USAID
FROM THE AMERICAN PEOPLE

SECTOR ENVIRONMENTAL GUIDELINES

HEALTHCARE WASTE

2014

This document was prepared by The Cadmus Group, Inc. under USAID's Global Environmental Management Support Program, Contract Number GS-10F-0105J. The contents are the sole responsibility of the authors and do not necessarily reflect the views of USAID or the United States Government.

Cover Photo: USAID/Honduras Health Service Improvement: A mother and child in a clinic in Taulabé, Honduras. For the past five years, USAID has helped local governments in Copán take over the management of area health care systems through a process called decentralization, which transfers health care management responsibilities and resources from the central government to the local government. The central government continues to finance health care services, while local governments implement and manage them.

Photographer: Hector Medrano

About this document and the *Sector Environmental Guidelines*

This document presents one sector of the *Sector Environmental Guidelines* prepared for USAID under the Agency's Global Environmental Management Support Project (GEMS). All sectors are accessible at www.usaidgems.org/bestPractice.htm.

Purpose. The purpose of this document and the *Sector Environmental Guidelines* overall is to support environmentally sound design and management (ESDM) of common USAID sectoral development activities by providing concise, plain-language information regarding:

- the typical, potential adverse impacts of activities in these sectors;
- how to prevent or otherwise mitigate these impacts, both in the form of general activity design guidance and specific design, construction and operating measures;
- how to minimize vulnerability of activities to climate change; and
- more detailed resources for further exploration of these issues.

Environmental Compliance Applications. USAID's mandatory life-of-project environmental procedures require that the potential adverse impacts of USAID-funded and managed activities be assessed prior to implementation via the Environmental Impact Assessment (EIA) process defined by 22 CFR 216 (Reg. 216). They also require that the environmental management/mitigation measures ("conditions") identified by this process be written into award documents, implemented over life of project, and monitored for compliance and sufficiency.

The procedures are USAID's principal mechanism to assure ESDM of USAID-funded Activities—and thus to protect environmental resources, ecosystems, and the health and livelihoods of beneficiaries and other groups. They strengthen development outcomes and help safeguard the good name and reputation of USAID.

The Sector Environmental Guidelines directly support environmental compliance by providing: information essential to assessing the potential impacts of activities, and to the identification and detailed design of appropriate mitigation and monitoring measures.

However, the Sector Environmental Guidelines *are **not** specific to USAID's environmental procedures. They are generally written, and are intended to support ESDM of these activities by all actors, regardless of the specific environmental requirements, regulations, or processes that apply, if any.*

Region-Specific Guidelines Superseded. The *Sector Environmental Guidelines* replace the following region-specific guidance: (1) *Environmental Guidelines for Small Scale Activities in Africa* ; (2) *Environmental Guidelines for Development Activities in Latin America and the Caribbean*; and (3) Asia/Middle East: *Sectoral Environmental Guidelines.* With the exception of some more recent Africa sectors, all were developed over 1999–2004.

Development Process & Limitations. In developing this document, regional-specific content in these predecessor guidelines has been retained. Statistics have been updated, and references verified and some new references added. However, this document is not the result of a comprehensive technical update.

Further, *The Guidelines* are not a substitute for detailed sources of technical information or design manuals. Users are expected to refer to the accompanying list of references for additional information.

Comments and corrections. Each sector of these guidelines is a work in progress. Comments, corrections, and suggested additions are welcome. Email: gems@cadmusgroup.com.

Advisory. *The Guidelines are advisory only. They are not official USAID regulatory guidance or policy. Following the practices and approaches outlined in the Guidelines does not necessarily assure compliance with USAID Environmental Procedures or host country environmental requirements.*

CONTENTS

HEALTHCARE WASTE: GENERATION, HANDLING, TREATMENT, AND DISPOSAL

An emergency room hospital in Azerbaijan is renovated as part of an emergency medicine initiative. AFTER: The Government of Azerbaijan and local health professionals are excited about the renovated hospital, whose emergency rooms feature a brighter atmosphere and modern emergency equipment.

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 acess to such services. 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 developing countries. Training and infrastructure 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 some cities small hospitals may incinerate waste in dedicated on-site incinerators, but often 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.

