I. WASTE CHARACTERIZATION

Documentation

In practice it is difficult to identify and segregate every article of medical waste from the solid waste stream. Therefore, most states list specific waste types in their definitions of medical waste rather than formulate a characteristic definition that would have to be applied on an item-by-item basis. In the same vein, these Guidelines list ten categories of waste for handling as medical waste. The rationale for selecting these categories is based on two characteristics that wastes must possess to come under the Guidelines: (1) the potential of the waste to transmit infection and (2) properties of toxicity and/or low level radioactivity.

Infectious Capability

The U.S. Environmental Protection Agency (EPA) defines *medical wastes* as any solid waste which is generated in the diagnosis, treatment (e.g., provision of medical services), or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biologicals (U.S. Environmental Protection Agency, March 24, 1989, pp.12373-12374). The EPA has restricted *infectious agent* to mean "any organism (such as a virus or a bacteria) that is capable of being communicated by invasion or multiplication in body tissues and capable of causing disease or adverse health impacts in humans" (American Veterinary Medical Association, 1989, p. 443). *Infectious waste* is waste that contains pathogens with sufficient virulence and quantity such that exposure to the wastes could result in infectious diseases.

However, currently there is no definitive, quantitative analysis that can be used to determine whether or not a waste is "infectious" (Minnesota, 1988, p. B.5). The characteristic of infectious *potential* is therefore based on principles of disease transmission.

The process of disease transmission can be conceptualized as a series of six links, with each link representing an essential step in the transfer of an infectious agent from one susceptible host to the next. If a break occurs in any of the links along the chain, the process of disease transmission is inhibited. The six links are as follows:

1. The presence of a sufficient quantity of an infectious agent.
2. The existence of a favorable environment ("reservoir") for survival of infectious agents.
3. A mode of escape for infectious agents.
4. An infectious mode of transmission.
5. An infectious route of entry.
6. A susceptible host.

The Agency for Toxic Substances and Disease Registry lists four main transmission modes of infection (U.S. Department of Health and Human Services, 1990, pp. 2.9-2.10):

1. "Direct transmission occurs when there is contact between an agent's source and a susceptible host. Direct transmission can occur through direct contact or droplet spray."
2. Airborne transmission occurs when "the etiologic agent is contained in or on relatively small particles that remain suspended in air for long periods of time. . . . Whatever the source, the aerosolized material must be produced and then propelled by an activity involving the release of comparatively high levels of energy."
3. "Vehicle-borne transmission occurs when an infectious agent is transported from its source to a susceptible host by contaminated materials or objects (indirect contact)."
4. Vector-borne transmission occurs "when a vector, most commonly an arthropod (insect), carries the agent on or in its body, or the agent develops in the vector."

"A determination of the probability of any given waste to preserve intact the chain of disease transmission provides a logical means for delineating relative infectivity. According to this method, the individual segments of the biomedical waste stream can be analyzed for their relative ability to provide a favorable environment for the growth and survival of infectious agents (link two) and to deliver sufficient quantities of those agents to a susceptible host via an infectious route of transmission (emphasis on link four).

Guidelines

The rationale behind the definition of what constitutes medical waste is based on two sets of criteria:

1. *The potential of the waste to transmit infection.* These wastes, by virtue of their characteristics, are capable of preserving the chain of disease transmission. Seven categories of wastes (numbers 1-7 on the following page) are universally handled as medical wastes, regardless of their source, because:

a. the infectious potential of a waste cannot necessarily be determined by its appearance;

b. the particular source of the item and/or its infectious nature may not be identifiable;

c. it is impractical and infeasible to test each item for its pathogen content (i.e., type and quantity).

2. *Wastes which possess a risk to public health or the environment for reasons other than infectious potential.* These wastes fall into three additional categories: wastes with low levels of radioactivity which are not under Nuclear Regulatory Commission regulations; and cytotoxics and wastes with trace amounts of toxic chemicals which do not fall into the hazardous waste category regulated by Subtitle C of the Resource Conservation and Recovery Act (RCRA). All bulk quantities of such wastes must be given primary consideration as Subtitle C wastes and are therefore not within the parameters of these Guidelines.

"Links three and five relate primarily to the handling of those wastes determined to be infectious and therefore serve as the basis for the establishment of worker-safety programs which include barrier protection and containment procedures" (Minnesota, 1988, p. III.8).

The actual ability of a medical waste type to uphold links two and four of the chain of disease transmission thus provides the most logical basis for designating it as infectious waste.

