Chapter 2
Handling Medical Wastes and Potential Occupational Risks

The degree of risks posed by medical wastes is not clear. Two main types of risks associated with medical wastes can be distinguished: occupational and environmental. Occupational exposure to health workers and waste handlers is often cited as the primary type of health risk posed by medical wastes. Yet, precise information on the types and frequency of actual occupational injuries or illnesses due to handling medical wastes is not readily available.[1] Environmental risks can be posed directly by illegal or careless management and disposal practices or more indirectly through the emissions and ash handling from medical waste incinerators.[2]

In this context, questions regarding the significance of all-large and small-generators of medical wastes become important. This section first describes the general nature of ***handling*** (including initial handling, storage, and transportation) of medical wastes and the types of risks associated with it, and then discusses the potential magnitude of these risks. What is known about the possible risks associated with incineration and other treatment methods for medical wastes will be discussed in subsequent chapters.

Handling: Packaging, Storage, and Transportation

Handling medical wastes—including initial handling, storage, and transportation-involves issues of potential occupational risks and potential operational problems. Improper handling of medical wastes is closely linked to problems resulting from inadequately packaged and contained wastes as they move about the hospital and then are transported off-site for disposal. The integrity of packaging, particularly of such items as sharps, is critical to ensuring the containment of wastes during their collection, storage, and transportation.

Packaging

Polyethylene bags are frequently used for containing bulk wastes (e. g., contaminated disposable and residual liquids); they may have to be double-bagged with polypropylene bags that are heat resistant if steam sterilization (see below) is used. These bags, however, must be opened or of such a nature as to allow steam to penetrate the waste. Color-coded bags are frequently used to aid in the segregation and identification of infectious wastes. Most often red or red-orange bags are used for infectious wastes (hence the term "red bag' waste). An ASTM Standard (#D 1709-75) for tensile strength based on a dart drop test and the mil gauge thickness of the plastic determine its resistance to tearing (62,70). Use of the biological hazard symbol on appropriate packaging is recommended by the EPA to assist in identifying medical wastes. (See figure 1.) In addition, EPA recommends that all of these packages close securely and maintain their integrity in storage and transportation (81).

In general, compaction or grinding of infectious wastes is not recommended by EPA before treatment. Even though it can reduce the volume of waste needing storage, compaction is not encouraged due to the possibility of packages being violated and the potential for aerosolization of microorganisms. Commercially available grinding systems that first involve sterilization before shredding or compaction may alleviate this latter concern (62).[3]

Sharps are of concern, not only because of their infectious potential, but also because of the direct prick/stab type of injury they can cause. For sharps, puncture-proof containers are currently the preferred handling package. EPA recommends these

[1] Studies do exist on needlestick injuries. For example, recent data indicate that approximately 20 percent of all hospital needlestick injuries are due to wastehandling. (See ref. 11; numerous other surveys and studies of needlestick injuries have been conducted, e.g., refs. 45,68).

[2] Although not discussed extensively in this paper, accidental exposure through transportation mishaps is likely to be increasingly a source of concern. If more medical waste is shipped off-site in the future, the potential for accidental spills outside of the generating facility will increase.

[3] Yet, waste haulers note that proper handling of wastes is jeopardized by any compaction that occurs at some point before disposal.

Figure 1.–Biological Hazard Symbol

NOTE: Symbol is fluorescent orange or orange-red, and dimensions are specified for use.

SOURCE: U.S. Environmental Protection Agency, Guide for Infectious Waste Management, EPA/530-SW-86-014 (Washington, DC: May 1986).

types of packages for solid/bulk wastes and sharps; bottles, flasks, or tanks are recommended for liquids.[4] In the past, needles were re-capped, chopped, or disposed of by other practices that are no longer common due to their potential for worker injury and, in the case of chopping, for aerosolization of microorganisms during the chopping procedure (62).

