Chapter 8
Healthcare waste: Generation, handling, treatment and disposal

Contents

Although small-scale healthcare activities provide many important benefits to communities, they can also unintentionally do great harm through poor design and management of waste management systems.

Problems

- Little or no management of healthcare wastes
- Disposal of healthcare wastes with general solid waste
- Improper burial of wastes
- Improper operation of incinerators
- Dumping into sewage and water systems

Brief Description of the Sector

Small-scale healthcare activities, such as rural health posts, immunization posts, reproductive health posts, mobile and emergency healthcare programs, and urban clinics and small hospitals, provide important and often critical healthcare services to individuals and communities that would otherwise have little or no access to such services. They are the front line of defense against epidemics such as AIDS, malaria, and cholera and a key component of any comprehensive development program. The medical and health services they provide improve family planning, nurture child and adult health, prevent disease, cure debilitating illnesses, and alleviate the suffering of the dying.

Currently, little or no management of healthcare wastes occurs in small-scale facilities in Africa. Training and supplies are minimal. Common practice in urban areas is to dispose of healthcare waste along with the general solid waste or, in peri-urban and rural areas, to bury waste, without treatment, in an unlined pit. In some cities small hospitals may incinerate waste in dedicated on-site incinerators, but often they fail to operate them properly. Unwanted pharmaceuticals and chemicals may be dumped into the local sanitation outlet, be it a sewage system, septic tank or latrine.

Potential Environmental Impacts of Development Programs in the Sector and Their Causes

Although small-scale healthcare activities provide many important benefits to communities, they can also unintentionally do great harm through poor design and management of waste management systems.

A new health post at an internally displaced persons (IDP) camp – Pomba Nova – near Sumbe Angola. The Health post has no water supply.

Healthcare waste is dangerous. If handled, treated or disposed of incorrectly it can spread disease, poisoning people, livestock, wild animals, plants and whole ecosystems.

Types of Waste

- General waste
- Hazardous waste
- Highly hazardous waste

Types of waste. These wastes generally fall into three categories:

- ***General*** healthcare waste, similar or identical to domestic waste, including materials such as packaging or unwanted paper. This waste is generally harmless and needs no special handling; 75–90% of waste generated by healthcare facilities falls into this category.
- ***Hazardous*** healthcare wastes including infectious waste (except sharps and waste from patients with highly infectious diseases), small quantities of chemicals and pharmaceuticals, and non-recyclable pressurized containers.
- ***Highly hazardous*** healthcare wastes including sharps, highly infectious non-sharp waste, stools from cholera patients, and bodily fluids of patients with highly infectious diseases. They also include large quantities of expired or unwanted pharmaceuticals and hazardous chemicals, as well as all radioactive or genotoxic wastes.

Table 3.1: Types of hazardous and highly hazardous medical wastes relevant to small-scale facilities

Hazardous Waste		**Highly Hazardous Waste**	
Infectious	Wastes thought to contain low concentrations of infectious agents, such as disease-causing bacteria, viruses, parasites, and fungi, that could spread the disease *Examples*: tissues/swabs; materials or equipment that have been in contact with infected patients; human excretions such as pus, feces and vomit from patients without highly infectious diseases; wash water	Sharps	Sharp objects that can easily cut or injure a handler. Used hypodermic needles are the most common and dangerous, as they are often contaminated with highly infectious blood *Examples*: syringe needles, scalpels, knives, infusion sets, broken glass
Pathological	Tissue or body fluids from humans or animals without highly infectious diseases *Examples*: blood, body parts, organs, animal carcasses	Highly infectious (non-sharps)	Contain high concentrations of highly infectious agents and pose an extreme health hazard *Examples*: body fluids, such as blood, from patients with highly infectious diseases; microbial cultures; and carcasses of inoculated laboratory animals
Chemical (in small quantities)	Waste containing purified chemical substances that are toxic, corrosive, flammable, reactive, and/or explosive *Examples*: unwanted disinfectants, solvents, film developer, laboratory reagents	Chemical and pharmaceutical (in large quantities)	The same pharmaceuticals and chemicals that are only hazardous in small quantities may be highly hazardous in large quantities
		Heavy metal	*Examples*: Some rechargeable batteries, mercury from broken thermometers or blood-pressure gauges, some medical equipment batteries
Pharmaceutical (small quantities)	Waste containing pharmaceuticals *Examples*: bottles/boxes of expired or unwanted medications	Genotoxic	Wastes containing substances which can cause mutations, birth defects and cancer. Facilities with laboratory facilities might stock some genotoxic chemicals *Examples*: chemotherapy drugs
Pressurized containers	Gas cylinders, gas cartridges, aerosol cans	Radioactive	Waste containing radioactive substances *Examples*: Some laboratory wastes, wastes associated with radiation therapy. Not likely to be used by small-scale healthcare facilities.

Major Threats From Improper Waste Handling

- Disease transmission, through infectious waste, sharps, and contaminated water.
- Chemical and toxic threats, through chemical and pharmaceutical exposure.

Disease transmission. Transmission of disease through infectious waste is the greatest and most immediate threat from healthcare waste. If waste is not treated in a way that destroys the pathogenic organisms, dangerous quantities of microscopic disease-causing agents—viruses, bacteria, parasites or fungi—will be present in the waste. These agents can enter the body through punctures and other breaks in the skin, mucous membranes in the mouth, by being inhaled into the lungs, being swallowed, or being transmitted by a vector organism.

People who come in direct contact with the waste are at greatest risk. Examples include healthcare workers, cleaning staff, patients, visitors, waste collectors, disposal site staff, waste pickers, drug addicts and those who knowingly or unknowingly use "recycled" contaminated syringes and needles.

