

c) Approximate quantities

The following data may be available at a health care establishment and can be used to provide useful estimates of health care waste generation (derived from [4]):

- number and types of medical areas
- number of beds in use in each medical area
- number of inpatients and outpatients
- number of staff (difficult to confirm in some establishments)
- budget (difficult to obtain in some establishments).

These data are most beneficial for estimating the number of storage bins required and sizing on-site and off-site health care waste disposal facilities. Transport and treatment systems should aim to be large enough to handle each day's health care waste production, and disposal sites should be big enough to provide a minimum of 6 months disposal capacity.

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

If typical in-country health care waste generation rates are not available then counting the number of bags or containers and applying an average weight to each is a fast way of

getting a broad estimate of health care waste generation in a particular facility. Weighing programmes are more accurate but take more effort as a representative sample has to be identified, weighing repeated on various days and sufficient measurements collected to produce a reliable estimate.

In difficult situations, health care waste (general and hazardous) generation factors can be applied, based on data taken from [1], as follows:

Total health care waste

- primary health care clinic: 0.1 kg/patient per day
- small district hospital: 1 kg/bed per day
- general hospital: 2 kg/bed per day
- tertiary level or major teaching hospital: 4 kg/bed per day

2. Diagnosing the existing health care waste management situation in health care establishments

2.1 Basic questions to answer

It is possible for all managers of health care establishments, whatever their local situation and resources, to take some measures to reduce the health care waste risks, particularly infection risks, and the general squalor caused by accumulated wastes in medical wards and around buildings and grounds. When faced with a situation where health care waste has gathered, the most useful practical approach is to use whatever is available locally to move waste away from patient areas quickly and safely. Therefore, recognizing the risk and the need for leadership, a health care manager should determine the following.

- Is the management prepared to offer leadership where existing waste management is unacceptable?
Without a will by the leadership of an institution to make improvements little can be achieved by staff alone.
- Where is waste being produced and what is in it?
Usually a straightforward task of looking around the medical areas.
- Where is waste accumulating close to patients?
By visual inspection of medical areas and asking the nursing staff.
- What storage and handling materials (bins, bags, trolleys, etc) are available to remove waste from patient areas?
By personal knowledge and talking to engineering and support staff.
- Which staff should be supported to ensure patient areas are cleaned?
By personal knowledge of the capabilities of senior medical and nursing staff and through department managers if the institution is large enough.
- Is any waste being taken off-site at present for safe disposal?
By talking to nurses, support staff and the local waste carrier or municipality.
- Is there a remote area within the health care establishment (or some other location nearby) where the infectious component in the waste can be safely buried?
By personal knowledge and talking to engineering and support staff.

2.2 Key points to remember

When reviewing the current waste management situation the following key points are important to remember.

- Poor health care waste practices and the adverse impact of such practices are an avoidable problem.
- The general public regard poorly managed health care waste as an indicator of a poor standard of health care.
- Health care waste contains many of the human pathogens that cause hospital acquired infections, as well as chemicals and pharmaceuticals that can cause injury and harm (Figure 1).
- The proportion of infections transmitted from health care waste to patients is not known.
- The potential pathways for transmission of pathogens from health care waste can be blocked easily.



Figure 1. Safe management of health care waste and associated infection control procedures are necessary to avoid secondary infections in health care establishments

2.3 General principles

2.3.1 Controlling infection risks

Safe health care waste management is an integral part of controlling infection risks. It has to be recognized as a core issue rather than treated as a superficial task that is somebody else's problem. There is little point curing people of their primary illness if they face a high likelihood of developing a secondary infection. While health care waste is not the only source of potential infection, it is one of the most easily avoided, through organized storage, collection, transport and disposal. The basis for improving a prevailing situation is for the manager and, through effective delegation, other key staff members to do something rather than nothing.

The positive effect from senior personnel taking the waste management situation seriously cannot be underestimated. Inspirational changes in the attitude of nursing and support staff have been seen where the managers have demonstrated a firm intent to change poor waste practices. It has a considerable motivational effect on middle level and junior medical staff, particularly nursing staff and technicians.

2.3.2 Plan of action

An inevitable consequence of the recognition by a manager that health care waste is a problem to be tackled is the creation of a plan of action. This should not be a lengthy task after diagnosing the prevailing situation. To be practical it needs to contain the following essential elements of a good plan of action.

- Recognize the problem and the risks if unresolved.
- Agree a sensible (and sustainable) set of things to be done.
- Agree the resources (no matter how small) available to get things done.
- Assign responsibilities for who does what and when.
- State how progress will be monitored and success acknowledged.
- State quality control procedures/supervision of the health care waste management plan/system to keep track of the achievements, check improvements and identify gaps and needs.

For additional information, see [2] and the WHO web site: www.healthcarewaste.org

2.4 Minimum approach

While a health care waste action plan may not necessarily be written down in a small institutional setting, simple actions should be developed as a minimum through discussion with all of the relevant people in the establishment so that it becomes a matter of professional honour that it is carried out. For some larger facilities the plan may be described in a one or two-page note stating what was discussed and agreed upon (e.g. actions, by whom and how they will be achieved). More comprehensive written plans are required for large establishments.

A plan of action should look at both removing existing waste accumulations and starting a new system to prevent the problem re-occurring in the future. Plans are implemented more effectively when someone is put in charge. In small medical institutions this is most likely to be the senior manager directly, supported by a respected doctor or nurse who assumes the responsibility. In larger health care establishments the senior manager may delegate the responsibility. However, the ultimate responsibility remains with the senior manager to ensure that improvements are made. Two delegation possibilities are common.

The first option is to assign the task of improving waste management to the infection control committee. Such a committee would normally form a waste management sub-committee. The person put in charge of the health care waste management system is usually a senior doctor or, preferably a senior nurse, someone who has worked at the hospital for many years and is respected by the other staff members. If the establishment already has a designated infection control officer, that person would be the logical choice.

The second option is to assign the task to the hospital engineer (or services manager), if that position exists, and to set up a separate waste management committee with senior departmental representatives. There is a risk with this arrangement that health care waste management will be viewed as a housekeeping task, rather than as an essential component of infection control. The link to infection control adds to the profile in the minds of medical staff, especially the hard-to-influence groups, such as most doctors.

If there is an existing serious secondary infection problem, taking the time to estimate waste quantities and gather information across the whole health care establishment is inappropriate. Initiating better waste management as part of other infection control changes is of paramount importance.

Where resources are limited, start health care waste segregation (see Section 5) in medical areas where patients may be most susceptible to secondary infection, e.g. maternity, neonatal and post-operative surgical departments, treatment areas involving immuno-suppression, and also isolation wards where the wastes generated are assumed to be contaminated with highly contagious pathogens.

Highly infectious waste, e.g. waste from medical laboratories (Figure 2) and highly contagious patients, should be disinfected (preferably using an autoclave) prior to joining the hazardous health care waste stream. Body fluids suspected to contain highly contagious pathogens should be disinfected immediately (e.g. using sodium hypochlorite disinfectant).

Reuse of strong, empty plastic containers, such as those containing detergents and disinfectants, for the collection of used sharps is safer than discarding them directly into bags containing potentially infectious health care waste.



Figure 2. Petri dishes and other laboratory wastes should not be mixed with general waste. They should be collected separately and disinfected prior to joining the hazardous health care waste stream

2.5 Desirable enhancements

Where a health care establishment is not dominated by crisis management a more organized approach to starting better health care waste management can be taken. The elements of a more orderly, planned approach are as follows:

- Get useful estimates of waste production.
- Describe the waste management system to be introduced.
- Make arrangements to find or purchase new containers to segregate wastes and trolleys for collection, local storage and on-site transport.
- Organize medical staff to start segregation initially in one or two ‘pioneer’ locations.