More information about waste management (including waste management of asbestos or lead) for hospitals under construction or rehabilitation

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

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.

can be found in the *Construction Sector Environmental Guideline*. The importance of potable water and sanitation projects to improve public health is discussed in the *Water and Sanitation Sector Environmental Guideline*.

CLIMATE CHANGE

Many communities are stressed by changes in temperatures, rainfall patterns, and extreme weather events that may be further exacerbated by global climate change. It is becoming more difficult to predict future climate based on historical baseline conditions or trends. This uncertainty is increasing project design risks and community vulnerabilities. In response, project designers now also include a focus on climate change adaptation — defined as adjustment to natural or human systems in response to actual or expected climate change effects. Successful healthcare waste projects include efforts to moderate climate-related risks and vulnerabilities and to take advantage of potential benefits to improve the likelihood of long-term project success. This Guideline provides information on the relationship between climate change and healthcare waste management activities. At the same time, project design should assess the potential contribution of a proposed project to greenhouse gas emissions, and reduce contributions by selecting from cost-effective strategies and actions that minimize these emissions. Taken individually, impacts of small activities may appear minimal, but collectively, their scale and magnitude can have far reaching effects on human health and life-sustaining natural systems.

When making use of climate change scenarios, those involved in healthcare waste management projects need to take adequate account of the associated uncertainties around climate change and plan for robustness through adaptive management. Risk management frameworks can be used to understand the implications of uncertainties about climate change impacts when informing planning, investment and operation decisions.

POTENTIAL ENVIRONMENTAL IMPACTS OF DEVELOPMENT PROGRAMS IN THE SECTOR AND THEIR CAUSES

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

Types of Waste

- General waste
- Hazardous waste
- Highly hazardous waste

Types of waste

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 the 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 includes sharps, highly infectious non-sharp waste, stools from cholera patients, bodily fluids of patients with highly infectious diseases, large quantities of expired or unwanted pharmaceuticals and hazardous chemicals and radioactive wastes, genotoxic wastes (affecting genetic composition and multiple generations), or teratogenic wastes (affecting development of the exposed individual).

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

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; 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 infectious blood Examples: syringe needles, scalpels, knives, infusion sets, broken glass
Pathological	Tissue or body fluids from humans or animals Examples: blood, body parts, organs, 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 (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, and heavy metal (large quantities)	The same pharmaceuticals and chemicals that are only hazardous in small quantities may be highly hazardous in large quantities 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 or teratogenic	Wastes containing substances which can cause mutations, birth defects and cancer in the exposed individual or in genetic material affecting generation after generation. Facilities with laboratory facilities might stock some genotoxic or teratogenic chemicals Examples: chemotherapy drugs
Pressurized containers	Examples: Gas cylinders, gas cartridges, aerosol cans	Radioactive	Waste containing radioactive substances (not likely to be used by small-scale healthcare facilities) Examples: Some laboratory wastes, wastes associated with radiation therapy.

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 – healthcare workers, cleaning staff, patients, visitors, waste collectors, disposal site staff, waste-pickers, drug addicts, and those who recycle contaminated syringes – are at greatest risk.

Major threats from improper waste handling

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

Although sharps pose an inherent physical hazard of cuts and punctures, the much greater threat comes from syringes or needles used on infected patients, which can infect people with HIV/AIDS and the hepatitis B and C viruses through accidental pricks or reuse of syringes/needles. These infections may be fatal.

Contamination of water supply from untreated healthcare waste can also have devastating effects. Most sewage is not treated in developing countries. If untreated infectious stools or bodily fluids are flushed into the sewer system, they can create or extend epidemics. The absence of proper sterilization procedures may have increased the severity and size of cholera epidemics 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 a threat to the environment and human health. Since hazardous chemical wastes may be toxic, corrosive, flammable, reactive, and/or explosive, they can harm 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 or pits, the leachate may contaminate ground and surface water. Such contamination may threaten people who use the water for drinking, bathing and cooking, and damaging local plants and animals.