Although sharps pose an inherent physical hazard of cuts and punctures, the much greater threat comes from sharps that are also infectious waste. Again, healthcare workers, waste handlers, waste-pickers, drug addicts and others who handle sharps can, and have, become infected with HIV/AIDS and hepatitis B and C viruses through pricks or reuse of syringes/needles. These infections may be fatal.

Contamination of water supply from untreated healthcare waste can also have devastating effects. If infectious stools or bodily fluids are not treated before being disposed of, they can create and extend epidemics, since sewage treatment in Africa is almost nonexistent. For example, the absence of proper sterilization procedures is believed to have increased the severity and size of cholera epidemics in Africa during the last decade.

This pit contains sharps and some bloody cotton swabs. It will fill with water when it rains, and the waste material may attract various disease vectors, including flies, birds and rodents.

Chemical and toxic threats. Chemical and pharmaceutical wastes, especially large quantities, can be health and environmental threats. Since hazardous chemical wastes may be toxic, corrosive, flammable, reactive, and/or explosive, they can poison, burn or damage the skin and flesh of people who touch, inhale or are in close proximity to them. If burned, they may explode or produce toxic fumes. Some pharmaceuticals are toxic as well.

When chemical and pharmaceutical waste is disposed of in unlined landfills, especially unlined pits, these wastes may contaminate ground and surface water—particularly when large quantities are disposed of.

This can threaten people who use the water for drinking, bathing and cooking, and damaging plants and animals in the local ecosystem.

Burning or incinerating healthcare waste, while often a better option than disposal in an unlined pit, may create additional problems. Burning or incineration of healthcare waste may produce toxic air pollutants such as acid gasses, Nitrogen Oxides (NO_x), particulates, dioxins and heavy metals and distribute them over a wide area. Dioxins and heavy metals are of particular concern. Dioxins believed to be potent cancer-causing agents, do not biodegrade, and accumulate in progressively higher concentrations as they move up the food chain. Heavy metals such as mercury and cadmium are toxic and/or cause birth defects in small quantities and can also concentrate in the food chain.

Finally, disposable pressurized containers pose another hazard for incineration, as they can explode if burned.

In short, disposal of large quantities of hazardous chemicals and pharmaceuticals is a serious problem. In most of Africa, no methods are available to small-scale facilities that are safe and affordable.

Environmental Mitigation and Monitoring Issues

This guideline recommends that designers and managers of small-scale healthcare facilities take an incremental approach to improving waste management practices. The first priority are actions and procedures that will reduce risk the most at the least cost. The ultimate goal is to develop a complete, if minimal, program.

The two subsections that follow outline the minimum elements of a complete healthcare waste management program for a small-scale facility. They indicate:

- which elements will result in the most significant improvements at least cost—and should therefore be introduced first; and
- what questions to ask when developing a healthcare waste management program for a small-scale facility.

Two tables are also included that should be useful to planners and managers. Table 3.2 covers treatment and disposal options appropriate for small-scale healthcare activities; table 3.3 covers best management options by waste category. These do not cover every option, but highlight those that are realistic for small facilities.

The solution:

An incremental approach

Since money for healthcare waste management is scarce, the first priority is actions and procedures that reduce risk the most at the least cost.

Another health post waste disposal site in a village near Segou, Mali. What might be the cumulative effects over time of leaving this pit uncovered?

Table 3.2: Treatment and disposal options appropriate for small-scale healthcare facilities

Treatment/ disposal method	Description	Effective for	Advantages	Disadvantages
Double-chamber ("pyrolitic") incineration	A permanent furnace of masonry/concrete, refractory materials, and metal. Waste thermally decomposes in the first, oxygen-poor (pyrolitic) chamber, which operates at 800–900°C. The second, post-combustion chamber, burns the gases produced in the first chamber at 900–1200°C.	Infectious & highly infectious wastes* Pathological wastes, Sharps Most chem. And pharm waste. (should be 5% or less of total burn load)	Disinfects very effectively Fewer toxic emissions, odor and smoke than single-chamber and drum incinerators (but still should not be used to incinerate PVC) Reduces waste volume by ~95%	Effective performance requires qualified operators and regular maintenance. Sharps in ashes will still pose physical hazard. Higher costs than other incineration, burning and burial options in this table. *However, the "De Montfort" series of low-cost pyrolitic incinerators have now been extensively field-tested. Materials costs are less than $1000 and expected lifetime is 3-5 yrs before major maintenance. See resources section.*
Single-chamber incineration	A permanent simple furnace of solid construction, e.g., concrete. Waste is placed on a fixed grate. Burning is maintained by the natural flow of air. Operating temperature reaches <300°C. May need to add kerosene or similar fuel to maintain combustion. Pictured in Prüss et al. 1999, chapter 8, figures 8.3 and 8.4.	Infectious waste* Sharps waste Pathological waste	Disinfects effectively. Reduces waste volume by ~80%; burning efficiency of 90–95%. Low investment and operating costs.	Emits pollutants such as fly ash, acid gases, and some toxins. May produce odors. Should not be used to incinerate PVC plastics. (Avoiding PVCs will prevent the worst toxin & odor problems.) Sharps in ashes will still pose physical hazard. Not good for most pharmaceutical or chemical waste.
Drum or brick incinerator	A simple furnace with less mass and insulating value than a single chamber incinerator. Constructed out of an empty oil drum or a short chimney of bricks placed over a metal grate and covered with a fine screen. Operating temperature < 200°C. May need to add kerosene or similar fuel to maintain combustion. Pictured in Prüss et al. 1999, chapter 8, figures 8.5 and 8.6.	Infectious waste* Sharps waste Pathological waste	Disinfects reasonably well, destroying 99% of microorganisms. 80–90% burning efficiency.	Emits black smoke, fly ash, acid gases, and some toxins. May produce odors Should not be used to incinerate PVC plastics. (Avoiding PVCs will prevent the worst toxin & odor problems.) Sharps in ashes will still pose physical hazard. Not good for most pharmaceutical or chemical waste.
Open-air burning	Burning of wastes in or next to pit where they will be buried. May need to add kerosene or similar fuel to maintain combustion. Not recommended as a permanent solution, but better than burying untreated on site.	Infectious waste* Sharps waste	Similar to drum or brick incinerator.	Burning may be incomplete and residues still infectious. More hazardous to staff involved. Greater risk of scavenging by waste-pickers or of transfer of pathogens by vectors including insects, animals or birds. Not effective for pathological waste. Even if disinfected, sharps in ashes will still pose physical hazard. Not good for most pharmaceutical or chemical waste.
Autoclaving	Steam treatment of waste at high temperature and pressure for a sufficient amount of time for sterilization. Usually used for	Highly infectious wastes*	Efficient at disinfecting. Has no significant environmental	Requires qualified operators. Cannot be used on pathological, pharmaceutical, and chemical waste. Autoclaves designed to sterilize