- Set up a sensible route for the on-site disposal of hazardous health care waste (if no off-site location is available).
- Learn from early teething problems and demonstrate benefits to staff.
- Roll out progressively across all medical areas.
- Introduce simple record-keeping, e.g. waste generation rates.
- Ensure new staff are trained to continue using the system.
- Establish simple quality control procedures to provide information on: achievements made; tracking of waste movements; checking of waste generation rates; incidents and accidents when handling waste; and ensuring accountability of ward supervisors.
- Ensure that workers and medical staff are vaccinated against hepatitis B and tetanus and that they are aware of the importance and availability of post-exposure prophylaxis.

3. Roles and responsibilities

3.1 Basic questions to answer

Organized introduction of a health care waste management system provides the best opportunity to get a new system operating in a sustainable way and used by all staff. Everyone in a health care establishment should have a responsibility to make the new system work. Specific people have key roles to play.

A health care manager should be able to answer the following questions.

- From the initial waste management plan, which activities are essential to make the new system work effectively?
- Which staff have the necessary medical, organizational or technical skills to help start the new waste system?
- Who should be assigned specific supervisory roles and responsibilities?
- Which medical area(s) is (are) ready and willing to try out the new system?
- What are the responsibilities for participation to be placed on all medical staff?
- Are porters/housekeeping/engineering staff ready (i.e. properly equipped and trained) to handle and dispose of the health care waste?

3.2 Key points to remember

The introduction of a new health care waste system should be explained in a manner that medical and support staff can appreciate as relevant to their work. A common approach is to make it an extension of existing procedures for infection control and hospital hygiene. The following are key points to remember.

- Maintaining infection control has a powerful professional influence on most medical staff and is a duty understood by support staff.
- Dealing with health care waste safely is a responsibility of all staff.
- Every person producing a waste item is responsible for ensuring its safe segregation at the time of generation.
- A senior nurse in each medical area should be responsible for secure local waste storage, labelling filled containers and ensuring their regular removal for treatment and disposal.
- A senior manager should be responsible for safe handling and subsequent treatment and disposal of health care waste.

- Support staff should have a clear routine for transporting waste containers and storing them in a separate central storage area before treatment and disposal.

3.3 General principles

3.3.1 Infection control roles

Where an infection control committee or similar group already exists in a health care establishment, management can assign roles for health care waste management through this committee. It is a ‘top-down’ approach but the easiest way for management to get key staff involved and motivated to implement the health care waste action plan.

The committee would empower a motivated ward sister or doctor to develop with their staff a workable method of waste segregation and local storage within each of the medical areas. A nominated member of the committee, e.g. a senior nurse or infection control officer, would monitor the implementation of the health care waste management system on behalf of the infection control committee.

An infection control committee should comprise, at least:

- hospital manager
- infection control officer (sometimes a specialist doctor or senior nurse)
- person responsible for health care waste management, if different from infection control officer
- heads of medical departments, especially laboratory services, surgery, maternity, paediatric, pharmacy and radiography
- matron or senior nursing officer
- heads of engineering and housekeeping departments.

3.3.2 Waste management committee

Where a large, organized health care waste system is to be introduced, particularly at large health care establishments, a waste management committee could be set up [1,2]. This should include many of the infection control committee members, supplemented by a finance officer. One of the senior ranking members with good experience and motivation would also be designated as Waste Management Officer and be responsible to the senior manager for the day-to-day operation and monitoring of health care waste management system.

3.3.3 Motivating staff through ‘champions’

Even after a hospital manager has taken the decision to develop a new health care waste management system, there is often a malaise among many staff that ‘nothing can be done’. It is at this stage that a commitment has to be engendered with (at least some) medical and nursing staff to try out the new approach. In effect, one or two medical areas should be selected to demonstrate the changes. There are always some individuals who are quicker to see the benefits to their patients and are more willing to try something new. These ‘champions’ should be identified and encouraged. If the new method is successful in their areas, propagation throughout a health care establishment will follow more readily. It is always easier to promote change when committed medical staff spread good practice by ‘word of mouth’ and when others can see benefits of the changes working in practice.

It is noted that medical staff in maternity and neonatal medical areas tend to have a heightened interest in adopting improved hygiene. These locations make ideal starting points for introducing new waste management practices.

3.3.4 Individual responsibility

Individual responsibility has to be placed on all staff to understand and use a new health care waste system. It is the person who produces a waste item that decides if it is a hazard risk or non-risk item and who must have the knowledge and discipline at all times to place it in the correct container.

3.4 Minimum approach

The use of an infection control or a waste management committee and a designated waste management officer to pilot health care waste improvements may not be possible in small health care establishments, remote locations or lower-income areas.

A minimum approach is for a manager to target a high priority medical area(s) and collaborate directly with its senior nurse and doctor to begin waste segregation, alongside other hygiene improvements. This direct involvement reduces the number of people to be organized and enables limited resources to be concentrated on a key problem area.

It is also necessary to ensure that segregated general and hazardous health care waste are kept separate and disposed of in separate ways. Medical staff will lose confidence in the benefits of waste segregation if hazardous waste components are re-mixed with general wastes in subsequent handling and disposal. Once hazardous health care waste has been separated at source it needs to be segregated in on-site handling and storage through to final treatment and disposal (see Section 5).

3.5 Desirable enhancements

In a health care establishment where an organized introduction of an improved health care waste system is planned and adequate resources (e.g. containers, bags, trolleys and segregated storage facilities) are available, the use of an infection control committee (with or without a waste management sub-group) as the driver for change is the standard approach. The following individual responsibilities should be assigned [1].

- Health care establishment manager: appoints the infection control/waste management committee members, designates the waste management officer, agrees the plans for health care waste management and allocates resources to support the new system.
- Waste management officer (sometimes a specialist doctor, senior nurse or infection control officer): is the lead person to implement and maintain the health care waste system, reports to the health care establishment manager, liaises with the infection control officer, head pharmacist and head radiologist, ensures the correct training of medical staff, ensures good practices are followed throughout the waste system, facilitates solutions to problems, ensures arrangements are in place to deal with emergencies and investigates any waste-related accidents.
- Heads of medical and housekeeping departments: ensure that all doctors, nurses and other staff (e.g. porters, cleaners and auxiliary staff) are aware of the waste segregation and local storage procedures, encourage good practices and enforce compliance.
- Matron or senior nursing officer: are responsible for training new nurses and medical assistants in good health care waste handling practices.
- Head of engineering department: is responsible for overseeing and training other support staff that handle and transport health care waste away from medical areas, operate and maintain on-site segregated storage and any treatment and disposal facilities and ensures that supplies of consumable items are available (e.g. waste bags, etc.).

4. Technical guidelines, standards and regulations

4.1 Basic questions to answer

Establishment of a sustainable health care waste management system benefits from a national legal framework that regulates and organizes the different elements of a health care waste management system (health care establishments, local authorities, disposal facilities, etc). Once developed, the national health care waste management policy should be supported by legislation and guidelines that regulate and provide guidance on its application. In the absence of a legal framework, managers of health care establishments may take the initiative to improve their health care waste management systems by adopting internal policies and rules that promote good practice given their particular circumstances. Taking such an initiative also can be an important step towards reducing nosocomial and occupational infections within the establishment.

A health care manager should be able to answer the following questions.

- Are there laws or legislation that regulate health care waste management at local, regional or national level?

Health care waste management may, in some countries, be part of legislation on hazardous waste or infection control.

- Are there national policy documents and technical guidelines that may assist managers in improving their health care waste management systems?

Guidelines or procedures on health care waste management may be incorporated in existing national infection control guidelines/rules/regulations.

In the absence of a set of technical guidelines or legal framework, managers may check with local and regional colleagues whether there is a health care establishment that has succeeded in developing a set of internal rules or guidelines. If not, then the manager may wish to refer to international guidelines and standards. However, managers need to be realistic in interpreting these to their local situation.

If the legislation and technical guidelines are in force a manager should determine if additional assistance is required from national, regional and international institutions and organizations to proceed with implementation and enforcement of the health care waste management plan.