Types of Medical Waste

Sharps: The American Blood Resources Association defines sharps as "objects or devices having acute rigid corners, edges, points or protuberances capable of cutting or piercing" (American Blood Resources Association, 1986, p. 1). Based on the principles of disease transmission, the potential for infection from contact with medical waste sharps is significantly greater than that related to contact with non-sharp waste. The greater potential is due to the fact that sharps can create a portal of entry whereas a portal must exist prior to contact with non-sharps for infection or disease to occur.

Cultures and stocks: These wastes from pathological and medical laboratories have an especially high potential for the transmission of infection. Laboratory safety practices have been established for four levels of protection provided to personnel, the environment and the community. The levels consist of combinations of laboratory practices and techniques, safety equipment, and laboratory facilities appropriate for the operations performed and the hazard posed by the infectious agents and for the laboratory function or activity (U.S. Department of Health and Human Services, 1988, p. 7). These biosafety levels are presented in the following table by ascending degree of protection.

Summary of Recommended Biosafety Levels for Infectious Agents

Biosafety	*Practices & Techniques*	*Safety Equipment*	*Facilities*
1	Standard microbiological practices	None: primary containment provided by adherence to standard laboratory practices during open bench operations.	Basic
2	Level 1 practices plus: Laboratory coats; decontamination of all infectious wastes; limited access; protective gloves and biohazard warning signs as indicated.	Partial containment equipment (i.e., Class I or II Biological Safety Cabinets used to conduct mechanical manipulative procedures that have high aerosol potential that may increase the risk of exposure to personnel.	Basic
3	Level 2 practices plus: special laboratory clothing; controlled access.	Partial containment equipment used for all manipulations of infectious material.	Containment
4	Level 3 practices plus: entrance through change room where street clothing is removed and laboratory clothing is put on; shower on exit; *all wastes are decontaminated on exit from the facility.*	Maximum containment equipment (i.e., Class III biological safety cabinet or partial containment equipment in combination with full-body, air-supplied, positive-pressure personnel suit) used for all procedures and activities.	Maximum Containment

(*Source:* U.S. Department of Health and Human Services, 1988, p. 10, emphasis added.)

Types of Medical Waste

The following categories of wastes should be segregated at the point of generation for management as medical wastes:

1. *Sharps* that have been used in animal or human patient care or treatment or in medical, research, or industrial laboratories. Includes hypodermic needles, syringes, scalpel blades, and blood specimen tubes; also pasteur pipettes and broken glass that have been exposed to infectious agents. For purposes of disposal, the Occupational Safety and Health Administration (OSHA) categorizes orthodontic wires as sharps.

2. *Cultures and stocks* of infectious agents and associated biologicals. Includes specimen cultures from medical and pathological laboratories; cultures and stocks of infectious agents from research and industrial laboratories; wastes from the production of biologicals; and discarded live and attenuated vaccines; culture dishes and devices used to transfer, inoculate, and mix cultures.

3. *Bulk human blood and blood products*. Liquid waste human blood, products of blood, items saturated and with the potential for dripping blood, serum, plasma, and other blood components.

4. *Pathological* wastes. Human tissues, organs, body parts and body fluids that are removed during surgery and post mortem procedures, with the exception of teeth, feces, excreta and corpses and body parts intended for interment or cremation.

5. *Isolation* wastes. Includes wastes contaminated with blood, excretions, exudates, or secretions from sources isolated to protect others from highly communicable infectious diseases which are identified as viruses assigned to Biosafety Level 4 by the Centers for Disease Control.

6. *Animal* waste. Contaminated animal carcasses, body parts, fluids and bedding of animals that have been afflicted with suspected zoonotic disease or purposely infected with agents infective to humans during research, in the production of biologicals, or in the in vivo testing of pharmaceuticals. (State agriculture departments and the U.S. Department of Agriculture

Unused sharps: There are several reasons for adopting a uniform policy for all sharps (Reinhardt and Gordon, 1991, p. 38):

- Although uncontaminated sharps are much less likely to cause disease than contaminated sharps, there remains the risk of physical injury (cuts, scrapes, and needle sticks).
- Risk of infection accompanies physical injury by sharps. Even a sterile sharp discarded into waste becomes nonsterile from being in the waste.
- No one likes to be stuck, and physical injury from sharps is unpleasant. It is also disturbing to the injured person because of the fear of AIDS it often evokes . . .
- A uniform sharps policy eliminates decisionmaking because no one has to decide whether or not a particular sharp is contaminated.
- Training and management are simpler, easier and more efficient when all sharps are handled in exactly the same way.
- Uniform sharps handling means universal use of sharps containers, a practice that offers protection for all handlers of sharps.
- A uniform sharps handling policy is consistent with public health concerns about drug abuse and the reuse of needles and syringes.