Treatment/ disposal method	Description	Effective for	Advantages	Disadvantages
	sterilizing reusable medical equipment. Steam must be able to penetrate the waste.		adverse impacts. Relatively low investment and operating costs.	equipment have a limited capacity.
Encapsula-tion	Containers are filled three-quarters full with hazardous waste. Material such as cement mortar, clay, bituminous sand, or plastic foam is used to fill the container. When capping material is dry the container is buried or landfilled.	Sharps waste Small amounts of chem. and pharm. waste	Simple and safe. Low cost.	Not effective for non-sharps infectious waste.
Safe burying	Burial of waste in a pit on site. Access to site should be limited. Pit lined with clay, if available. To extend useful life of pit, should be used only for hazardous waste Less than 1 kg buried at one time. Each layer of waste is covered with a layer of earth. Illustrated in Prüss et al. 1999, ch, 8, fig.8.12.	Infectious waste Sharps waste Small amounts of chem. and pharm. waste	Provides some measure of human health and environmental protection by making waste inaccessible. Organic materials will eventually biodegrade.	Soil can become polluted if permeable. Difficult to prevent scavenging.
* however, infectious and highly infectious *liquid* waste should be disinfected with bleach, lime oxide, or other disinfectant. See table 3.3.				
In all cases where waste is treated, the treated waste should be buried using safe burial methods or disposal in a sanitary landfill.				

The methods below are included for completeness. However, they are not available to most small-scale facilities in Africa:

Wet Thermal Treatment	Similar to autoclaving. Waste is shredded and exposed to high-pressure, high-temperature steam.	Infectious wastes	Efficient at disinfecting. Has no significant environmental adverse impacts. High capacity. Relatively low investment and operating costs.	Shedder liable to mechanical failure. May require off-site transport. Cannot be used on pathological, pharmaceutical, and chemical waste. Requires qualified operators.
Microwave irradiation	Waste is shredded, humidified and irradiated with microwaves. Heat destroys micro-organisms.	Infectious wastes	Efficient disinfection. Environmentally sound. Shredding reduces waste volume.	Relatively high capital and operating costs. Shedder liable to mechanical failure. May require off-site transport. Cannot be used on pathological, pharmaceutical, and chemical waste. Requires qualified operators.
Sanitary Landfill	Waste is packaged to minimize exposure and placed in a shallow hollow dug below the working face. Waste is then immediately covered with 2 m of mature waste. Alternatively, packaged waste is placed in a 2 m-deep pit in mature waste and covered immediately. Waste-picking must be prevented.	Infectious waste Sharps waste Small amount of chem. and pharm. waste	Low-cost option. Organic materials may eventually biodegrade.	Requires access to sanitary landfill. Transportation to site creates many opportunities for exposure. Improper handling of leachate (liquid that filters through the waste) can cause water pollution and potential public health risks. May be difficult to prevent scavenging.
In all cases where waste is treated, the treated waste should be buried using safe burial methods or disposal in a sanitary landfill.				

Table 3.3 : Best management options by waste category for small-scale activities

Type of waste	Management Options	Comments
Solid infectious waste	Autoclave, incinerate/burn, or bury	Autoclaving is ineffective for pathological waste such as body parts.
Stools from patients with cholera or other forms of diarrhea	Isolate patients if possible and capture stool/excreta in a bucket. Disinfect this excreta by adding chlorine oxide powder, dehydrated lime oxide (CaO), bleach (sodium hypochlorite) or other disinfectant. In case of epidemic, disinfect all hospital sewage. Pour treated stools into a pit where they will be filtered by the soil, but will not contaminate drinking water.	
Blood and other infectious bodily fluids	Disinfect by adding chlorine oxide powder, dehydrated lime oxide (CaO), bleach (sodium hypochlorite) or other disinfectant. Pour treated fluids into a pit where they will be filtered by the soil, but will not contaminate drinking water.	
Sharps	Separate from other waste. Immediately after use put in plastic, metal, or cardboard container that will keep liquid from leaking; cardboard containers should be lined with plastic bags. If possible, containers should be colored yellow and marked "SHARPS," "Infectious waste," "Dangerous," or something similar, in all relevant languages. Incinerate or encapsulate the sharps when containers reach ¾ full. If container is to be reused, sterilize with bleach or other disinfectant.	
Pharmaceutical waste, small quantities	Water-soluble, mild liquid-form pharmaceuticals, such as vitamin solutions; cough syrups; intravenous solutions of salts, amino acids, lipids, glucose; eye drops, etc., may be diluted with large amounts of water and discharged to fast-flowing watercourses ONLY. Neither antineoplastic* (cytoxic/ anti-cancer) drugs nor antibiotics should ever be discharged to water courses. Equivalent materials in solid or semi-solid form, (e.g. vitamins) can be removed from packaging and buried safely on site or disposed to latrine or seepage pit. Where fast-flowing water is not available and for other pharmaceuiticals:. • **Incinerate**. Small quantities of pharmaceutical waste can be collected with and incinerated together with solid infectious waste Important notes: Double-chambered incinerators operating in excess of 800C are strongly preferable, though the reality is that many facilities will have only single-chamber incinerators available. Open (pit) burning of pharmaceuticals is not acceptable. Do not incinerate ampoules as these can explode. Either encapsulate or crush-and-bury. Do not incinerate PVC packaging. Antineoplastic* (cytoxic/ anti-cancer) drugs cannot be incinerated safely except at very high (at least 1200C) temperatures • **Encapsulate.** Pharmaceuticals and sharps may be encapsulated together.	For more information see: *Guidelines for safe disposal of unwanted pharmaceuticals in and after emergencies*. World Health Organization, Geneva, 1999, Chapter 4. http://whqlibdoc.who.int/hq/1999/WHO_EDM_PAR_99.2.pdf *Safe Management of Wastes from Health-Care Activities*. Wold Health Organization, Geneva: 1999. http://www.healthcarewaste.org/en/documents.html?id=1.