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 can concentrate in the food chain and/or cause birth defects, even in small quantities. Disposable pressurized containers pose another hazard for incineration, as they can explode if burned. Table 2 in the Environmental Mitigation and Monitoring Issues section below outlines effective treatment and disposal methods for chemical and toxic wastes.

CLIMATE CHANGE

PLANNING FOR A CHANGING CLIMATE

Healthcare waste management system design, construction and operation must take into account the frequency, intensity, and duration of extreme events, including droughts, floods, high winds, and tropical storms. For healthcare waste management programs or installations to last for decades or more, they need to be designed to withstand exposure to an altered climate and be resilient to deviations from historical conditions. Specifically those aspects of healthcare waste management design, construction and use sensitive to weather (e.g., location, vulerabilty to flooding or rising water tables, increased precipitation, and extreme rain and wind events) require greater attention to risk analysis and climate change probabilities than in the past, to help ensure that appropriate designs are selected and the long-term success of solid waste management programs are achieved.

Of particular concern in the healthcare waste sector are potential impacts on disposal sites as well as on management facilities and collection and transportation systems which need to be designed for exposure to an altered climate. Wastes must be treated with a frequency appropriate to the climate. As temperature increases, especially in regions of warm climate, wastes should be treated sooner (within 24 hours) than in cooler temperate climates.

In the context of EIA, mitigation is the implementation of measures designed to eliminate, reduce or offset the undesirable effects of a proposed action on the environment.

In the context of climate change, mitigation is an intervention to reduce the sources or enhance the sinks of greenhouse gases in order to limit the magnitude and/or rate of climate change.

ADAPTING TO CLIMATE CHANGE BY MINIMIZING VULNERABILITY THROUGH PROJECT DESIGN

Adapting healthcare waste management to climate change involves planning for the effects of extreme climate events on collection, transfer, processing, and disposal sites. Design and siting for structures near the sea should take into account potential changes in daily sea levels, sea rise, and storm surges. The same principle applies to construction near flood plains, rivers and wetlands. Designers and project managers now include a focus on incorporating information on climate from both past baseline trends, as well as near-term projections (e.g., next 25-50 years, where feasible). In many cases, managing for greater uncertainty and risk associated with potential extreme conditions, rather than past historical trends, emphasizes the **precautionary**

principle over "**business as usual**." This type of focus on risk analysis and management is commonly applied by the financial and insurance industries and can also be used in assessing proposed development activities.

Adapting planning, design, and project execution to climate change involves ensuring that new waste disposal structures are able to withstand variations in climatic conditions and especially extreme weather events. For example, design and siting for transfer stations and disposal facilities should take into account projected sea level rises, and storm surges. The same principle applies to facilities located in or near flood plains, rivers and wetlands. Constructing disposal facilities in these areas should be avoided whenever possible. Increases in wind and extreme wind events, flooding and fluctuating water table conditions associated with climate change must also be addressed to minimize potential contamination at disposal sites. Climate change adaptation also includes integrating renewable and/or back up energy systems to maintain collection and disposal in the event of sudden or intermittent flooding or fuel shortages.

From a **risk management** perspective, it is less costly to design for the potential direct and indirect impacts of climate change on healthcare waste management projects, than to risk failure of the waste management system. More importantly than the possible economic risk of a poorly designed waste disposal system, medical waste facilities that are susceptible to design failure and service interruptions caused by climate change related activity present an elevated risk of adverse human health consequences.

MINIMIZING GREEHOUSE GAS (GHG) EMISSIONS AND MAXIMIZING SEQUESTRATION

All waste management practices generate greenhouse gases directly (i.e. contribute emissions) and indirectly (i.e. through energy consumption). A holistic approach to waste management has potentially positive consequences for greenhouse gas emissions. While minor levels of emissions are released through treatment and disposal of healthcare wastes, the separation and recovery of non-hazardous paper and organic wastes e.g., to recycle paper and compost organics) reduces fossil fuel use and avoids emissions in other sectors of the economy.

ENVIRONMENTAL MITIGATION AND MONITORING ISSUES

The following questions and suggestions are intended to help project designers and managers identify factors and practices that may cause—or prevent—adverse environmental impacts. Bear in mind that the first priority of most livestock managers and farmers is household food security and family welfare. Sustainable practices must always be balanced against these immediate demands.