New technologies for containing needles and facilitating their safe handling continue to emerge. For example, one company has announced a process which uses polymers to sterilize and encapsulate sharps (and other infectious wastes) into a solid block-like material. A number of companies have also developed encapsulating systems and other sharp disposal processes (e. g., a shredder with chemical treatment of needles and other sharps) (10). These processes may potentially be cost-effective disposal options for doctor offices and other small generators of sharps and other infectious wastes, provided landfill operations would accept the encapsulated wastes.

[4]The CDC has similar recommendations (75,76).

Storage

Storage of the waste needs to be in areas which are disinfected regularly and which are maintained at appropriate temperatures (particularly if wastes are being stored prior to treatment) (62). EPA recommends that storage time be minimized, storage areas be clearly identified with the biohazard symbol, packaging be sufficient to ensure exclusion of rodents and vermin, and access to the storage area be limited (81). The importance of the duration and temperature of storing infectious wastes is noted, due to their association with increases in rates of microbial growth and putrefaction.

The recommendation by EPA for storage of infectious waste is limited, however, to suggesting that "storage times be kept as short as possible' (81). EPA does not suggest optimum storage time and temperature because it finds there is "no unanimity of opinion' on these matters. As the EPA ***Guide*** notes, there is State variation in specified storage times and temperatures. State requirements often stipulate storage times of 7 days or less for infectious wastes that are unrefrigerated. Sometimes longer periods are allowed for refrigerated wastes.

Transportation

EPA recommendations with respect to the transportation of infectious wastes briefly address the movement of wastes while on-site and in an even more limited way address the movement of wastes off-site. The recommendations are largely limited to prudent practices for movement of the wastes within a facility, such as placement of the wastes in rigid or semi-rigid and leak-proof containers, and avoidance of mechanical loading devices which might rupture packaged wastes (81). Broader issues, such as recordkeeping and tracking systems for infectious or medical wastes once they are taken off-site, and the handling and storage of wastes at transfer stations, have not yet been addressed.

EPA does recommend that hazard symbols "should be in accordance with municipal, State and Federal regulations" (81). Yet, State and Federal agencies have promulgated conflicting or incompatible guidelines with respect to the use of the biohazard symbol and other transportation specifications. States often follow the EPA guidance on the use of the biohazard symbol, but application of

regulations and policies of the Department of Transportation (DOT) and Department of Energy (DOE) may suggest more limited use of the symbol, creating confusion for commercial handlers of medical wastes (43).

DOT has issued regulations for the transportation of etiologic agents. These regulations may apply to most medical wastes contained in packages bearing the biohazard symbol, as a result of the DOT's definition of "etiologic agent" in the Code ***of Federal Regulations.***[5] This is a result of the fact that the precise content of most medical waste boxes with a biohazard symbol is not known, but is likely to contain a defined etiologic agent. Further, the DOT regulations specify that packages of this sort be a maximum of one liter in size.

Further, the various classification of medical, and specifically infectious, wastes by different States complicates the interstate shipment of wastes. Depending on the State, a waste may be designated either as a hazardous, solid, or special waste, or simply as freight for the purposes of interstate commerce. Some States have manifest systems, others do not. These factors complicate, but do not prevent, the shipment of wastes within (and outside of) the country. If more medical wastes are shipped between States, which is the apparent trend, the likelihood of accidents will increase. The desirability of more consistent and complete guidelines or regulations regarding the off-site transportation of infectious wastes should be considered in this context.

Potential Occupational Risks

On October 30, 1987, the Department of Labor (DOL) and the Department of Health and Human Services (DHHS) issued a Joint Advisory Notice on "Protection Against Occupational Exposure to Hepatitis B Virus (HBV) and Human Immunodeficiency Virus (HIV)" (80). This Notice goes beyond the CDC guideline changes made in August 1987 that focused on AIDS. Essentially, the universal precaution concept is extended by the Joint Advisory Notice to occupational exposure to Hepatitis B. The Notice advises healthcare workers to assume all body fluids and tissues they come into contact with are infected with a blood-borne disease.