4.2 Key points to remember

A national policy framework with regulations and technical guidelines is a key element for a successful and sustainable health care waste management system. However, the national policy framework should make allowances for variations in local capacity and socioeconomic conditions in the regulations and technical guidelines. At this stage, many countries in the Eastern Mediterranean/Middle East and North Africa regions have not yet reached a fully complete policy framework, with flexible mechanisms to allow for local conditions. Therefore good initiatives from managers of health care establishments at the regional and local levels may provide flexible solutions and good examples that could be followed by other health care establishments.

It is important to remember the following.

- A law or regulation is not a prerequisite for a manager to take the initiative to improve health care waste management.
- Learning from other good practices in the region can assist in improving the health care waste management system in the establishment.
- Sometimes, laws can be too narrowly focused on defining waste types and general requirements relating to environmental protection in the treatment and disposal of wastes, rather than on the detailed procedures for handling wastes and protecting the health and safety of patients and staff of the health care establishment.
- Developing simple and sensible rules locally *now* is better than waiting for a national regulation *eventually*.
- Sharing experience with other managers could improve their health care waste management systems and also sensitize and influence decision-makers to move ahead with the development of a flexible national framework, with flexible regulations and technical guidelines to take account of local conditions.

4.3 General principles

4.3.1 Local procedures

The simplest way to organize a new waste system, where no prescribed national regulations exist, is for medical and infection control staff to sit down together and draw up their own set of procedures—for all staff to follow, usually based on technical guidelines and standards. It is common for larger health care establishments to do this. Locally prepared procedures should focus on the practical aspects of what staff should do and how they should do it. There is little benefit in preparing long documents giving extensive explanations, which busy staff are unlikely to read. The most effective types

of guidance are those that use simple plain language on one or two sides of a sheet of paper, or that are pictorially presented on a poster.

4.3.2 Technical guidelines and standards

The development of technical, environmental and ethical guidelines and standards is most likely to occur when a high degree of professional interest has been created in a subject. They can be prepared by government technical agencies, such as a public health authority or environmental regulator. Alternatively, nongovernmental bodies, such as professional associations or special interest groups (e.g. an environmental group) can create them. Guidelines and standards published by international agencies such as the World Health Organization and United Nations Environment Programme can also be used as the starting point by local organizations. Standards have a tremendous power to influence behaviour, especially if failure to meet them is publicized or leads to a loss in professional or personal standing among peers. In a regulatory vacuum, progressive organizations will develop their own standards which are often used as a basis for national standards.

Standards may be designed to protect consumers, employees, patients, the environment, etc., for example: the strength and material of construction of waste collection bags; specifications for the containers receiving used sharps; the maximum concentrations of pollutants in emissions from waste treatment facilities; or the maximum time health care waste can remain in storage before disposal. Standards usually derive from current good practice and can have a powerful external influence on managers and medical staff to conform when compliance or non-compliance is reported to central authorities, or even publicly.

4.3.3 National legislation

National legislation should provide a general foundation for improving health care waste management systems by indicating in broad terms what is regarded as good and acceptable practice in the health care industry. Legislation usually places obligations and controls on what is permitted and prescribes sanctions on those that deviate from accepted practice. In reality, a law will remain ineffective if resources (finance, materials, knowledge) are not available in the health care sector to implement it, and/or if enforcement is weak.

The main benefit of a national law covering health care waste is that it can give a uniform basis for a country to develop good practices by providing:

- definition of waste types
- defined legal obligations of waste producers

- requirements for record-keeping and reporting to regulatory agencies
- authority for an inspection system
- courts with powers to settle disputes and impose penalties on offenders
- establishment of procedures to permit or prohibit some waste handling, treatment and disposal practices.

Examples of model waste laws can be found in [8], [9] and [10]. Some countries promulgate primary legislation that is very detailed and highly prescriptive. This approach tends to make health care waste systems inflexible, stifling innovations and acceptance of new developments that improve efficiency and performance. Government time is needed to change a law to take into account new developments. A law covering health care waste is likely to have relatively low priority on the political agenda so revisions can take several years to achieve.

An alternative approach is to enact primary legislation that sets out only in general terms the concepts and principles of good health care waste management. This is known as ‘framework’ or ‘enabling’ legislation. The detailed description of methods and standards to be achieved is then placed in secondary legislation, such as ministry regulations or decrees.

4.3.4 Legal principles

Five guiding principles are commonly adopted in waste-related laws.

The “polluter pays” principle

This requires any waste producer to be made legally and financially responsible for the safe and environmentally sensible disposal of their waste. The responsibility to ensure that the disposal of waste causes no environmental damage is placed upon each waste generator (e.g. a health care establishment).

The “precautionary” principle

The rationale of the principle is that if the outcome of a potential risk is suspected to be serious, but may not be accurately known, it should be assumed that this risk is high. This has the effect of obliging health care waste generators to operate a good standard of waste collection and disposal, as well as provide health and safety training and protective equipment and clothing for their staff.

The “duty of care” principle

This recognizes that any person (and their employing organization) managing or handling health care waste, or waste-related equipment, is morally responsible to take good care of the waste while it is under their responsibility.

The “proximity” principle

The philosophy behind this principle is that treatment and disposal of hazardous waste (including health care waste) should take place at the nearest convenient location to its place of generation, in order to minimize the risks to the general population. This does not necessarily mean treatment or disposal has to take place at each health care establishment; instead it could be done at a facility shared locally or at a regional or national location. An extension to this principle is the expectation that every country should make arrangements to dispose of all wastes in an acceptable manner inside its own national borders.

Prior informed consent principle (also known as ‘cradle to grave’ control)

This principle introduces the concept that all parties involved in the generation, storage, transport, treatment and disposal of hazardous wastes (including health care waste) should be licensed or registered to receive and handle named categories of waste. In addition, only licensed organizations and sites are allowed to receive and handle these wastes. No hazardous wastes (including health care waste) should leave a place of waste generation until the subsequent parties (e.g. transport, treatment and disposal operators and regulators) are informed that a waste consignment is ready to be moved. Special arrangements can be made (sometimes known as a ‘season ticket’) for regular movements of a hazardous waste from an individual waste generator.

4.3.5 Regulations

A set of regulations should describe acceptable, safe practices for each part of the health care waste system: waste minimization; segregation; storage; handling; transport; treatment; and disposal. The regulations should be flexible enough to allow changes to a system if, for example, new equipment, handling methods, or treatment technologies become available, or if infection control procedures change. Regulations should also describe further the legal requirements outlined in the primary legislation and define the responsibilities of all involved in managing wastes.

4.4 Minimum approach

Lack of a national legal framework should not impede a health care establishment manager from taking the initiative to improve health care waste management. Often it is the success at pioneer facilities that influences national governments subsequently to enshrine improvements made into a law or regulation for others to follow. A basic set of local, internal procedures should describe the three-bin waste segregation system, explain the waste storage (Figure 3), collection, treatment and disposal arrangements and clearly state what every person is expected to do and why. Useful guidance is found in [2] and [3].

When a good health care waste system has been set up by local initiative it will quickly be recognized and respected by peers and regulators.



Figure 3. Central storage areas in health care establishments may provide breeding sites for vectors of many diseases (see the cat in the photo) if not designed and maintained appropriately. Separate segregated central storage areas for hazardous health care waste and general waste should be stipulated in internal procedures and rules and in national regulations

4.5 Desirable enhancements

Although outside the mandate of managers of individual health care establishments, enhancement beyond rules and practices developed at this level would be the adoption of regulations for health care waste management at the national level. The ultimate objective of such legislation for national governments is to ensure conformity with good practice across the entire health care industry.

More prescriptive regulations may include the following additional features and safeguards.

- Increase the number of mandatory standards applicable to the management of health care waste.
- Create a control and inspection system to enforce standards and other legal requirements.
- Define further responsibilities and professional obligations and formal qualifications in health care waste management on personnel at all levels.
- Require health care establishments to allocate a minimum proportion of their budget to health care waste management.