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?

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 chemical and pharmaceutical 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" style or series of low-cost pyrolitic incinerators have now been extensively field-tested. Materials costs are less than $1000 and expec-ted 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 (can be limited by not burning 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.

TREATMENT/ DISPOSAL METHOD*	DESCRIPTION	EFFECTIVE FOR	ADVANTAGES	DISADVANTAGES
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 (can be limited by not burning 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 health waste that is not burned thoroughly may still be 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 sterilizing reusable medical equipment. Steam must be able to penetrate the waste.	Highly infectious wastes**	• Efficient at disinfecting. • Has no significant environmental adverse impacts. • Relatively low investment and operating costs.	• Requires trained/qualified operators. • Cannot be used on pathological, pharmaceutical, and chemical waste. • Autoclaves designed to sterilize equipment have a limited capacity.

TREATMENT/ DISPOSAL METHOD*	DESCRIPTION	EFFECTIVE FOR	ADVANTAGES	DISADVANTAGES
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. (Pictured in Prüss et al. 1999, chapter 8, figure 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.
The methods below are included for completeness. However, they are unlikely to be available to most small-scale facilities in most developing countries:				
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 trained/qualified operators.

TREATMENT/ DISPOSAL METHOD*	DESCRIPTION	EFFECTIVE FOR	ADVANTAGES	DISADVANTAGES
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 trained/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 2m 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.
**Infectious and highly infectious *liquid* waste should be disinfected with bleach, lime oxide, or other disinfectant.

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 (Effective disposal methods for pathological waste are outlined in Table 2 above).
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. • Burn or encapsulate the sharps when containers reach ¾ full. • If container is to be reused, sterilize with bleach or other disinfectant.	

TYPE OF WASTE	MANAGEMENT OPTIONS*	COMMENTS
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. o Most small health facilities will not use antineoplastic drugs. However, if view of the special handling they require, they are noted here for completeness. • 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 pharmaceuticals: • 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. • 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.	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. World Health Organization, Geneva: 1999. http://www.healthcarewaste.org/en/documents.html?id=1.

TYPE OF WASTE	MANAGEMENT OPTIONS*	COMMENTS
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 pharmaceuticals, 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.	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 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.

TYPE OF WASTE	MANAGEMENT OPTIONS*	COMMENTS
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.
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

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

1. **A written waste management plan** should describe all of the practices for handling, storing, treating, and disposing of hazardous and non-hazardous waste, as well as types of worker training required. This plan is usually drawn up after doing a comprehensive assessment of waste handling at the facility.
2. **Staff responsibilities should be clearly assigned** to make workers feel accountable for how well tasks are completed and ensure that no step in the process is overlooked.
3. **Formalized rules for generation, handling, storage, treatment, and disposal must be maintained.**
4. **Training in safe handling, storage, treatment, and disposal** will ensure that staff are aware of all hazards they might encounter and that they are practicing good hygiene, safely handling sharps, properly using of protective clothing, and safely packaging, labeling, and sorting waste, and safe storage of waste. Training helps ensure correct response to spills and prevents staff, patients, and visitors from exposure and injury. Untrained workers handle wastes in ways that endanger themselves and the local community.
5. **Protective clothing** – surgical masks, gloves, aprons, and boots – should be readily available to protect workers when moving and treating various types of collected infectious waste.
6. **Good hygiene practices prevent worker sickness.** 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. Workers should 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. **Workers should be vaccinated** against potentially deadly viral hepatitis B and tetanus infections.

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

8. **Temporary storage containers in designated locations should be used** to store hazardous waste for short periods (only)—less than 24 hours in warm climates. Also, hazardous wastes should be put in a labeled, covered container in a fixed location away from patients or food.

9. **Minimization, reuse, and recycling procedures** ensure that less waste generated so there is less waste to manage. Unnecessary disposal of valuable chemicals and pharmaceuticals can be avoided through good inventory practices – using the oldest batch first, never opening a new container before the last one is finished, preventing products from being thrown out during routine cleaning, and checking on delivery to make sure materials are not about to expire. Where possible and safe, use reusable syringes and needles. This generates less waste (approximately 0.5–2% of 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** (sorting and separating) 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 waste from general waste reduces the amount that must be treated by 75–90%. The dangers of sharps 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, pharmaceuticals, PVC plastic, and materials containing heavy metals.