[5]49 CFR 172.401

Tasks performed by healthworkers are divided into three categories.[6] Category I includes tasks that routinely involve exposure to blood, body fluids, or tissues; Category II tasks routinely do not involve exposure to these substances, but could on occasion (e. g., to administer first aid); and Category III includes tasks that involve no exposure to blood, body fluids, or tissues and for which Category I tasks are not a condition of employment. The Notice also advises that workers should not perform Category I and 11 tasks before receiving training relating to the facility's standard operating procedures (SOPS), work practices, and protective clothing required for each type of task. (See table 2.)

Special work practices for the disposal of sharps, such as using disposable, puncture-resistant containers to reduce stick injuries, are noted in the Advisory. Further, it recommends that employers should provide free voluntary Hepatitis B immunization for any workers performing Category I tasks who test negative for Hepatitis antibodies. At the request of employees, the employer should have a voluntary program to monitor for Hepatitis and AIDS antibodies following a known or suspected exposure to blood, body fluid, or tissues. This should include confidential medical counseling if they are found seropositive for either virus. Employers are also encouraged to keep records of the training, tasks, etc., of employees engaged in Category I or II tasks. Currently, the CDC estimates that only 20 to 40 percent of healthcare workers are immunized.

In October 1987, DOL/DHHS sent letters to approximately 500,000 healthcare employers to inform them of the Advisory Notice (80). The letter notes that as many as 18,000 healthcare workers per year may be infected by the Hepatitis B virus and several hundred will become acutely ill or jaundiced from the virus. Ten percent will become long-term carriers and as many as 300 healthcare workers may die each year as a result of Hepatitis B infections or complications. The letter also states that the Occupational Safety and Health Administration (OSHA, part of DOL) will respond to employee complaints and conduct inspections to ensure proper procedures are being followed.

[6]It should be noted, that the use of Categories I, II, and 111 are not required by OSHA, but are used on a voluntary basis.

Table 2.-Joint Advisory Notice on the Protection Against Occupational Exposure to Hepatitis B Virus (HBV) and Human Immunodeficiency Virus (HIV)– Training Program Recommendations

According to the Joint Advisory Notice, "The employer should establish an initial and periodic training program for all employees who perform Category I and II tasks. No worker should engage in any Category I or II task before receiving training pertaining to the Standard Operating Procedures (SOPS), work practices, and protective equipment required for that task."

The training program should ensure that all workers:

1. **Understand the modes of transmission of HBV and HIV.**
2. **Can recognize and differentiate Category I and II tasks.**
3. **Know the types of protective clothing and equipment generally appropriate for Category I and II tasks, and understand the basis for selection of clothing and equipment.**
4. **Are familiar with appropriate actions to take, and persons to contact, if unplanned Category I tasks are encountered.**
5. **Are familiar with and understand all the requirements for work practices and protective equipment specified in SOPS covering the tasks they perform.**
6. **Know where protective clothing and equipment is kept; how to use it properly; and how to remove, handle, decontaminate, and dispose of contaminated clothing or equipment.**
7. **Know and understand the limitations of Protective clothing and equipment. For example, ordinary gloves offer no protection against needlestick Injuries. Employers and workers should be on guard against a sense of security not warranted by the protective equipment being used.**
8. **Know the corrective actions to take in the event of spills or personal exposure to fluids or tissues, the appropriate reporting procedures, and the medical monitoring recommended in cases of suspected parenteral exposure.**

SOURCE: U.S. Department of Health and Human Services, Centers for Disease Control, "Recommendations for Prevention of HIV Transmission in Health-Care settings," *Morbidity and* Mortality Wee/r/y *Report*, vol. 38, Aug. 21, 1987.

It is not clear, however, that healthcare and other workers are being adequately informed of the advisory and trained in the new recommended procedures. For example, in California concerns have been raised by some unions over the approach of some healthcare facilities in establishing infection control programs in response to the Joint Advisory Notice. Hospitals and other healthcare employers are reportedly providing "minimal training programs and [may be requiring] workers to sign a form stating that they've been trained [in order] to prevent future liability' to the facility (36,68).