Illustrative examples of more complex technical guidance for development of national legislation can be found in [11], [12] and [13].

5. Improving health care waste management in medical areas

5.1 Basic questions to answer

When establishing a new health care waste management system, the manager needs to be clear about the arrangements that will be made in the first medical area(s) to adopt the scheme. Others will be watching the results achieved in clinical practice, hygiene and infection control improvement and judging its success or failure. Typically, a health care establishment manager should be able to answer the following questions:

- Who is in charge of organizing the new practices for waste segregation and storage in the selected medical area(s)?
It is proposed that the system should initially focus on the three largest health care waste components, namely, general wastes, potentially infectious waste and sharps, but widen eventually to include the other distinct hazardous health care waste components (see Section 1).
- Has the head(s) of the first medical area(s) to adopt the scheme agreed to support the new system?
The head(s) of the first medical area(s) to adopt the scheme should be asked to show leadership and motivate their medical staff, especially doctors who are often slower to change their practices.
- What, broadly, are the practical, local arrangements that have been made?
e.g. new clearly marked bins, bags and sharps boxes procured, clearly identified places for waste containers, information posters, instructions to medical staff, arrangements with porters to collect containers, infection control monitoring arrangements.
- When will the new system start?
It is usually good for staff morale for the manager at the outset to set a firm date to start the new system.
- What other infection control and hygiene measures will be introduced at the same time?
e.g. improved hand hygiene, surface disinfection including toilet and shower cleaning, laundering of linen and equipment disinfection.
- At larger health care establishments, when will a decision be needed to introduce the new health care waste system to other medical areas?
Do not leave it more than a month and use staff from the first medical area(s) to train those in the other areas.

5.2 Key points to remember

A new system based on separating general waste from hazardous health care waste in each medical area is a relatively simple concept to present to staff. The following are key points to remember.


- As a minimum, remove waste from patient areas frequently.
- Separating waste at its time of production into different containers is a starting point.
- A three-bin system (general waste, potentially infectious waste and sharps containers) is the basis of a safer health care waste management system.
- Highly infectious waste containing contagious pathogens and all medical laboratory wastes preferably should be pre-treated by disinfecting in an autoclave before entering the hazardous health care waste stream.
- The quantities of other hazardous health care waste components (e.g. chemical, radioactive and pharmaceutical wastes, disused pressurized containers and old cylinders) in most health care establishments are small compared to potentially infectious and general wastes. However, they can still cause harm if not separated out and disposed of properly. Separate handling and disposal routes should be established in those departments where these wastes are generated.

5.3 General principles

5.3.1 Simple first steps

One approach to achieve a sustainable change in the way that health care waste is handled in a medical area is to introduce it as a series of simple steps. Adopting steps to segregate health care waste into their main components (general non-risk waste, used sharps and potentially infectious components), store them securely and regularly remove them from medical areas will reduce the risk of nosocomial and occupational infection and improve general standards of cleanliness and hygiene.

The following first steps to improved waste management are described by WHO [3]:

- Establish a three-bin system in a medical area. 
- Colour code containers, e.g. black for general health care waste, yellow for both potentially infectious health care waste bags and used sharps boxes.
- Minimize transmission routes. Keep waste containers covered.

- Assign different locations for black and yellow waste containers to reduce incorrect segregation.
- Fill bags no more than three-quarters full to minimize spillage. Minimize the number of containers in use at one time.
- Seal filled containers and label and date to identify the medical area, to enable inadequate segregation to be traced back.
- Fix a collection schedule for containers for each waste category.
- Identify places for local temporary storage (e.g. housekeeping room or dedicated waste storage room) or use coloured 240-litre wheeled bins.
- Differentiate between trolleys and carts for general and potentially infectious health care waste components.
- Assign central segregated storage for potentially infectious health care wastes awaiting on-site or off-site treatment and disposal. Without refrigeration in warm climates, maximum storage time is 24 hours in the hot season, 48 hours in the cool season.
- Pre-treat highly infectious waste from laboratories and isolation wards and patients before it enters the hazardous health care waste stream (preferably using an autoclave). Body fluids (e.g. vomit and stools from patients with cholera) should be disinfected (e.g. simple disinfection with sodium hypochlorite).
- Train staff.

5.3.2 Sustainability of resources

The choice of waste container and other items required by the upgraded health care waste system should be determined by what is affordable to the establishment and can be supplied locally. Otherwise, the new health care waste system will begin with the risk that the regular supply of materials to segregate and handle the wastes may be unsustainable. If the supply of consumables and replacement equipment is interrupted at any stage then the continuity of the waste management improvements will be in jeopardy.

WHO recommends collecting general waste in strong black disposable plastic bags, potentially infectious hazardous health care waste in yellow disposable plastic bags, and used sharps in rigid containers, respectively. Black and yellow plastic-bagged wastes should be held in leak-proof bag holders. Once filled and sealed the infectious and sharps waste should remain isolated from human contact. Temporary storage containers and trolleys for on-site transport should have the same colour coding.

If disposable bags are not available then reusable plastic or metal containers with lids can be used and should be washed and disinfected regularly, preferably daily. Each container

should be coloured black or yellow or have a sign to distinguish its use for either general or hazardous health care waste.

Isolating sharps from patients and staff is paramount to avoid secondary infections through physical ‘stick’ injuries. WHO recommends placing used sharps in rigid yellow plastic or waxed cardboard boxes (clearly labelled). If these cannot be locally supplied then any rigid plastic containers (e.g. detergent bottles, distilled water containers) can be used, but they must be clearly labelled as containing used sharps.

5.3.3 Other health care waste components

It is common practice in the countries of the Middle East and North Africa/Eastern Mediterranean regions for body parts and placentas to be collected separately and buried. In some countries, a patient’s relatives may request removed pathological remains (including body parts but not placentas) for their personal disposal according to local custom. These should be disinfected and well wrapped before being handed over to relatives.

Outdated medicines should be returned to the health care establishment pharmacist, who has the expertise to store the materials until their treatment and disposal. In specialized medical facilities where cytotoxic compounds are used to treat cancer, wastes containing cytotoxic chemicals should be collected and stored separately by the genotoxic safety officer or the pharmacist. They are highly toxic and require separate handling, treatment and disposal. Secure storing of pharmaceutical waste in a different colour-coded container (e.g. brown) is advisable.

Chemical wastes should be stored in a secure, ventilated location and properly managed to prevent the likelihood of adverse chemical reactions (e.g. explosion or corrosion). Mercury spillage, e.g. from broken thermometers should be carefully collected and disposed of in a safe manner. The pharmacist may be responsible for storing chemical waste, although in larger establishments and research institutions the head of the medical laboratory may be a more suitable person.

Sealed radiation sources and unsealed radioactive materials are produced in nuclear medicine and radiotherapy departments, respectively. Spent sealed sources (long half-life) are returned to suppliers as part of the terms of the original supply contract. Unsealed radioactive materials (generally short half-life) are stored for typically ten half lives to enable the radioactivity to decay to insignificant levels similar to that of the background environment. Decayed radioactive solutions are normally passed to the sewer. If such wastes also contain chemical materials they should be treated as chemical health care waste after radioactive decay. Decayed materials present within contaminated syringes and gauze should join the hazardous health care waste stream.

The simplest approach to handling corroded and damaged gas cylinders that may still be under pressure (such as those used for heating, cooking or medical purposes) is to contract with the suppliers of gases to take back cylinders and use their own dismantling service. Burial at a municipal dumpsite is unacceptable as the cylinder may leak gas which, if flammable, could ignite or explode.

5.4 Minimum approach

5.4.1 Three-bin system

Where no organized infection control exists, a rapid improvement can be made to the culture and appearance of a medical area by controlling general waste, used sharps and potentially infectious health care waste. The first action in each patient area should be to segregate these waste components at the time of waste generation and keep them segregated until final disposal. This allows the bulk of the waste (general waste) to be disposed of via the municipal route and the smaller volumes of potentially infectious health care waste to be handled and disposed of in a more secure manner.