Type of waste	Management Options	Comments
Pharmaceutical waste, small quantities (cont'd)	If incineration or encapsulation is not feasible, remove outer (but not inner) packaging and dispose of via safe burial on-site. However, this is NOT acceptable for antineoplastic* (cytoxic/anti-cancer) drugs or narcotics. See WHO's *Guidelines for Safe Disposal of Unwanted Pharmaceuticals in and After Emergencies* p 24. **Most small health facilities will not use antineoplastic drugs. However, if view of the special handling they require, they are noted here for completeness.*	
Pharmaceutical waste, large quantities	Water-soluble, mild liquid-form pharmaceuticals, such as vitamin solutions, cough syrups, intravenous solutions, eye drops, etc., may be diluted with large amounts of water and discharged to fast-flowing watercourses ONLY. This is NOT acceptable for antibiotics or antineoplastic (anti-cancer) drugs. Equivalent materials in solid or semi-solid form, (e.g. vitamins) can be removed from packaging and landfillled, *if* scavenging can be prevented. Where fast-flowing water is not available and for other pharmaceuiticals, in order of preference: • Return to supplier. • Arrange for very high temperature incineration (>1200C) (A cement kiln may also be used for this purpose, at not more than 5% total fuel volume.). Note that destruction of antineoplastics requires incineration temperatures of at least 1200C; cement kilns usually satisfy this condition. (Other options are available for some classes of pharmaceuticals.) . *If no other option is available*, waste can be encapsulated. Note that special procedures apply for encapsulating antineoplastics.	See resources immediately above. Acceptable options are neither cheap nor easy and are not likely to be readily available to small-scale facilities, i It is therefore critical to minimize the amount of pharmaceutical waste generated.
Chemical waste, small quantities.	In general, bury. If collected together with infectious waste, small quantities of chemical waste can be treated as infectious waste (i.e., follow the same procedures of incineration/burning and safe burial).	
Chemical waste, large quantities	Return to supplier. Subcontract for incineration in a double-chamber incinerator that operates at >900°C, if available. Export to a location with adequate facilities for safe disposal. Other options are available for some subcategories.	Acceptable options are neither cheap nor easy and are not likely to be readily available to small-scale facilities, i.e., there is no safe way to dispose of these materials. It is therefore critical to minimize the amount of chemical waste generated.
PVC plastic and other halogenated materials	Bury.	DO NOT BURN. Doing so will create highly toxic pollutants and spread them over a wide area.
Materials containing heavy metals	E.g., broken thermometers, manometers, rechargeable batteries. Capture mercury and reuse or recycle via local cottage industry, if available. Batteries may also be locally recyclable via cottage industry.	DO NOT BURN. Doing so will spread highly toxic pollutants over a wide area.
Pressurized containers	Return undamaged containers to supplier. Empty damaged containers completely and recycle via local cottage industries. Small cans can be buried with ash, residues and other waste on site.	Do not burn/incinerate because of high risk of explosion.

Type of waste	Management Options	Comments
Wash-water and sewage	Treat using best available treatment system (see *Water Supply and Sanitation* guideline in this volume for more information). If sewage will not be treated, disinfect wash water by adding chlorine oxide powder, dehydrated lime oxide (CaO), bleach (sodium hypochlorite) or other disinfectant. Pour treated liquid in a pit where it will be filtered by the soil, but will not contaminate drinking water.	
Incinerator ash/ residues from burning	Bury in pit on site.	
In all cases where waste is treated, the treated waste should be buried using safe burial methods or disposal in a sanitary landfill.		