In 1987, OSHA began enforcing some of its existing regulations to respond to the hazard presented by occupational exposure to blood and body fluids. These include regulations for sanitation and waste disposal; personal protection equipment (PPE); housekeeping; sign and tags; and the application of the General Duty Clause of the Occupational Safety and Health Act. A detailed description of this program can be found in OSHA's instructions to its compliance officers (79).

In addition, OSHA sought input through an Advance Notice of Proposed Rulemaking about the need for and content of additional regulations. The Service Employees International Union, AFL-CIO, CLC (SEIU), and the American Federation of State, County, and Municipal Employees (ASFME) petitioned OSHA in September 1986 to issue a standard to protect healthcare workers from potential exposure to Hepatitis B and AIDS and make the Hepatitis B vaccination available to high risk workers free of charge (1,66). OSHA expects to issue regulations by the end of 1988.

SEIU, while waiting for OSHA to respond to their petition, conducted "an informal survey of infectious disease control practices within forty hospital departments in four urban centers experiencing high rates of AIDS infection, the results of which became available in June 1987,7 (See tables 3 and 4.) The SEIU survey, while not statistically significant due to the small sample size, concluded that "employer voluntary compliance of infection control guidelines is spotty at best, even in healthcare institutions located in urban areas experiencing high rates of AIDS infection" (66). SEIU highlighted several issues relating to the management of medical wastes. For example, it noted that studies of non-healthcare occupational exposures to bloodborne diseases are almost non-existent, but that exposure of these other types of workers to such diseases is known. SEIU, therefore, maintains that the scope of coverage of OSHA regulations should be based on the known modes of transfer (i.e., exposure), not arbitrary occupational and industry sector categories.

The National Solid Waste Management Association (NSWMA) also maintains that solid waste

7SEIU represents 850,000 service workers in the public and private sectors, of which 275,000 are healthcare workers in hospitals, nursing homes, and a variety of other health and medical facilities. In addition, at least half of their membership in other types of jobs (this includes workers such as janitors, mortuary and cemetery workers, technicians, and police officers) may be exposed to blood, blood products, body fluids, and injuries from sharps.

Table 3.—Compliance Rates With Joint Advisory Notice—70-Hospital Sample (In percent responding "Yes")

	Ail hospitals	Hospital size		
		Large	Medium	Small
Personal protective equipment (PPE):				
Gloves readily available	**89%**		87%	**100%**
Sufficient quality	**67**		14	***60***
Right sizes	**60**		60	**20**
Masks or goggles available	**58**		61	**100**
Fluid resistant gown available	**39**		48	**20**
Work practices/equipment:				
Handwashing facilities in vicinity	**86%**		87%	**100%**
Ambubags available	**63**		72	**40**
Needle disposal containers in vicinity	**75**		81	**100**
Self-sheathing needles	**23**		19	**25**
Linen red bagged	**87**		91	**80**
Standard operating procedures:				
Procedures developed	**28%**		36%	***0 %***
PPE routinely used when contact with bodily fluids is anticipated	**56**		**70**	***60***
Training:				
Educational materials	**87%**		74%	80%
OSHA worker brochure	**4**		**o**	**20**
Training in universal bloodborne disease precautions	**54**		**63**	**50**
Medical:				
Hepatitis B vaccine available	**74%**		70%	***8 0 %***
If available, free of charge	**90**		100	**75**
Confidential HIV testing available	**26**		26	**0**
if available, counseling provided	**66**	**70**	50	**0**

SOURCE: Service Employee International Union, AFL-CIO, CLC, "Comments on OSHA's Advance Notice of Proposed Rulemaking to Control Occupational Exposures to Hepatitis Band AIDS"(Waahington, DC: Jan. 26,1988)

Table 4.—Compliance Rates With Joint Advisory Notice—30-Department Sample (in percent responding "Yes")