The segregation of general waste, potentially infectious health care waste and used sharps into three containers is known as the three-bin system (Figure 4). At a minimum reusable containers manufactured in different colours (or painted different colours), without disposable plastic bags, may be used to segregate these categories of



Figure 4. Three bin-system: yellow bag for potentially infectious wastes, black bag for general wastes, and leak-proof and puncture-proof reusable containers for used sharps with statements “Do not fill above the line” and “ sharps waste”

waste. Alternatively, signs and marks can be put on containers to differentiate their use for a particular health care waste category. Containers should be filled to only three-quarters of their capacity to avoid spillage and kept covered to prevent casual access by people or disease vectors. Filled containers should be taken out regularly from patient areas and general waste stored in a central location segregated from potentially infectious waste and used sharps. Separate disposal routes should be used subsequently.

If immediate removal from patient areas is not possible then two local storage places should be found in or near the medical area: one storage place for general waste containers and the other for potentially infectious and used sharps containers. The containers should be clearly labelled, closed and kept in a location away from possible disturbance by patients and visitors. Wastes should also be collected at different times from the two local storage places, the intention being to continue keeping the separated waste categories segregated. A minimum of one removal from each storage point should be provided in every working shift.

Where reusable bins are used they should be washed and preferably disinfected before return to a medical area.

5.4.2 Worker safety

Protective gloves, goggles and overalls should be provided to porters to reduce further the risk of infection and injury from handling and transferring hazardous health care waste from temporary medical storage to central storage areas.

5.5 Desirable enhancements

In a well functioning medical area, i.e. with good infection control practices in place, several improvements can be made to the minimal approach to waste separation. The most distinctive is the use of disposable colour-coded strong plastic bags for general and potentially infectious wastes and rigid containers for used sharps. The colour coding system recommended by WHO is:

- black for general waste (also known colloquially as ‘black bag’ waste);
- yellow for potentially infectious health care waste (also known colloquially as ‘yellow bag’ waste);
- yellow for rigid, leak-proof, single use containers suitable for used sharps. Improvised rigid containers are acceptable, and should be clearly labelled. Examples are empty disinfectant, distilled water and dialysis solution containers. Where resources are available, specially manufactured strong waxed cardboard or yellow plastic containers are preferable.

Plastic bags for general and potentially infectious wastes should be raised off the floor by using bag holders, situated in marked locations. When bags and containers are filled to three-quarters of their capacity they should be tied and labelled with the date and department. To maintain waste isolation from patients and staff the sealed bags should be put into separate local storage areas, ideally 240-litre (or similar) wheeled containers (Figure 5). Black, wheeled containers should be used for general wastes and yellow for potentially infectious waste.

Removal of wastes should be according to a regular collection timetable with one or more removals from each local storage area in each working shift. If logistically possible, a further refinement would be to arrange separate routings around the health care establishment: one for patients, staff and unused medical materials, and the other for wastes, dirty linen and used materials. This is the so called ‘clean’ and ‘dirty’ system of access.



Figure 5. Example of a 240-litre wheeled container for local storage of yellow bagged waste

6. Transport, treatment and disposal methods

6.1 Basic questions to answer

Segregating and regularly removing health care waste from medical areas is a major managerial and logistical achievement. However, it is only the front-end of a two-stage process. To complete the improvement in infection control and hygiene, the segregated health care waste has to be transported away from medical areas for safe temporary storage, treatment and disposal. Unsafe uncontrolled storage and disposal of this waste can lead to further infection and adverse health impacts on those who come in contact with it by accident.

A health care manager would want to know what options are available for the safe disposal of waste and should be able to answer the following questions.

- Who is in charge of the removal of segregated hazardous health care wastes and its disposal?
- What is the importance and objective of a selected treatment and disposal option?
The primary purpose of treatment and disposal is to protect public health through the destruction or isolation of hazardous health care waste from people, grazing animals and disease vectors. Protection of public health is of paramount importance to avoid the recycling of pathogens in the community.
- What are the practical arrangements to be put into place?
Will additional money or resources be needed? Can the additional resources be afforded in the foreseeable future?
- Can the health care establishment work with others to share the treatment or disposal burden?
Centralized treatment and disposal is more economic but relies on a high level of trust and commitment between health care establishments to work together and should be encouraged wherever practicable.
- What, if any, outside organizations need to be involved?
Try to keep to a minimum. As more organizations and specialists become involved, the more scope exists for complexity and delay. Organizations will need to consider including professional institutions, unions, government departments or agencies, municipalities, aid or grant-giving bodies.
- Will the health care waste disposal system be in operation when waste segregation begins in medical areas?
Sustaining staff motivation is threatened if segregated wastes are re-mixed during temporary storage and final treatment and disposal.

- Can the private sector provide well managed collection, transport, treatment and disposal services for hazardous health care waste at an affordable price?
Private contractors should be considered carefully to determine if they offer a safer service beyond what can be achieved by the health care establishment itself.
- Can the health care establishment pay for municipal solid waste collection and disposal services?
The municipal solid waste management system is likely to be the most appropriate and affordable means for collection and disposal of general waste. However, the municipal system may not have developed the capability for separate collection, treatment and disposal of hazardous health care waste.

6.2 Key points to remember

Getting a safe and affordable waste treatment and disposal system started is much more difficult than tackling the waste segregation problem in a medical area. This is one issue that cannot be ignored because overly complex systems can be expensive and are liable to be unsustainable in the longer term. A manager should consider the following key points.

- Even simple treatment or disposal of health care waste is better for public health than doing nothing.
- Minimal hazardous health care waste treatment or disposal involves burial. The key point is to isolate this waste to prevent casual access by people and to destroy the infectious pathogens by natural decomposition.
- On-site safe burial of hazardous health care waste is easier to control and avoids having to organize or rely on others to transport and provide safe disposal of the waste at an external facility. It is often favoured in lower income areas, small health care establishments in regional locations or crisis situations.
- Enhanced health care waste treatment and disposal can achieve pathogen destruction more efficiently and in a more environmentally beneficial manner. It is particularly suited to densely populated areas where hazardous health care waste volumes are high, and environmental sensitivity is at its peak. If undertaken off-site by a specialist organization, it frees up management time to concentrate on improving infection control and hygiene procedures within the establishment.
- Enhancements are usually more costly or complex and only realistic if affordable and can be maintained locally.

6.3 General principles

Managers at health care establishments often spend little time considering back-end engineering issues. Health care waste treatment and disposal fall frequently into this category. The following main issues need to be resolved for the three principal types of health care waste (general, potentially infectious and used sharps): separate transfer to segregated temporary central storage points, as well as simple or more sophisticated on-site or off-site treatment, and/or disposal.

a) On-site transport

A manager should consider the following.

- Porters transfer segregated health care waste to separate central storage points.
- Protective gloves, goggles and overalls should be provided to porters to reduce further the risk of infection and injury from transporting waste.
- Use separate central storage points: one for general waste and one for infectious health care waste and used sharps. Typically, sealed potentially infectious and used sharps containers are stored in the same central storage point since the treatment and disposal route chosen is usually the same for both.
- Transport by trolley is less risky than manual carrying. If a used syringe needle or blade has been mistakenly placed in a bag and protrudes out it could injure and infect staff when hand carried without care or placed on the ground where others could brush past it.
- Where available, covered trolleys such as two-wheeled 240-litre plastic bins are popular, puncture-resistant and leak-proof. Otherwise an open top trolley or cart is sufficient.
- Central storage of bags containing health care waste and used sharps containers in a secure compound is tolerable. Use of large, four wheeled, leak-proof and puncture-resistant covered bins is better, if they are available.
- There should be two **separate** central storage areas on-site at each health care facility: i) for hazardous health care waste; and ii) for general waste.

b) On-site treatment and disposal

A manager should consider the following.