Minimum elements of a complete waste management program

Minimum Program Elements

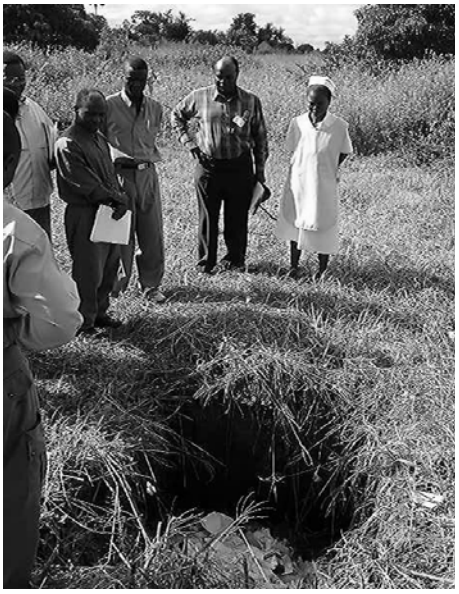
1. Written plan
2. Clear responsibilities
3. Written, internal rules
4. Staff training
5. Protective clothing
6. Good hygiene practices
7. Vaccinated workers
8. Designated storage locations
9. Waste minimization
10. Waste segregation
11. Waste Treatment
12. Final disposal site
13. Periodic reviews

Small-scale facilities require a sound healthcare waste management system to minimize damage to health and the environment caused by their wastes. A comprehensive minimal program includes the following practices:

1. *A written waste management plan*. The plan describes all the practices for handling, storing, treating, and disposing of hazardous and non-hazardous waste, as well as types of worker training required. Usually drawn up after doing a comprehensive assessment of waste handling at the facility.
2. *Clearly assigned staff responsibilities.* Make responsibilities clear so that workers feel accountable for how well tasks are completed and so that no step in the process is overlooked.
3. *Written internal rules for generation, handling, storage, treatment, and disposal.* Formalize desired practices, as written rules may be better maintained.
4. *Staff trained in safe handling, storage, treatment, and disposal.* Training is necessary to ensure that staff are aware of all hazards they might meet and that they are practicing good hygiene, safe sharps handling, proper use of protective clothing, proper packaging and labeling of waste, and safe storage of waste. Training helps ensure correct response to spills, injury, and exposure. Untrained workers handle wastes in ways that endanger themselves and the local community.
5. *Protective clothing available.* Workers need specific types of clothing, such as surgical masks and gloves, aprons, and boots, to protect themselves when moving and treating various types of collected infectious waste.
6. *Good hygiene practices.* Many infectious agents must enter the mouth or be swallowed to cause disease. Even if protective

clothing is worn, some organisms will get on workers' hands and faces. Thus, workers need to wash their hands and faces regularly with soap and warm water. They get sick more often when they do not observe good hygiene practices.

7. *Vaccinated workers.* Workers should be vaccinated against potentially deadly viral hepatitis B and tetanus infections.
8. *Temporary storage containers in designated locations.* Hazardous healthcare wastes should be stored only for short periods—less than 24 hrs in the warm season in warm climates. Also, they should be put in a labeled, covered container in a fixed location—for example, a specific corner of the room. They should not be stored near patients or food.
9. *Minimization, reuse, and recycling procedures.* The less waste generated, the less there is to manage. Unnecessary disposal of valuable chemicals and pharmaceuticals can be avoided through good inventory practices: for example, by using the oldest batch first; by never opening a new container before the last one is finished; by preventing products from being thrown out during routine cleaning; and by checking on delivery to make sure materials are not about to expire. Where possible and safe, using reusable syringes and needles generates approximately 0.5–2% of the waste of using disposables, and costs 5 to 15 times less. Minimize use of products containing PVC plastics. Competitively priced substitutes for PVC plastic are available that perform equally well.



Identifying and training responsible staff is a first step in the effective management of healthcare wastes.

10. *A waste segregation system.* Segregating (sorting and separating) waste both reduces the volume of waste and enables different kinds of materials to be handled appropriately. Approximately two-thirds of waste from small-scale facilities is general waste. Separating hazardous from general waste reduces the amount that must be treated by 75–90%. The dangers of sharp waste can be minimized when sharps are collected in separate puncture-proof containers. Other elements that can be segregated for separate handling, treatment, and/or disposal include hazardous liquids, chemicals and pharmaceuticals, PVC plastic, and materials containing heavy metals.
11. *Treatment methods for hazardous and highly hazardous waste.* Treatment options available to small-scale facilities for hazardous

and highly hazardous waste are limited (see table 3.2 for details). **The most important function of treatment is disinfection.** It is the high concentration of infectious agents that makes infectious waste dangerous. Risks associated with current methods for managing healthcare waste exist because little is being done to reduce these concentrations prior to disposal. For rural facilities, burning in the open air in a drum or brick incinerator, or a single-chamber incinerator, preferably combined with good waste segregation practices, is the recommended option.

Because the air pollution produced by burning poses a much greater hazard in urban areas, autoclaving of infectious waste combined with encapsulation of sharps may be the best option for urban facilities. If a larger nearby hospital with more advanced treatment and disposal systems is located nearby, small facilities could investigate piggy-backing on those systems, although precautions will need to be taken to reduce risks associated with transporting the waste.

12. *A final disposal site.* Facilities must have a place to dispose of waste that cannot be treated, and the residues from treated waste. **It is recom-mended that small-scale facilities bury waste on site,** ideally in a pit lined with clay or a similarly impermeable material to prevent contamination of ground water. Most urban facilities lack adequate space for on-site burial, and disposal in a public landfill may be the only option. However, many precautions must be taken under this option, to protect handlers and waste-pickers from infection. Sharps should be encapsulated to prevent accidental sticks and recovery for intentional reuse.
13. *A schedule for periodic review of adherence to the plan and effectiveness of the plan.* Maintaining good waste management practices is a process of continuous improvement. A program schedule must be established for regular follow-up to ensure planned practices are in place, are being carried out correctly, and are actually minimizing risk, damage and disease.