Low-Level Radioactive Waste: Radioactive waste from medical institutions is comprised of any waste containing or contaminated with radioactive isotopes (radionuclides). Low-level radioactive waste from institutions that use radionuclides for in vitro or laboratory testing or in amounts less than 200 uCi (and within specific radionuclide limits) are exempt from federal regulation and may be disposed of as solid waste according to Nuclear Regulatory Commission rules as set forth in 10 CFR 31.11 (Reinhardt and Gordon, 1991, p. 163). The Federal Low-Level Radioactive Waste Policy Act, amended in 1985, requires each state to be responsible for providing disposal capacity for its own low-level radioactive waste (Public Law 96-573.94).

Antineoplastics/cytotoxics: Cytotoxic chemicals are hazardous pharmaceuticals used in chemotherapy, and seven such compounds are on the RCRA "U" list of hazardous waste. Most can reasonably be expected to be mutagenic, teratogenic, and/or carcinogenic to man and animals (Reinhardt and Gordon, 1991, p. 142). Wastes resulting from the use of these materials (products of a process or operation) are not regulated Ibid.).

"Perhaps the wastes of most serious concern are unused portions of source containers (containers in which drugs are supplied), expired drugs, and surplus mixtures, which typically have larger quantities or higher concentrations of the drug. Chemically contaminated waste is also generated, including used needles and syringes, tubing and bottles used for intravenous administration, empty drug vials and ampoules, gloves, aprons and disposable benchtop coverings from biological safety cabinets. Needles, and perhaps some other items, may be considered both chemically contaminated waste and infectious waste" (Ibid.).

Antineoplastics generate three categories of wastes:

1. bulk contaminated materials, intravenous solutions or containers whose contents weigh more than 3 percent of the capacity of the container;
2. trace contaminated materials;
3. contaminated human excreta.

Cytotoxics "cannot be dispensed of in bulk quantities in medical waste incinerators without a RCRA hazardous waste incinerator permit. It is also true that these RCRA hazardous wastes could not be treated by most nonincineration treatment methods. Yet, given that these substances are usually encountered as 'trace' contaminants, rather than 'bulk wastes,' they are not managed as RCRA hazardous wastes, and can legally be disposed of with other medical wastes" (U.S. Congress, Office of Technology Assessment, 1990, p. 13).

Chemical wastes: Chemical waste is regulated as hazardous waste if it exhibits one of four characteristics: ignitability, corrosivity, reactivity or the ability to produce toxic leachate in a landfill. EPA defines the criteria for these characteristics in Subpart C of 40 CFR Part 261.

"EPA also regulates some chemical wastes that are discarded commercial chemical products listed in 40 CFR 261.33(e) as acute hazardous wastes (having hazardous waste numbers beginning with P) or in 40 CFR 261.33(f) as toxic wastes (numbered with U). . . . The rules also cover residue remaining in a non-empty container and debris regulations cover field situations and exposures to other animals.)

7. *Unused sharps.* Hypodermic needles, suture needles, syringes, scalpel blades. This category is included because of the risk of the item having been used without the handlers' knowledge and the added potential for illicit use if these items are disposed of as solid waste. In addition, unused sharps have the potential to cause physical injury from improper handling.

8. *Low-level radioactive* waste. From administering radiopharmaceuticals and performing nuclear medicine procedures and radio-immunology procedures. These wastes, such as radioactive sharps, are not under Nuclear Regulatory Commission regulations.

9. *Antineoplastic (cytotoxic, cytostatic)* drugs. Trace contaminated materials and contaminated human excreta that are not handled as RCRA hazardous wastes.

10. *Small volumes of chemical hazardous* waste. These are volumes that are exempt from Subtitle C of the Resource Conservation and Recovery Act. These wastes are products of a process or operation involving the use of hazardous chemicals.