- Basic disposal for used sharps and potentially infectious health care waste is burial within the grounds of a health care establishment in a dug pit, covered with earth. Waste is isolated quickly and disposal relies on no other organization, but a risk of groundwater pollution and scavenging may exist.

- A basic treatment step before disposal is chemical disinfection (e.g. for used sharps). Open burning grounds are known to have been used in the past. This method is environmentally unacceptable and should not be practised.
- In recent years, an intermediate incineration technology for lower-income countries and non-urban locations has become available. This comprises a double chamber combustion unit (e.g. the De Montfort incinerator system with a temperature of 800 degrees Celsius or higher [7,14]) which provides thorough waste destruction including sharps using modest or no additional fossil fuel to support combustion. The technology is not expensive to construct and provides controlled burning with little visible smoke. It does not control non-visible pollutants such as volatile heavy metals or halogenated gases. This solution may be feasible where environmental authorities consider such technology is appropriate for the local circumstances and where the surrounding neighbours do not object.
- Health care establishments in high-income and some middle-income countries in the Eastern Mediterranean/Middle East and North Africa region use advanced waste treatment systems, e.g. high temperature double chamber incineration, wet thermal disinfection and microwave technology for on-site treatment of the health care waste they generate. These systems provide better destruction of pathogens but their capital investments and operation costs are higher than the basic systems of on-site treatment described above. In order to reduce costs, these systems are generally recommended for a group of local or regional health care establishments (see Section 6.3.4).

c) Transportation off-site

A manager should consider the following.

- If treatment or disposal is at off-site locations then a system of transporting the waste is required. As a minimum a tractor and trailer or small truck will be sufficient if the site is nearby.
- Protective gloves, goggles and overalls should be provided to transport staff who load wastes to reduce further the risk of infection and injury.
- There should be two **separate** central storage areas on-site at each health care facility: i) for hazardous health care waste; and ii) for general waste.
- Off-site transport of general and hazardous health care waste should be carried out by two separate vehicles: i) pick-up of general waste by vehicles used to collect municipal wastes by the municipality; ii) pick-up of hazardous health care wastes by special purpose vehicles.
- If the off-site facility is 2 or more kilometres away then a larger truck will be required for potentially infectious waste and sharps which also may be used to collect hazardous

health care waste from other health care establishments. The design of the truck interior should minimize damage to health care waste bags and the floor should be sealed to prevent leakage of fluids [1].

d) Off-site treatment and disposal

A manager should consider the following.

- Centralized off-site treatment is usually favoured in middle and higher-income areas, especially where strict environmental pollution controls are applied.
- Central facilities allow health care establishments to share and reduce the cost of achieving highly controlled disposal of potentially infectious health care waste and used sharps (and often pathological and pharmaceutical health care waste).
- Advanced waste treatment systems include high temperature (circa 1200 degrees Celsius) double-chamber incinerators, wet thermal disinfection systems (similar to autoclave systems), autoclave technology and microwave technology. The destruction of pathogens is more thorough but these systems consume more resources and are more expensive to operate. Consequently, they are most often recommended for central treatment facilities that can offer lower costs due to economies of scale.
- All advanced treatment processes require final disposal of residues to landfills. This is usually to a municipal disposal site, which is the same destination as the general waste from health care establishments.

Other hazardous health care waste, if produced, also requires separate treatment and disposal (see Section 5.3.3).

6.4 Minimum approach

6.4.1 On-site treatment and disposal

The minimum approach at a health care establishment with no history of organized waste disposal and in a crisis is to dispose of potentially infectious health care waste in a disposal pit on-site. In this situation isolating waste to protect public health is the overriding concern. Liming the waste (with quick lime) may be prudent if the crisis is due to the presence of a highly contagious disease. If cement is available and affordable then used sharps and pharmaceutical health care waste can be encapsulated in concrete and buried in a dug pit. This technique can also be useful to dispose of toxic chemical waste solutions.

In many establishments medical staff place used sharps in sodium hypochlorite disinfectant solution prior to disposal by burial, incineration or encapsulation. The practice reduces some of the infective potential from a handling injury but disinfectant penetration into the annulus of a needle is not reliable. Even after disinfection these used sharps should still be regarded as potentially infectious.

Open burning, supported by soaking in fuel, is a practice that should be discouraged, and only used in emergency situations. Frequently, burn out of waste is not thorough and considerable volumes of acrid smoke and other toxic pollutants are generated. Similarly, disposal of small quantities of chemicals and pharmaceuticals into sewers is a practice that must be discouraged.

6.4.2 Off-site treatment and disposal

If there is a controlled municipal landfill nearby, burial of potentially infectious health care waste each day beneath 2 metres of partially decomposed municipal waste may be a practical option. At a depth of 2 metres re-excitation by scavengers should be preventable. Scientifically, burial of potentially infectious and sharps wastes is unlikely to cause additional public health or pollution problems in a controlled landfill (see Figure 6). It is a low-cost option that could be used in those places where controlled landfilling has been achieved and where scavenging by people and animals is not present [6].



Figure 6. Example of a controlled landfill

6.5 Desirable enhancements

6.5.1 On-site treatment and disposal

More advanced treatment options provide better destruction of pathogens present in hazardous health care waste and offer facilities to reduce groundwater and air pollution below the levels of the most basic methods of treatment and disposal discussed above.

Where a health care establishment can take a more organized approach, then the use of well-constructed single or double chamber incinerators (e.g. De Montfort style brick machines, often available through aid agencies in kit form) is a common first step. Detailed instructions are provided with the kits for construction and operation of these simple, but effective, facilities.

Alternatively small units adopting the other enhanced techniques of treatment, such as autoclaves and microwave technologies, can be installed on-site at health care facilities. The smaller units can be selected to serve one or several nearby health care facilities. However using a central regional facility usually offers a more cost-effective approach.

6.5.2 Off-site treatment and disposal

The most successful systems rely on high throughputs of waste, using the volumes produced by several health care establishments. Consequently, enhanced systems are commonly central systems involving shared reliance between waste generators, waste transporters, treatment operators and landfill disposal operators. Costs are inevitably higher than the minimum approach but the basic disposal techniques are often not permitted in places where rising national environmental protection standards and social expectations must be met [1,5].

The systems used in centralized facilities in higher income countries are as follows.

1. High temperature, double chamber pyrolytic incineration (Figure 7)

Good disinfection efficiency, and large reduction in waste volume and weight are achieved. The combustion engineering skills needed are widely available in most countries. Incineration produces mixed combustion gases that require gas cleaning, and requires extra fuel to support combustion at a high temperature. The cost of investment varies widely.




Figure 7. High temperature double chamber pyrolytic incinerator



Figure 8. Steam disinfection system with shredder

2. Microwave disinfection

Waste must be shredded first then dampened, before being ed by microwave generators. Pathogens are destroyed by heat conduction and heat radiation. Since this is a non-combustion process fewer off-gases are produced. In addition, some volume reduction occurs due to pre-shredding of the waste. There is no weight reduction and the system requires trained staff and some reliance on international sources of spare parts.

3. Steam disinfection including autoclaving (Figure 8)

Waste must be shredded. This is followed by heating to a high temperature using high pressure steam. Pathogens are destroyed by heat conduction and high pressure steam. Large volumes of steam are produced but with re-condensation of waste vapour off-gases have low pollution potential. No weight reduction is achieved but there is some volume reduction from the shredding. The method requires trained

staff with maintenance skills for high-pressure steam systems. These are usually available in most countries.

4. Dry thermal disinfection

Waste must be shredded first before entering a chamber that resembles a cooking oven. There is no combustion of waste so only small volumes of off-gases are produced. Pathogens are destroyed by heat conduction and heat radiation. Some weight and volume reduction results through water evaporation. The technique requires trained staff.

7. Training approaches

7.1 Basic questions to answer

All medical and support staff should be trained to understand the benefits of the new health care waste management system and what their responsibilities will be. If a person is not shown how to carry out a task to meet certain requirements, then management cannot hold them accountable for inadequate performance.