11. **Treatments for hazardous and highly hazardous waste** available to small-scale facilities are limited (see table 3.2 for details). High concentrations of infectious agents make these wastes dangerous, and the risks associated with current methods for managing healthcare waste exist because little is done to reduce concentrations before disposal. **The most important function of treatment is disinfection.** For rural facilities, burning in the open air in single-chamber incinerator, drum, or brick 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 must be available** where residues from treated waste and waste that cannot be treated can be disposed of properly. **Small-scale facilities should 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. Precautions must be taken when disposing waste in a public landfill 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** 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. Maintenance of good waste management practices is a process of continuous improvement.

For additional information on designing and operating waste management programs, please refer to the Environmental Mitigation and Monitoring Guidelines section of the *Solid Waste Sector Environmental Guideline*.

This incinerator was installed in Malawi. Harmful medical waste is now incinerated thoroughly, reducing air pollution and preventing partially burnt materials such as needles and other hazardous waste from making their way to nearby areas where children play.

FIRST STEPS

A healthcare 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:

A healthcare facility does not need to do everything at once. Implementing just a few key practices can dramatically reduce risk and improve health and safety.

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 dispose of in a sanitary landfill.
2. Segregate the waste. Begin with sharps. If possible, separate hazardous and general waste.
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—ensure that soap and water are 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.
   - Protective clothing—provide thick gloves and aprons for staff handling healthcare waste.

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

These four steps are the best way for facilities with limited resources to begin working towards a complete minimal healthcare waste management program.

This approach is further elaborated in *Safe management of wastes from health-care activities*, edited by A. Prüss, E. Giroult and P. Rushbrook (see reference list). Available at: http://whqlibdoc.who.int/publications/9241545259.pdf.

Last, when planning a new facility, to minimize the potential spread of disease and environmental impact 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

- How many employees will the facility/facilities have?
- 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?
- 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

- 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?
- How much of this will be hazardous or highly hazardous waste?
- How and where will the facility's healthcare waste be stored before collection and/or treatment?
- 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?
- What will happen to bath water? Water from laundry operations?
- Where will patient urine and excreta be disposed of?

TREATMENT AND DISPOSAL OF HEALTHCARE WASTE

- How will waste be treated? If it will be burned, how will the remaining ash and materials be handled and disposed of?
- 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?
- 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?
- If there is open access to the landfill/dump, will waste-pickers, children, others be at risk?
- 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

- Who will be responsible for healthcare waste management at the healthcare facility?
- 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.

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.*				

ELEMENTS/ACTIONS	IN PLACE?	BY WHOM	BY WHEN	OUTCOME EXPECTED
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.*				
8. *Good hygiene practices. Are soap and, ideally, warm water readily available workers to use and can workers 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.* • Are there labeled, covered, leak-proof, puncture-resistant temporary storage containers for hazardous healthcare wastes?				

ELEMENTS/ACTIONS	IN PLACE?	BY WHOM	BY WHEN	OUTCOME EXPECTED
11. Minimization, reuse, and recycling procedures. • Does the facility have good inventory practices for chemicals and pharmaceuticals, i.e.: o Is the oldest batch used first? o Are new containers opened only after the last one is empty? o Are there procedures in place to prevent products from being thrown out during routine cleaning?				
12. 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)?				
13. 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?				

ELEMENTS/ACTIONS	IN PLACE?	BY WHOM	BY WHEN	OUTCOME EXPECTED
TREATMENT PRACTICES				
14. Frequent removal and treatment of waste • Are wastes collected daily? • Are wastes treated with a frequency appropriate to the climate and season? o Warm season in warm climates within **24 hrs** o Cool season in warm climates within **48 hrs** o Warm season in temperate climates within **48 hrs** o Cool season in temperate climates within **72 hrs**				
15. *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://whqlibdoc.who.int/publications/9241545259.pdf (French and Spanish in preparation).