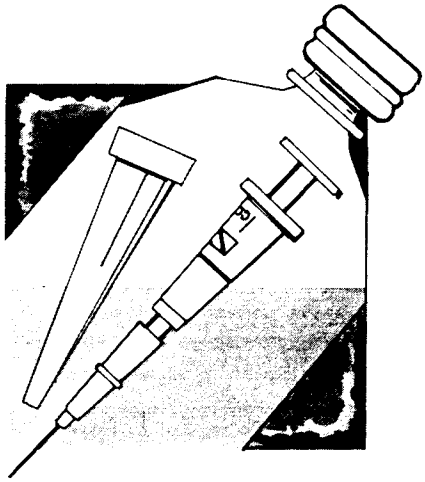
resulting from the cleanup of a spill. . . . . Wastes resulting from the use of these materials (products of a process or operation) are not regulated, such as materials contaminated with a listed chemical generated in the course of a standard procedure" (Reinhardt and Gordon, 1991, p. 142).

Wastes with Multiple Characteristics: Frequently, medical wastes generated will fall into more than one of the ten categories in the Guidelines, such as radioactive sharps. A hierarchy for assigning priorities to the waste characteristics that present the greatest hazard can assist in waste management decisions.

Principles for the Management of Wastes with Multiple Characteristics (adapted from Reinhardt and Gordon, 1991, p. 178, 179):

1. Give priority to the characteristic that presents the greatest risk.
   a. Ascertain which hazards are present in each waste.
   b. Assess the relative degree of risk present in each hazard.
   c. Assign priority to the hazard with the greatest risk.
   d. Develop a management scheme based on the relative degrees of risk.
2. Select treatment/management procedures that are compatible with all the hazards present in the waste.
3. If possible, select a treatment technique that will provide suitable treatment for all the hazards.
4. If necessary, provide additional treatment for eliminating the remaining hazards.

Items That Are Not Medical Waste: According to the principles of infectious disease transmission, minimally soiled items in contact with infectious agents are probably not capable of infectious disease transmission because the potentially infectious materials will be contained or confined in the waste materials (U.S. Department of Health and Human Services, 1990, p. 3.3). If these items become saturated with blood, excretions, exudates or secretions containing a sufficient number of infectious agents, however, they would then be similar to material in the cultures and stocks, bulk human blood and blood products and animal waste categories and capable of infectious disease transmission, provided an appropriate portal of entry is present in a susceptible host (Ibid., p. 3.3- 3.4).

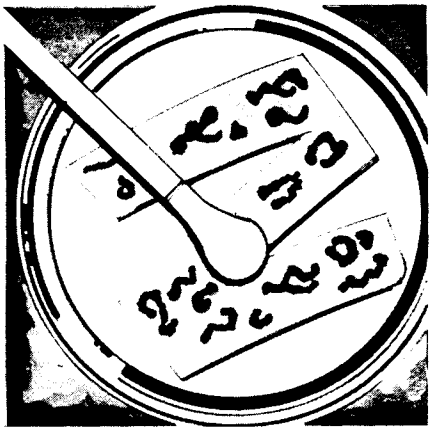


II. GENERATION

Documentation

Although hospitals have been the primary target of medical waste regulations, they are not the only generators of medical wastes. Small practices and non-facility sources such as illicit drug users have also been responsible for beach wash-ups and mismanagement of medical wastes.

These incidents have initiated stricter state and federal oversight of medical waste management. Medical facilities are the most easily identifiable sources for regulation, but not necessarily the worst offenders. Tighter control of medical facilities has seemed to alleviate some of the public concern over medical waste issues, but there are many other types of generators who need to improve their management methods.

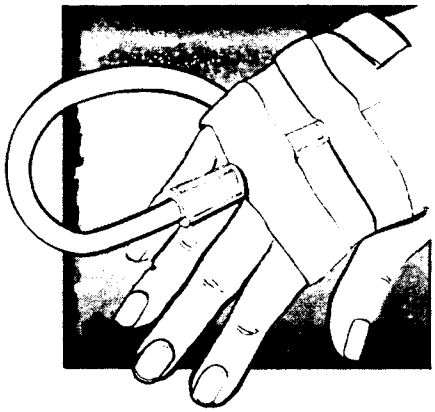


Types of Generators

There are many sources of medical waste with a wide variation in the amount of waste produced by each type of generator. The range of potential generators includes:

Hospitals:
- general medical and surgical
- psychiatric
- tuberculosis
- other specialty (obstetrics and gynecology, eye/ear/nose/throat, rehabilitation)

Intermediate care facilities:
- nursing homes
- in-patient care facilities for the developmentally disabled



Clinics:
- chronic dialysis
- free clinics
- community
- employee
- surgical
- urgent care
- abortion
- drug rehabilitation
- health maintenance organizations