A health care manager needs answers to the following questions, from those responsible for setting up the new waste management system.

- Who is responsible for training staff?
Training should be led by the infection control officer or, at a larger health care establishment, the waste management officer.
- What training has been devised for medical and support staff?
Look through the training materials already available nationally or from the WHO and other international bodies. Is it simple to understand and straightforward to use? Can it be delivered to small groups in their medical areas to minimize disruption to normal medical duties?
- Is any specialist training needed to improve the treatment and disposal end of a new waste system?
Only modest training will be needed if minimal on-site treatment and disposal are to be used. More extensive training of technicians and engineers will be required for more sophisticated treatment and disposal options.
- What resources for training are going to be needed?
- When will the training start?

7.2 Key points to remember

Training is necessary to increase the chances of the new waste management system being well received and properly implemented by medical and support staff. The following are key points to remember.

- Every member of staff should be trained to carry out their waste management duties.
- Identify the target groups (e.g. doctors, nurses, support staff) and train them separately using tailored training programmes in line with their occupations. Keep the training short and simple for each target group (Figures 9 and 10).



Figure 9. Training of nurses and senior nurses



Figure 10. Training of health care waste handlers

- Start more intensive training of those involved in operating waste treatment and disposal facilities as soon as possible. It takes time to build up the necessary skills and confidence among technicians and engineers to develop and operate better waste treatment and disposal facilities.
- Once trained, there should be no excuse for doing it incorrectly.

7.3 General principles

7.3.1 Training to inspire

Training is intended to make the waste management plan effective, explain what people should do, explain personal responsibilities when handling waste and reinforce the aims to improve infection control, hygiene and personal and patient safety. The best approach to training is to work with staff to let them discover through practice their personal abilities and the benefits of the new waste system. Training should not be about lecturing in an unimaginative way.

7.3.2 The training and awareness raising package

The common approach is for the infection control committee to delegate someone to devise a training package for staff and awareness raising materials for patients and visitors. Useful guidance is provided in [1] and [5]. The package should identify:

- the target groups in medical areas for training (i.e. managers, doctors, nurses, housekeeping staff, porters and auxiliary staff, engineers and technicians);
- content for a one-hour practical training course in the workplace for each target group, including distributing useful notes and possibly showing a demonstration video;
- content of a longer one-day or two-day course for supervisory staff in each group;
- duration of the training programme and number of training courses to be delivered;
- arrangements to train new staff and provide refresher courses in the future;
- copies of labels, signs, posters and instructions to be distributed around the health care establishment;
- arrangements to educate and raise the awareness of patients and visitors (e.g. distribution of brochures, fliers, posters and discussion of these materials with patients and visitors) about the risk of health care waste, improvements being made, safe practices they can do to prevent their exposure and their role in reducing secondary infections in health care establishments.

7.4 Minimum approach

In many small or regional locations and crisis situations time for organized training events using prepared training materials is a luxury. In these circumstances, the nurses and doctors in a medical area typically work out a new system themselves, assisted by the infection control officer. Once started, they will then demonstrate by example to other medical staff elsewhere and, hence, train them on the job.

WHO has suggested [1] that a minimal level of training for all staff producing and handling health care waste should cover:

- identification and separation of wastes, the use of containers, as well as the handling and storing of all health care waste components;
- wearing of protective gloves and aprons when handling health care waste containers;
- operation of on-site treatment and disposal facilities;
- safety precautions, emergency measures and protection from chemical hazards;
- occupational risks associated with handling sharps.

7.5 Desirable enhancements

An organized introduction of a new waste management system should be accompanied by a training package. The link with infection control and hygiene needs to be emphasized. Training arrangements should be part of the waste management plan and discussed and agreed with the manager of the health care establishment.

Wherever possible hospital staff involved in setting up and using the new waste system should lead the training rather than relying on external specialists. Training in waste management should also become part of the induction training for all new members of staff.

Health care waste management should be part of the basic training that every nurse receives at nursing school and should be included in the education curricula of doctors.

8. Health protection and safety practices (for medical staff and waste handlers)

8.1 Basic questions to answer

Action plans for the safe management of health care waste in health care establishments (as a minimum approach, see Section 2) include provisions for minimizing the risks of secondary infection and physical injury to patients, staff and visitors. An infection control programme and procedures should also address measures to improve occupational safety and hygiene.

The most frequently exposed groups are medical staff and waste handlers. They are regularly exposed to blood and other body fluids during their daily work. Many infections, including human immunodeficiency virus (HIV), hepatitis B (HBV) and hepatitis C (HCV) are found in nosocomial infection surveys. The risk of infection depends on the prevalence of a disease in body fluids and the type and frequency of exposure. Exposure to health care waste can be minimized by training in safe working practices and use of equipment and protective clothing. Continuous monitoring of staff health, including immunization and post-exposure prophylaxis, e.g. in the event of needle-stick or other sharps injuries, and medical surveillance is of paramount importance.

A health care manager should be able to answer the following questions.

- Are all staff aware of the potential risk associated with health care waste?
If not known ask casually a cross-section of staff.
- Who trains and checks new staff to ensure they understand the importance of maintaining good safety practices to minimize occupational exposures?
This applies especially to new doctors, nurses, medical assistants and cleaning staff.
- Are all staff immunized against, at least, hepatitis B?
HBV is a widely present infection and easily transmitted to others in blood and body fluids.
- What protective clothing is available to medical staff and those handling wastes?
A rapid assessment of risks posed to staff from present health care waste practices should identify the protection measures necessary.
- What is being done now to prevent needle-stick injuries?
This is the most common cause of infection in health care workers.
- What is being done now to clean up spills of body fluids (e.g. vomit, blood, urine and faeces) quickly?

8.2 Key points to remember

When reviewing the current arrangements for minimizing the risk of infections to staff and waste handlers from the hazards posed by health care waste, the following key points should be remembered.

- The principal routes for transmission of a communicable disease are air, water, food/ingestion, vectors and physical contact. Physical contact is the most common transmission route.
- There are three distinct types of contact transmission of infection to patients: i) from the hands of medical staff; ii) from contaminated equipment used on patients; and iii) from poorly cleaned surfaces and rooms.
- The main source of contact transmission of infection to medical staff and waste handlers is through needle-stick injuries.
- Data from a recent study in 98 health care facilities in a country in the Eastern Mediterranean Region [16] showed that 36% of percutaneous injuries occur due to two-handed recapping of needles.
- Among the 35 million health workers worldwide, about 3 million receive percutaneous exposures to bloodborne pathogens each year; two million of those to HBV, 0.9 million to HCV and 170 000 to HIV. These injuries may result in 15 000 HCV, 70 000 HBV and 500 HIV infections [15].
- Ensure that all staff are aware of the safe medical practices when treating patients and the risks associated with handling health care waste.
- Most needle-stick injuries are related directly to poor working practices, such as recapping of needles, and failure to dispose of used needles (and used sharps) properly in puncture-resistant sharps containers. Prevention of occupational sharps injuries is an important component of infection control in health care establishments.
- If serious incidents of infection are occurring then something is going wrong that cannot be ignored.

8.3 General principles

8.3.1 Medical staff and worker safety

Medical and health care waste staff are exposed to many body fluids in their daily work. The risk of contracting an infection depends on the prevalence of a disease, the presence of possible transmission routes to workers and the frequency of exposure. The most common form of occupational exposure experienced by medical staff and waste

handlers is by pathogens present in blood, such as hepatitis B and C and HIV, through a needle-stick injury [15].

Safety measures to protect staff focus on three topics [1]:

- training of staff on handling wastes and used sharps, avoiding accidents and post-exposure procedures;
- provision of protective clothing and equipment;
- establishing immunization, post-exposure treatment and regular medical surveillance.

Reporting, containing and cleaning up spillages of infectious materials quickly and thoroughly are essential to avoid the risk of infection in the health care establishment. General procedures for effective spills control are described in many authoritative publications [see 1,12,13,16].