RESOURCES AND REFERENCES

REFERENCES

- *Medical Waste: Storage, Transport and Disposal.* U.S. Environmental Protection Agency Guidelines. Re-issued September 2003. Available at: http://www.epa.sa.gov.au/xstd_files/Waste/Guideline/guide_medical.pdf

  This guideline defines medical waste and provides an overview of environmental protection legislation (Schedule 1, Part B of the *Environmental Protection Act 1993).* It also discusses requirements for storing, collecting, and transporting medical waste.

- *The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal: Protocol on Liability and Compensation for Damage Resulting from Transboundary Movements of Hazardous Wastes and their Disposal. 1992.* Available at: http://www.basel.int/Portals/4/Basel%20Convention/docs/text/BaselConventionText-e.pdf

  The goal of this international environmental agreement is to "protect human health and the environment against the adverse effects of hazardous wastes." As of March 2013, 180 countries have ratified the agreement. *Annex 1: Categories of Wastes to Be Controlled* includes medical and pharmaceutical wastes.

- *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://whqlibdoc.who.int/publications/9241545259.pdf. 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/injection_safety/toolbox/docs/en/Teachersguide.pdf. 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

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.path.org/publications/files/TS_waste_disposal_guide.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). Available at: 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). Available at: http://www.who.int/immunization_safety/publications/waste_management/en/assessment_SSIs.pdf.

  This document 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. Available at: http://pdf.usaid.gov/pdf_docs/Pnacj763.pdf

  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://siteresources.worldbank.org/HEALTHNUTRITIONANDPOPULATION/Resources/281627-1095698140167/Johannssen-HealthCare-whole.pdf.

  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://apps.who.int/iris/bitstream/10665/63022/1/WHO_PEP_RUD_94.1.pdf?ua=1. 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.

  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 (http://whqlibdoc.who.int/publications/9241545259.pdf). 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. Available at: http://www.lboro.ac.uk/well/resources/well-studies/full-reports-pdf/task0326.pdf

  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.

DOCUMENTOS DISPONIBLES EN ESPAÑOL

- *Guías* sobre medio ambiente, salud y seguridad para instalaciones de atención sanitaria. Corporación Financiera Internacional. 30 Abril 2007. Available at: http://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/IFC+Sustainability/Sustainability+Framework/Environmental,+Health,+and+Safety+Guidelines/

- Manual de Gestión Integral de Residuos. República de Colombia Instituto Nacional de Salud. CODIGO: MNL-A05.002.0000-001 VERSIÓN 00. Gestión de Salud Ocupacional y Ambiental República de Colombia Instituto Nacional de Salud. 2010. Available at: http://www.ins.gov.co/lineas-de-accion/Red-Nacional-Laboratorios/Documentos%20de%20inters%20SRNL/PGIRH%20INS.pdf

- Gestión Integral residuos hospitalarios y similares en Colombia. Available at: http://www.slideshare.net/JoseG7/manual-residuos-hospitalarios

DOCUMENTS DISPONIBLES EN FRANÇAIS.

- Directives environnementales, sanitaires et sécuritaires pour les établissements de santé. La Société *financière internationale.* 30 Avril 2007. Available at: http://www1.ifc.org/wps/wcm/connect/5606648048855559b644f66a6515bb18/013_Health%2BCare%2BFacilities.pdf?MOD=AJPERES&CACHEID=5606648048855559b644f66a6515bb18

- Lignes directrices sur la gestion des déchets biomédicaux au Canada, CCME, 1992. Available at: http://www.ccme.ca/assets/pdf/pn_1061_fr.pdf

- Manuel de gestion des déchets médicaux. Comité international de la Croix-Rouge. Available at: http://www.icrc.org/fre/assets/files/publications/icrc-001-4032.pdf

- Gestion des déchets d'activité de soins. Pour réduire la charge de morbidité, la gestion des déchets d'activité de soins doit être rationnelle et recourir à d'autres techniques que l'incinération. Aide-mémoire N°281 Octobre 2011. Available at: http://www.who.int/mediacentre/factsheets/fs281/fr/index.html