Physician offices:
- general and family practice
- internal medicine
- pediatrics
- obstetrics and gynecology
- ophthalmology
- orthopedic surgery
- general surgery
- dermatology
- psychiatry
- otorhinolaryngology
- urological surgery
- cardiovascular disease
- neurology

Dental offices

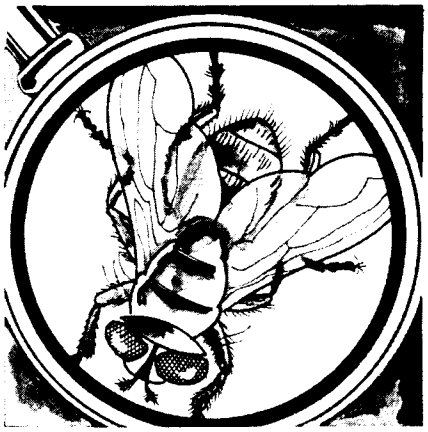
Laboratories:
- medical
- research
- industrial
- commercial diagnostic
- biologics manufacturing
- medicinal chemicals and botanical products
- pharmaceutical preparations

Funeral homes

Veterinarians

Agricultural

Blood Banks



Animal Care:
- shelters
- fur farms
- breeders
- experimentation units

Emergency medical services:
- ambulance services

Hospices

Household/Home Health Care:
- health care providers
- self care

Health units in:
- industry
- schools
- correctional facilities
- fire and rescue services

Medical and nursing schools

Illicit drug users

The U.S. EPA reports that the vast majority of regulated medical waste (about 77 percent) is generated by hospitals. However, hospitals comprise less than 2 percent of the total number of generators (U.S. EPA May 1990, pp. 1-3).

Generator Quantities as Percents of Total Regulated Medical Waste and Generator Types as Percents of the Total Number of Sources

Generator Type	*Percent of Regulated Medical Waste Generated*	*Percent of Generators*
Hospitals	77.10	1.88
Long-term Health Care Facilities	6.36	3.36
Physicians' Offices	5.67	47.70
Clinics	3.59	4.11
Laboratories	3.31	1.14
Dentists' Offices	1.63	26.08
Veterinarians	.99	10.07
Funeral Homes	.84	5.41
Free-Standing Blood Banks	.52	.24

Calculated from U.S. Environmental Protection Agency, May 1990, Table 1-1, p. 1-5

Small Generators

Most states specify that only entities generating over a certain amount of medical waste per month are subject to state regulations. In their definitions of medical waste "generators" many states exempt small generators, e.g., sources who generate between less than 50 and 220 pounds (100 kilograms) per month.

The American Hospital Association recommends basing medical waste regulations on the properties of waste rather than the size of the entity that generates it (Bureau of National Affairs, *Infectious Waste: The Complete Resource Guide*, v.I 1988 at p. 13 in Stewart, et al., 1989, p. VI.28). Likewise, these Guidelines are directed to all generators of medical waste unless otherwise indicated.

Public Education

Increases in medical waste from residential sources is attributable to a number of changes in and outside of the health care delivery system. The Agency for Toxic Substances and Disease Registry reports that the number of injuries refuse workers sustain from sharps in residential solid waste is increasing. This trend appears to coincide with the increasing trend to in-home health care (U.S. Department of Health and Social Services, 1990, p. 6.3).

There are several trends that have increased the amount of medical waste emanating from unregulated sources:

1. Hospital patients are released on an out-patient basis sooner and more frequently. They are often prescribed with medical supplies for self-care at home.

2. The use of disposable items has increased the volume of medical waste entering the solid waste stream from private homes. The American Diabetes Association estimates that diabetic patients generated one billion used syringes in 1987, assuming that the syringes were not reused (U.S. Department of Health and Social Services, 1990, p. 6.2).

3. Many one-time use items are available over the counter for small livestock operations and other business or non-profit entities that do not come within the jurisdiction of regulated generators of medical waste.

4. Increases in the users of illicit intravenous drugs are another source of unregulated medical waste. The National Institute on Drug Abuse estimates that there are between 1.1 million and 1.3 million illicit IV drug users nationwide (U.S. Department of Health and Social Services, 1990, p. 3.22).

In its 1990 report to Congress on the public health implications of medical waste the Agency for Toxic Substances and Disease Registry recommended that "guidelines for in-home health care medical waste management should be developed by relevant government and private-sector organizations. As much as possible, these guidelines should also address the management of other sources of non-regulated medical waste. These guidelines may assist in alleviating the negative environmental impact of this waste stream" (U.S. Department of Health and Social Services, 1990, p.14).