8.3.2 Protective clothing

The type of protective clothing to make available depends on the types of risk experienced by staff. Medical staff routinely have access to masks, gloves and aprons to protect them from direct contact with body fluids. Waste workers are more at risk from physical injuries from waste items (Figures 11 and 12). The following clothing is recommended by WHO [1] for health care waste workers:

- strongly recommended: overalls, industrial standard aprons and gloves, leg protectors and/or strong boots;
- advisable if there is risk of exposure to uncontained waste or if working with waste treatment equipment: safety glasses, face masks and helmets.

8.3.3 Needle-stick injury

The most common causes of needle-stick injuries are two-handed recapping of needles and unsafe disposal of sharps resulting in them protruding from waste bags. To avoid these causes the immediate disposal of used syringe and needle assemblies, blades and other sharps into a sharps container should be obligatory. However, in some medical interventions and laboratory manipulations recapping of needles may be practised. Therefore, training on the one hand technique for recapping needles should be addressed in training sessions (Figure 13).

All needle-stick injuries should be reported to infection control to administer post-exposure medical assistance, take blood samples for testing and provide surveillance until there is no longer a likelihood of developing a disease. Equally important is to investigate the cause and to change procedures to prevent the accident from reoccurring. Reporting 'near misses' also helps protect staff by changing procedures to minimize the chances of future accidents taking place.



Figure 11. Protective clothing of a worker in charge of loading bagged waste in an incinerator loading device



Figure 12. Protective clothing reduces the risk of infections and injuries to waste handlers



Figure 13. A training session on the one hand technique for recapping needles in a health care establishment in the Region. This technique is recommended particularly for dentists and laboratory technicians in haematology laboratories (i.e. in order to avoid haemolysis/destruction of red blood cells laboratory technicians should remove needles after their recapping)

The reporting of an accident should not penalize the worker(s) involved. This will only discourage staff from reporting injuries and stop them seeking the medical attention that they should receive. All incidents involving health care waste should be regarded as an accident and reporting all occurrences should be encouraged by managers to ensure a prompt and accurate response and to find ways to prevent it happening again.

8.3.4 Hand hygiene

The hands of medical staff frequently come into close contact with a patient and are an obvious transmission route for infections. This route occurs much more often than vector-borne or airborne transmission. Transmission by hand contact from staff to a patient or from patient to patient is rarely 'direct', but instead 'indirect'. An infected person contaminates the surface of an object or instrument, which then comes into contact with another patient. The exposed patient may then develop a nosocomial cross-infection.

It is not possible to avoid all contact with infected tissue or with potentially contaminated body fluids, excreta and secretions. Consequently, health care establishments should enforce an internal policy that expects all staff, not only medical personnel, to maintain a high standard of personal hygiene and cleanliness. To achieve this, washing facilities are needed for staff before, during and after their daily work. Achieving a good routine of personal cleanliness, especially hands, is a significant advancement in patient care.

Regular and thorough handwashing with soap and water removes over 90% of the microbial flora present on hands. It should be undertaken routinely after physical contact with every patient. The use of anti-microbial soap achieves a higher reduction of the microbial flora providing washing continues for several minutes.

8.3.5 Equipment hygiene

All objects in contact with patients are considered potentially contaminated. Objects in contact with instruments, linen and other items that have been in contact with patients are also considered potentially contaminated and should not be touched with bare hands at any time.

If the object is disposable, it should be discarded as waste. If it is reusable, the transmission of pathogens has to be prevented. This is achieved to different extents by cleaning, disinfection or sterilization. For additional information in this regard see [1].

8.3.6 Building hygiene

Thorough cleaning and disinfecting of buildings, rooms and floors should not be regarded as a minor housekeeping function. Building surfaces, ventilation systems and less accessible places and spaces act as reservoirs for pathogens, if not kept clean.

Procedures should be agreed with the infection control officer for cleaning high-risk areas, such as isolation rooms, emergency departments, operating theatres, medical laboratories, mortuaries, and central and local health care waste storage areas. The training and supervision of the cleaning staff is particularly important in this aspect of infection control. The safest approach is to assume high-risk areas are contaminated with infectious organisms and require regular and thorough cleaning.

Attention should also be paid to toilets and showers. Hand-washing facilities should be provided in each medical area, as well as in toilets and showers and should be thoroughly cleaned at least once a day or more frequently if used by a large number of people. Inadequate and unsanitary toilet facilities have to be regarded as unacceptable in a health care establishment.

The construction, maintenance and regular cleaning of septic tanks or external pit latrine systems should be treated as a priority to control the risk of infection transmission.

8.4 Minimum approach

Ideally, all of the safety measures described above should be implemented. They represent common sense procedures and, within the limitations of the resources available, should be possible for a manager to apply. WHO advises that the following simple set of ‘universal precautions’ are followed to protect patients and health care workers [15].

- Wash hands after any direct contact with patients.
- Ensure safe collection of sharps in puncture-proof and leak-proof containers (clearly labelled) in each patient area.
- Wear gloves for contact with body fluids, broken skin and mucous membranes.
- Wear a mask, eye protection and a gown and plastic apron if blood or other body fluids might splash.
- Cover all cuts and abrasions with a waterproof dressing.
- Promptly and carefully clean up spills of blood and body fluids.
- Set up a safe system of health care waste management and disposal.

In lower income areas and health care centres in rural settings, it is advised to provide hepatitis B vaccination to all staff.

8.5 Desirable enhancements

More can be done to achieve greater protection to health care workers beyond the universal precautions. Additional simple measures have been summarized by WHO [15] and are paraphrased below.

Routine immunization of all health care workers against hepatitis B is an effective way to protect them. It is the most prevalent bloodborne virus. The vaccine is effective, widely available and low cost (less than US\$0.5 a dose). The following simple steps considerably improve protection.

- Immunize health care workers early in their careers.
- Use a 0, 1 and 6 month schedule of three injections.
- If possible, conduct post-vaccination testing.

Note. Protection is lifelong, so routine boosters are not necessary. Pre-vaccination serological testing is also unnecessary.

If tuberculosis is endemic, all staff should also be vaccinated against that disease. Those staff handling waste should also be vaccinated against tetanus.

Personal protective equipment should be made widely available.

- Provide adequate supplies of equipment in each medical area.
- Involve staff in the selection of protective equipment; equipment of poor quality or uncomfortable to wear will not be used.
- Train staff in correct use of equipment.
- Make use of senior medical staff as role models to promote the use of equipment.
- Monitor staff compliance and appropriateness of use; inappropriate glove use wastes resources.
- Dispose of used personal protective equipment safely.

The risk of infection from a needle-stick injury must be minimized. When an occupational exposure does occur, then an effective response should be made.

- Develop guidelines outlining the first aid required, a reporting mechanism and a procedure to be followed for post-exposure prophylaxis and follow-up testing.
- Disseminate the guidelines to all staff.
- Ensure all staff have access to post-exposure information, education and communication.
- Provide support and counselling to those exposed.
- Where possible, provide post-exposure prophylaxis.
- Analyse reported cases of exposure in order to improve practices.

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Further reading

Johannssen, LM et al. *Health care waste management guidance note*. Washington, The World Bank, May 2000 (<http://wbln0018.worldbank.org/HDNet.HDdocs.nsf/0/0d87e869807f2f69852568d20054e66b?OpenDocument>).

The overall objective of this publication is to demystify the topic of health care waste management and demonstrate that positive improvements are possible in almost every situation with relatively modest levels of effort and investment. It is designed to provide managers and technical staff of health care facilities with the confidence to tackle poor health care waste management as part of their future programmes of work. The publication is intended to provide managers and advisers with an easy-to-read introduction to the subject, and technical staff with a reference work. It is not intended to be a prescriptive guideline. It is designed to assist those involved in health care projects across the countries common to the World Bank Middle East and North Africa and WHO Eastern Mediterranean regions. More specifically, it is intended to encourage the inclusion of health care waste management activities as a component of new health care investment and promotion programmes in the Region.