	Nursing home(8)	Blood bank(2)	Correctional facilities (4)	Med. labs and HMOs (7)	Mental health rehab. clinics (9)
Persona/protective equipment (PPE):					
***Gloves* readily available**	50%	100%0	100%	100%	89%
Sufficient quality	75	**0**	**100**	**57**	**63**
Right sizes	**25**	**0**	**50**	**57**	**75**
Masks or goggles available	**25**	**100**	**50**	**71**	**56**
Fluid resistant gown available	**75**	**100**	**50**	**14**	**44**
Work practices/equipment:					
Handwashing facilities in vicinity	63%	0%	75%	100%	780/0
Ambubags available	38	0	75	29	63
Needle disposal containers in vicinity	83	0	67	100	63
Self-sheathing needles	0	**0**	0	**14**	**0**
Linen red bagged	**75**	**0**	**100**	**43**	**78**
Standard operating procedures:					
Procedures developed	0%	O%	75%	57%	22%
PPE routinely used when contact with bodily fluids is anticipated	12	0	75%	100%	78%
Training:					
Educational materials	50%	500/0	100%	86%	00/0
OSHA worker brochure	0	0	**0**	**0**	**0**
Training in universal bloodborne disease precautions	75	0	**50**	**71**	**78**
Medical:					
Hepatitis B vaccine available	**38%**	**100%**	75%	100%	67%
If available, free of charge	**67**	**100**	75	80	57
Confidential HIV testing available	**0**	o	25	29	22
If available, counseling provided	**0**	o	25	43	0

SOURCE: Service Employee International Union, AFL-CIO,CLC, "Comments on OSHA's Advance Notice of Proposed Rulemaking to Control Occupational Exposures to Hepatitis Band AIDS" (Washington, DC: Jan. 26,1988)

workers are at risk and should be covered by OSHA's infectious waste regulations (34). Solid waste workers have been exposed to transmittable diseases on the job through such practices as compaction of untreated wastes in standard refuse vehicles. This can result in the aerosolization of pathogens and potentially lead to disease transmission.

Some observers, however, maintain that such risks are minimal (8,60). They maintain, for example, that if wastes are properly packaged and handled, two of the factors necessary for disease transmission are not present, i.e., mode of transmission and portal of entry. A frequently cited study, performed in West Germany in 1983, does report that there is no microbiologic evidence that biomedical wastes are more infective than residential waste (37). These issues, however, have not been extensively researched in the United States to determine the degree of risks posed by infectious wastes. In any case, those actually working associated with the housekeeping, janitorial, and refuse handling and disposal of medical wastes indicate that packaging frequently (although actual numbers are not available) does not hold wastes, and that workers are exposed. Bags and boxes may leak fluids, or sharps may protrude (51,66).

In general, the establishment of standard operating procedures (SOPS) is regarded as an effective way to better ensure the proper handling, storage, and transportation of medical wastes.[8] For example, the segregation of medical wastes has a critical impact on the handling, storage, and transportation of wastes. EPA recommends that infectious wastes be segregated at the point of origin; that distinctive and clearly marked plastic bags and containers for infectious wastes be used; and the biological hazard symbol be used as appropriate (81). Hospitals tend to segregate wastes into at least infectious and non-infectious groups (61 ,62). Critical to the proper functioning of this system is knowledge of the waste types and their hazards by healthcare workers, and their cooperation to segregate the wastes.

Even though segregation of wastes is considered key to a successful waste management program, it is also generally regarded as a highly problematic practice. That is, there is some difficulty in ensuring that healthcare workers will reliably segregate wastes. In part this results from the fact that, understandably, "most nurses and physicians consider the delivery of health care to be their primary mission, not sorting wastes into [seemingly] arbitrary categories (58). For this reason some hospitals apparently find it easier to designate all wastes from certain areas of the hospital as infectious.

Although this approach may be more costly, given that disposal costs for infectious waste are generally higher than those for general refuse, it does minimize the chances for crossover of infectious waste into the general wastestream (58,62). If all the wastes are mixed, then they would probably be considered infectious and managed as such (i. e., sterilization or incineration v. landfilling or sewer use). Once again, the central importance of the definition of medical wastes becomes apparent. The hospital's definitions of wastes affects the segregation of the wastes within the hospital and their handling, treatment, and ultimate disposal.

*See, e.g., ref. 17. It is certainly an important aspect of the approaches recommended by CDC, OSHA, and EPA for medical waste management.