The imposition and enforcement of state or federal regulations on individuals in their homes would be an impossible task. Likewise, local ordinances for trash separation and collection and use of sewage systems would encounter difficulties in enforcement. The Rockefeller Institute's Medical Waste Policy Committee recommends, instead, "a combination of local ordinances, patient education, and economic incentives:"

"The local ordinance would set forth specific duties such as separation and containment of sharps and disposal to avoid burdensome duties. A model ordinance could be developed to guide municipalities, just as model ordinances have been used to deal with the disposal of household toxic wastes (e.g. pesticides, paints).

" . . . patients at home must also be educated as to proper disposal of their medical wastes. . .education by the patient's physician or hospital staff at the time of discharge to home health care is likely to more focused and effective.

"Finally, economic incentives could be designed to further assure that patients comply with local ordinances and the guidances they have received from their physician and hospital. For example, a 'deposit-refund system for containerized wastes' could be instituted" (Stewart, et al., 1989, p. VI. 29-30).

"Perhaps most importantly, the public needs to understand the infectious waste management process and the fact that proper and safe management is possible. They need to feel confident that their health and environment are not threatened by infectious waste. The aesthetic and emotional concerns surrounding this issue are perhaps greater than any real hazard. Through a combination of public education and prudent management, this emotionally charged issue can be defused" (Cahail and Caquelin, 1989, p. 45).

The state of Washington is currently conducting a U.S. EPA-funded project to identify reasonable methods for home health care medical waste disposal. The study in concentrating on the handling of sharps.

Public Education

Education of the public, especially small generators such as home health care users of medical products, can greatly expedite the management of medical waste.

Educational efforts should:

1. Provide the public with an understanding of the medical waste management process and the fact that proper and safe management is possible;

2. Inform medical waste generators of safe and proper methods of disposal;

3. Inform persons who use syringes or similar items in the home (e.g. diabetics, etc.) as to ways in which they can reduce or eliminate hazards that may occur through improper disposal of these items.

4. Distribute pamphlets and administer on-site training programs designed to assist waste handlers in identifying potentially infectious waste as a limited subset of the composite medical waste stream;

5. Make employees within health care facilities aware of the potential hazards that exist and train them to handle them. They also need to know that just because something is thrown away, it does not suddenly disappear. Waste material can pose threats to both workers and the general public.

Minimization

The shift to the use of disposable products for health care and the implementation of universal precautions has significantly increased the quantity of medical waste generated. The growth in the use of disposables in health-care settings is attributable to a number of converging factors in recent decades. These include:

1. Increased concern over infection control;
2. Decreased available nursing staff (and a need to provide more expedient treatment and more convenient clinical practices);
3. Increased cost of health-care labor (and concern over the time needed to handle and sterilize reusable items); and
4. Consideration of disposables as part of the general solid waste stream of the health-care facility (with, in the past, resultant low cost for handling and disposal) (U.S. Congress, Office of Technology Assessment, 1990, p. 22).

"One widely held presumption is that the use of disposables is important from the perspective of infection control. . .

"Yet, infection control studies do not indicate a constant and consistent reduction in nosocomial infections where disposables replace reusable products" (Ibid., p. 22).

The quantity of wastes requiring special handling can be greatly reduced by an understanding and recognition of which wastes are medical wastes and must be segregated and which wastes can be managed as solid wastes. Separation of items that are returnable, reusable with or without cleaning, sanitizing or sterilization or are recyclable for purposes of reprocessing can further reduce the total volume of waste generated.

Reuse techniques involve cleaning and/or disinfection that does not significantly affect the waste's structural integrity and subsequent reuse. Recycling involves substantial reprocessing.

"Before treatment" approaches to waste prevention and materials management can reduce the amount of material that enters the waste stream.

"Lessons from the management of other waste streams, notably hazardous waste and municipal solid waste, indicate that a sound control strategy for waste management follows the basic steps of characterizing the waste stream in light of different treatment alternatives, segregating some wastes to facilitate management based on these characteristics, and looking 'upstream' to discover any opportunities to reduce the volume and/or toxicity of waste" (U.S. Congress, Office of Technology Assessment, 1990, p. 19).

Reuse:

"Reprocessing or reuse of single-use medical devices raises a number of technical, economic, ethical, and legal issues. The presence of residues from the reprocessing could affect the quality of a patient's care; the health care facility may be concerned about potential liability from reusing the device; devices that were not designed for multiple uses could fail when reused, and there may be inadequate or nonexistent quality control for the sterilization procedures used (U.S. Environmental Protection Agency, May 1990, p. 12.2).