First steps

Key Practices:

The four best steps to take at the beginning of a waste management program:

- Burn/incinerate waste on site
- Segregate waste
- Motivate staff to follow practices
- Give minimal waste-handling training to staff

A facility does not need to do everything at once. Implementing just a few key practices can dramatically reduce risk and improve the health and safety of facility personnel, patients, and the surrounding community. **IF A FACILITY DOES NOTHING ELSE, AT A MINIMUM IT SHOULD TAKE THE FOLLOWING FOUR STEPS**:

1. *Burn or incinerate the healthcare waste on site* (rural facilities). Ideally, burning should be conducted in a single-chamber incinerator. Second in desirability is burning in a drum or brick incinerator. If no other option is available, burning may be conducted in open pits. (See table 3.2 for a description of the various treatment options) Alternatively, bury in small pits (e.g., 2 meters in depth and 2 meters on each side), but above the water table or lined with clay or plastic, and protected by a fence or other effective barrier (e.g., rows of thorny brush).

Autoclave infectious waste and encapsulate sharps (urban and peri-urban facilities) and bury on site or

2. *Segregate the waste*. Begin with sharps. Separate hazardous and general waste, if possible.
3. *Motivate managers and other staff to follow new practices.*
4. *Give workers minimal training in how to safely handle hazardous waste, including:*

- personal hygiene—make soap and water readily available.
- sharps handling, especially how to avoid being pricked with hypodermic needles that could transmit HIV/AIDS, viral Hepatitis B or C, or other blood-borne diseases.
- use of protective clothing—provide thick gloves and aprons for staff handling healthcare waste.

Starting with these four steps is probably the best way for facilities with limited resources to begin working towards a complete minimal healthcare waste management program.

An outline of such an approach can be found in *Safe Management of Healthcare Waste at Health Posts and other Small-Scale Facilities* in Annex___. This guide is designed as a supplement to *Safe management of wastes from health-care activities*, edited by A. Prüss, E. Giroult and P. Rushbrook (see reference list). Available at http://www.who.int/water_sanitation_health/Environmental_sani/MHCWHanbook.htm.

Note on facility siting and design:

To minimize the potential spread of disease and environmental impact when planning a new facility, healthcare planners should:

1. Select a location with easy access to safe drinking water. The drinking water source should be dedicated exclusively to the facility, if possible, to reduce the risk of spreading disease.
2. Install adequate sanitation facilities to prevent the spread of disease from infected patients.
3. Avoid locations adjacent to schools to minimize children's risk of exposure.
4. Pick a location where waste can be safely buried (e.g., above the water table and protected from scavenging) or easily shipped off site off safe disposal in a sanitary landfill.

Sector Program Design—Questions to help guide development of a healthcare waste management program

The following is a list of questions to help guide development of a healthcare waste management program:

Steps to designing a healthcare waste management program.

- Collect general facility information
- Plan how the facility will handle the waste it generates
- Plan how waste will be treated and disposed through all steps in the process
- Clearly define management responsibility for waste handling

General facility information

1. How many employees will the facility/facilities have?
2. How many patients will the facility serve on a daily basis? How many beds will the facility have, and what is the expected bed occupancy rate?
3. How broad a range of health services will the facility conduct? Family planning or HIV testing services only? Mother and infant health support? General primary care? What kinds of resources will these services require: Distribution of pharmaceuticals? Laboratory facilities for testing? Food preparation? Bathing? Laundry?

Handling of healthcare waste

4. How much and what types of healthcare waste will be generated routinely, e.g., infectious sharps? What materials are used and stored that could at some point become waste, e.g., (expired) pharmaceuticals?
5. How much of this will be hazardous or highly hazardous waste?
6. How and where will the facility's healthcare waste be stored before collection and/or treatment?
7. How much segregation (separation) of waste is feasible? Sharps from other? Sharps and hazardous from general waste? Separate collection of sharps, hazardous and highly hazardous wastes?
8. What will happen to bath water? Water from laundry operations?
9. Where will patient urine and excreta be disposed of?

Treatment and disposal of healthcare waste

10. How will waste be treated? If it will be burned, how will the remaining ash and materials be handled and disposed of?
11. If waste is to be transported off site, how will this be done? How will the waste be packaged? What types of vehicles will be used to transport the waste? What precautions will be taken to protect handlers and bystanders?
12. Will any of the waste be taken to a dump or landfill site? If so, how will it be handled at this facility? Will it be buried immediately after arriving at the landfill/dump? Will it be burned on site? Is it likely to be left unattended at any time after being unloaded?

13. If there is open access to the landfill/dump, will waste-pickers, children, others be at risk?
14. Is there potential danger of well or ground water contamination from wastewater, or patient excreta or urine? How can these potential effects be mitigated?

Management issues

15. Who will be responsible for healthcare waste management at the healthcare facility?
16. What are the current operational standards for healthcare waste, and what are the applicable national, regional, and local policies?

Minimal Program Checklist and Action Plan

Small-scale facilities require a sound healthcare waste management system to minimize adverse health and environmental impacts caused by their wastes. The following elements of a complete minimal healthcare waste management program should be in place in all facilities. Adapted from "Healthcare waste: Generation, handling, treatment and disposal," in Environmental Guidelines for Small Scale Activities in Africa, 2nd Edition (Working Draft)*. Washington, D.C., USAID AFR/SD. 2002.*
http://www.encapafrica.org/EGSSAAsectionsfrom18Jun01draft/EGSSAA3-13medwastedraft.pdf

Elements/Actions	In Place?	By Whom	By When	Outcome Expected
Written Plans and Procedures				
1. A written waste management plan *Describing all the practices for handling, storing, treating, and disposing of hazardous and non-hazardous waste, as well as types of worker training required.*				
2. Internal rules for generation, handling, storage, treatment, and disposal of healthcare waste.				
3. Clearly assigned staff responsibilities that cover all steps in the waste management process.				
4. Staff waste handling training curricula or a list of topics covered.				
5. Waste minimization, reuse, and recycling procedures.				
Staff Training, Practices, and Protection				
6. Staff trained in safe handling, storage, treatment, and disposal. ▪ *Do staff exhibit good hygiene, safe sharps handling, proper use of protective clothing, proper* ▪ *packaging and labeling of waste, and safe storage of waste?* ▪ *Do staff know the correct responses for spills, injury, and exposure?*				
7. Protective clothing available for workers who move and treat collected infections waste *such as surgical masks and gloves, aprons, and boots.*				
Staff Training, Practices, and Protection cont'd.				
8. Good hygiene practices*. Are soap and, ideally, warm water readily available workers to use and can workers*				