". . .the practicality of reuse, given liability concerns and standard operating procedures for a particular health-care facility, may preclude reuse of particular medical items at an institutional level. Certain disposable items though are advantageous over reusable items for various reasons including controlling infection, saving labor costs for processing, and minimizing exposure to hazardous chemicals used in chemical sterilization processes. The use (and reuse) of disposables can be considered on an item by item basis, in light of how they will be used, including consideration of infection risks and other factors associated with those risks" (U.S. Congress, Office of Technology Assessment, 1990, p. 20).

Minimization

The minimization of medical waste can be accomplished through reuse, recycling and source reduction. Minimization techniques include:

- waste audits that emphasize characterization of the waste stream;
- development of a plan delineating necessary segregation techniques;
- education/training of the employees of the health-care facility;
- clearly marking and conveniently placing containers for segregation of wastes to encourage their use.

Source Reduction.

The following source reduction or prevention techniques can reduce the toxicity or quantity of discarded products before the products are purchased, used, and discarded:

1. Manufacturers can consider waste issues in designs of current and planned medical and health-care products and their packaging.
2. Consumers of medical and health-care products (e.g., hospitals) can direct their purchasing decisions, product use, and the discarding of products toward waste reduction goals.
3. Improvements in materials management practices can eliminate overpurchasing items with a limited shelf life or storage or handling practices that cause materials to be less useful.
4. Toxics such as cadmium in medical products (pigments in red bags, in batteries and some plastics) or PVC plastics can be replaced with less toxic materials such as non-chlorinated plastics.
5. Materials can be used that are safer to burn, that reduce incinerator emissions or have higher heat recovery potential or are more biodegradable.

Laboratories can implement the following practices to minimize medical waste production (National Research Council, p.43):

6. Researchers can plan experiments and select reagents that minimize the production of mixed waste.
7. Experimental design may be modified such that the wastes are generated separately and in minimal volumes. Microscale techniques are now available for most experimental procedures.
8. When feasible, consider substituting less hazardous materials.
9. Make appropriate waste containers available at the work site to ensure

Source Reduction:

The two fundamental characteristics of wastes that are the focus of reduction efforts are:

1. Toxicity, i.e., eliminating or finding benign substitutes for substances that pose risks when they are discarded.

"The difficulties inherent in managing wastes with multiple hazards make it important to optimize waste management by minimizing the production of multihazardous wastes. Certain policies and activities will help to achieve this:

a. Do not mix waste streams.

b. Promote substitution policies.

c. Reduce the quantities of multihazardous wastes generated.

d. Identify sources of multihazardous wastes.

e. Store wastes for decay of radioactivity or until disposal options become available" (Reinhardt and Gordon, 1991, p. 180).

2. Quantity, i.e., changing the design or use of products to minimize the amount of waste generated when they are discarded.

Waste Management Plan

Small generators of medical waste may not require a written waste management plan. However, home self health care providers should be knowledgeable in the proper packaging and disposal of their medical wastes. Professional home health care providers and other small generators should be trained in the proper handling and transport of medical wastes generated in the course of their duties.

convenient and correct segregation and labeling of the waste.

Waste minimization techniques can be implemented in all departments of health care facilities. The identification and segregation of materials that are not medical waste for inclusion in the solid waste stream can reduce the special costs and handling associated with the transport and treatment of medical wastes. Additional segregation for reusable and recyclable items can further reduce the amount of waste destined for disposal. Selection of items for purchase that are reusable, recyclable or of low toxicity will expedite waste minimization efforts later in the waste handling process.

Waste Management Plan

The medical waste management plan is central to any medical waste management program. The plan should define all medical wastes handled by the facility, those responsible for their management, and procedures for handling them from the point of generation through disposal.

Each medical waste generator should prepare a written management and operations plan outlining policies and procedures for the safe and effective management of medical waste. The plan should be reviewed and updated as necessary. This plan should include the following elements:

- compliance with applicable regulations
- department and individual responsibilities; listing of infection control, environmental control and housekeeping personnel
- hours and days of operation at the facility and the number of conveyances delivering biomedical waste that are expected daily and that can be accommodated daily
- procedures for medical waste identification
- a description of the medical waste handled by the facility including type and volume
- waste minimization procedures
- segregation
- packaging
- storage
- transportation methods
- treatment methods
- treatment monitoring records
- disposal methods
- the transporters and disposal facilities that will be used
- contingency planning
- procedures for spill response
- a general inspection schedule for the facility
- staff training and safety
- record keeping for waste that has been treated on-site
- record keeping for waste transported off-site for treatment and/or disposal
- the generator's system for distinguishing between treated and untreated wastes

The policies and procedures portions of all waste management plans should be available for public inspection. The entire waste management plan should be available to public health and environmental officials, transporters and treatment and destruction facilities. Facilities should consider the advantages of making their entire waste management programs available to the public since public support and elimination of public fears is critical for conducting business.