Elements/Actions	In Place?	By Whom	By When	Outcome Expected
be observed regularly washing.				
9. Workers vaccinated *for against viral hepatitis B, tetanus infections, and other endemic infections for which vaccines are available.*				
Handling and Storage Practices				
10. Temporary storage containers and designated storage locations*.* 11. *Are there labeled, covered, leak-proof, puncture-resistant temporary storage containers for hazardous healthcare wastes?*				
12. Minimization, reuse, and recycling procedures*.* ▪ *Does the facility have good inventory practices for chemicals and pharmaceuticals, i.e.:* o *use the oldest batch first;* o *open new containers only after the last one is empty; procedures to prevent products from being thrown out during routine cleaning; and*				
13. A waste segregation system*.* ▪ *Is general waste separated from infectious/hazardous waste?* ▪ *Is sharp waste (needles, broken glass, etc.) collected in separate puncture-proof containers?* ▪ *Are other levels of segregation being applied e.g. hazardous liquids, chemicals and pharmaceuticals, PVC plastic, and materials containing heavy metals ((these are valuable, but less essential)?*				
Handling and Storage Practices cont'd.				
14. Temporary storage containers and designated storage locations*.* ▪ *Are there labeled, covered, leak-proof, puncture-resistant temporary storage containers for hazardous healthcare wastes?* ▪ *Is the location distant from patients or food?*				
Treatment Practices				
15. Frequent removal and treatment of waste ▪ *Are wastes collected daily?*				

Elements/Actions	In Place?	By Whom	By When	Outcome Expected
▪ *Are wastes treated with a frequency appropriate to the climate and season?* o *Warm season in warm climates* *within **24 hrs*** o *In the cool season in warm climates* *within **48 hrs*** o *In the warm season in temperate climates* *within **48 hrs*** o *In the cool season in temperate climates* *within **72 hrs***				
16. Treatment mechanisms for hazardous and highly hazardous waste. *(The most important function of treatment is disinfection).* ▪ *Are wastes being burned in the open air, in a drum or brick incinerator, or a single-chamber incinerator?* ▪ *If not are they being buried safely (in a pit with an impermeable plastic or clay lining)?* ▪ *Is the final disposal site (usually a pit) surrounded by fencing or other materials and in view of the facility to prevent accidental injury or scavenging of syringes and other medical supplies?* ▪ *If the waste is transported off-site, are precautions taken to ensure that it is transported and disposed of safely?*				

***For more detailed checklists and guidance consult**:* Safe management of wastes from health-care activities*, edited by A. Prüss, E. Giroult and P. Rushbrook. Geneva, WHO, 1999, 228 pages. Available at: http://www.who.int/water_sanitation_health/Environmental_sanit/MHCWHanbook.htm. English (French and Spanish in preparation).*

References and Useful Resources

- ***Safe management of wastes from health-care activities,*** edited by A. Prüss, E. Giroult and P. Rushbrook. Geneva, WHO, 1999, 228 pages. Available at: http://www.who.int/water_sanitation_health/Environmental_sanit/MHCWHanbook.htm. English (French and Spanish in preparation). Can be ordered from WHO, MDI, CH-1211 Geneva 27 (e-mail: publications@who.ch). Price: SwF 72, SwF 50.40 for developing countries.

  This comprehensive handbook recommends safe, efficient and sustainable methods for the handling, treatment and disposal of wastes from healthcare activities. It addresses a variety of technical options, as well as organizational and policy issues essential in managing healthcare wastes. The handbook is targeted at public health professionals, regulators, and hospital managers and administrators.

- ***Teacher's Guide – Management of wastes from health-care activities***, A. Prüss & W.K. Townend, World Health Organization, Geneva, 1998, 227 pages. Available at: http://www.who.int/environmental_information/Information_resources/worddocs/HCteachguid/health_care_wastes_teacher.htm . English (French and Spanish in preparation). Can be ordered from WHO, MDI, CH-1211 Geneva 27 (e-mail: publications@who.ch) Price: SwF 35.-, SwF 24.50 for developing countries.

  The Teacher's Guide accompanies the WHO handbook on management of wastes from healthcare activities described above. It provides teaching materials (ready-to-copy texts for overhead transparencies, lecture notes, handouts, exercises and course evaluation forms) and recommendations for a three-day training course. It is designed mainly for managers of healthcare establishments, public health professionals and policy-makers.

- ***Guidelines for safe disposal of unwanted pharmaceuticals in and after emergencies***. World Health Organization, Geneva, 1999, 31 pages. Available at: http://whqlibdoc.who.int/hq/1999/WHO_EDM_PAR_99.2.pdf. Can be ordered from WHO, MDI, CH-1211 Geneva 27 (e-mail: publications@who.ch). Price: CHF 8.-, CHF 5.60 for developing countries.

  Practical guidance on the disposal of drugs in difficult situations in or after emergencies, in relation to armed conflicts, natural disasters or others. In such situations, large quantities of unwanted drugs may accumulate due to difficulties, mismanagement of stocks and inappropriate donations. The guidance provided consists of relatively simple and low-cost measures and is addressed to local authorities, healthcare personnel or other professionals confronted with these kinds of problems.