Operation

Segregation: With minimal segregation, items such as patient care disposables and even leftover food could be treated the same as blood or sharps. Thus, the volume of waste that could be treated as medical waste is potentially much larger than if these items are separated at the point of generation.

If the waste containers are clearly labeled to designate medical from solid waste items, haulers and treatment and disposal facilities can easily identify the type of waste. If the waste is not clearly identified, waste handlers have little way of determining its infectious potential and must therefore treat all of the wastes as medical waste. Segregating medical waste that is not potentially infectious and handling it as ordinary solid waste can greatly reduce the volume and expense of medical waste treatment and disposal.

Containment: "Proper packaging of infectious waste breaks the disease transmission chain at the third link — by denying infectious agents a mode of escape from their growth reservoir. If the infectious organisms cannot escape from their reservoir, then they cannot gain access to a susceptible host and induce disease (Minnesota, 1988, p. IV.2).

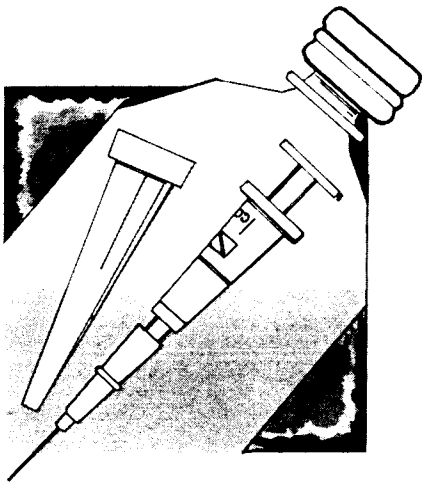
ASTM (American Society for Testing and Materials) has developed a dart test for assessing plastic bag thickness and/or durability for use as medical waste packaging. The test is the "Standard Methods of Test for Impact Resistance of Polyethylene Film by the Free Falling Dart Method, Standard of the American Society for Testing and Materials Designation D 1709-67, Method B."

Storage: Two types of facilities can increase the efficiency of medical waste trucking by combining medical wastes for transport to treatment facilities:

1. Transfer stations provide an intermediate point at which medical waste haulers can combine small loads of medical waste for further transport to treatment facilities. State storage and transportation requirements usually apply to these stations.

2. Collection stations provide a point to which small generators can bring their medical wastes for pickup by a transporter. These stations may not be as tightly regulated as transfer stations. The state of Texas regulates facilities in less populated areas that serve as collection points for generators who generate less than 50 pounds per month of waste and who transport their own waste.

The state of New Jersey is considering collection station regulations which include limiting the amount of medical waste that could be on-site at the station at a time and the length of time that it could reside there. The stations would register as non-commercial transporters. The state would allow storage of the wastes on trucks while at the collection station, unlike at transfer stations. Proper packaging and storage should apply to these stations and to the trucks that utilize them.



Operation

The clear designation and containment of medical waste at the point of generation for special handling and specific safety procedures for waste handlers to follow helps to ensure the protection of health care personnel and the public from exposure to infectious or unaesthetic materials. Proper management of generating sites expedites the transfer and treatment of medical wastes. The quality of handling is affected by the design of waste containers and storage areas. This section discusses the segregation, containment, labeling and storage of medical wastes.

Segregation

Segregation is the initial and crucial point in the waste handling process that determines the amount of waste and type of treatment to which it will be subjected in the ensuing waste management process.

1. Designate medical waste as soon as practical at the point/time of origin.
2. Separate medical waste from other solid waste (e.g., paper, garbage items).
3. Separate sharps.
4. Separate other medical wastes designated for on-site treatment from those intended for off-site treatment.
5. Separate wastes intended for recycling.
6. Segregate according to treatment method and packaging suitable for that method:
   a. liquid
   b. sharps
   c. non-sharp solid according to heat value, moisture content and biological and chemical composition
7. Provisions should be made for separating medical waste with multiple hazards (e.g., radioactive sharps) when additional or alternative treatment is required.