- ***Management of Solid Health-Care Waste at Primary Health-Care Centres: A Decision-Making Guide.*** World Health Organization, Geneva, 2005, 57 pages. ISBN 92 4 159274 5. Available at: http://www.who.int/water_sanitation_health/medicalwaste/decisionmguide_rev_oct06.pdf

  Decision tree-based guidance for selecting the most appropriate for option safely managing solid waste generated at Primary Health-Care centres (PHCs) in developing countries. The approach takes into consideration the most relevant local conditions, the safety of workers and of the general public as well as of environmental criteria.

- ***Findings on an Assessment of Small-scale Incinerators for Health-care Waste.*** S. Batterman. WHO, Geneva, 2004, 77 pages. Available at: http://whqlibdoc.who.int/hq/2004/a85187.pdf. This report provides an analysis of low cost small-scale incinerators used to dispose of health-care waste in developing countries. The report includes a situation analysis, a "best practices" guide, a screening level health risk assessment for ingestion and inhalation exposure to dioxin-like compounds, and other information related to the operation and evaluation of the incineration option for health-care waste.

- **Resources for low-cost pyrolitic (double-chamber) incinerators.** A number of moderate to low-cost incinerator designs are available. Of these, DeMontfort incinerators are probably the most widely deployed and evaluated. Developed specifically as a technically effective, appropriate-technology, low cost option in the developing country context, they have been used and tested widely by a number of organizations including WHO, UNICEF and UNDP**.** They are preheated by burning paper, coconut husks or other biofuel, bringing temperature in the combustion chamber up to ~600C prior to the introduction of

infectious waste. Except for very wet loads, they do not require additional fuel (e.g. kerosene or diesel) to maintain combustion.

Managing Health Care Waste Disposal: Guidelines on How to Construct, Use, and Maintain a Waste Disposal Unit. WHO Africa /IT Power India, 2005, 93 pages. Available at http://www.healthcarewaste.org/documents/WDU_guidelines2_en.pdf. Provides specifications, including construction diagrams, installation, operation and maintenance instructions for a Waste Disposal Unit based on the "De Montfort" Mark 8 pyrolitic incinerator.

"De Montfort" medical waste incinerators website. Provide siting, technical specifications, and operations and m aintenace guidance for the "De Montfort" series of low-cost pyrolitic incinerators. (Estimated materials costs $250–$1000**).** www.mw-incinerator.info/en/101_welcome.html.

***Findings on an Assessment of Small-scale Incinerators for Health-care Waste*.** S. Batterman. WHO, Geneva, 2004 (see above), provides photo-illustrations of numerous operating and maintenance shortfalls with DeMontfort incinerators leading to poor performance. Annex B contains information on other small-scale incinerator makes.

- ***Vital to Health? Briefing Document for Senior Decision-Makers, 1998.*** World Health Organization/US Agency for International Development (USAID). Contact: WHO Headquarters, attention Mario Conde, CH 1211, Geneva 27, Switzerland. Tel 41-22-791-4374 or US Agency for International Development, Children's Vaccine Programme, Office of Health and Nutrition, 3.07-037 Ronald Reagan Building, Washington DC 20523. Tel 1-202-712-4808, Fax 1-202-216-3702.

  This document provides information on unsafe injections. It illustrates misuse of medical sharps, and circumstances that lead to misuse. The document provides detailed information about safety standards for disinfecting sharps and their disposal. It also addresses the choice of different kinds of injection equipment and the issue of waste management.

- ***Healthcare Waste Management Guidance Note.*** Johannessen**,** Lars M. et al., Waste Management HNP Anchor Team. The World Bank, 2000, 68 pages. Available at: http://wbln0018.worldbank.org/hdnet/hddocs.nsf/c0d65c5ea6fcb4688525670c004d14c2/0d87e869807f2f69852568d20054e66b.

  A working document that attempts to synthesize currently available knowledge and information in healthcare waste management. It is meant to complement WHO's guidelines and provide particular information necessary for World Bank projects. Gives attention to management and policy issues and technical background on particular issues in greater detail than the WHO guidelines.

- ***Managing medical wastes in developing countries: report of a Consultation on Medical Wastes Management in Developing Countries***, Geneva, September 1992. World Health Organization, Geneva, 1994. Available at: http://whqlibdoc.who.int/hq/1994/WHO_PEP_RUD_94.1.pdf. WHO/PEP/RUD/94.1. Unpublished document.

  This report is concerned with waste management practices in hospitals and other facilities which are associated with health care. It promotes procedures and facilities to reduce the risk of disease transmission and the occurrence of accidents associated with such wastes. The main focus is on countries in tropical areas and those which are seriously constrained by the lack of financial resources and trained manpower.

- **Safe Management of Healthcare Waste at Health Posts and other Small-Scale Facilities** (Draft). 2000. USAID AFR/SD and REDSO/ESA. Available at: http://www.encapafrica.org/resource_docs/USAID_Healthcare_Wastemanagement_Guide.pdf

  A quick but thorough introduction to healthcare waste hazards and practices to minimize those hazards. Designed to be used in conjunction with. *Safe management of wastes from health-care activities*, Prüss et al., 1999, World Health Organization. Emphasizes an incremental approach to healthcare waste management at small-scale facilities. Designed to address the practices most predominant in Africa.

- **Healthcare or Health Risks? Risks from Healthcare Waste to the Poor**, Jenny Appleton and Mansoor Ali, WELL, Loughborough University 2000

  Study considers relative risk of various potential adverse environmental impacts of healthcare waste and considers these in relation to people most likely to be exposed to risk focusing particularly on the poor. The report provides examples of good practice and suggests an overall strategy for healthcare waste management that stresses an incremental approach with attention to areas of highest risk.