

CHAPTER V: DISPOSAL OF WASTES CONTAMINATED WITH INFECTIOUS AGENTS

These biohazard waste disposal guidelines are designed to not only protect the public and the environment, but also laboratory and custodial personnel, waste haulers, and landfill/incinerator operators at each stage of the waste-handling process. Generators of biohazard waste in the laboratory must ensure that the labeling, packaging, and intermediate disposal of waste conforms to these guidelines.

"Decontamination" means a process of removing disease-producing microorganisms and rendering an object safe for handling.

"Disinfection" means a process that kills or destroys most disease-producing microorganisms, except spores.

"Sterilization" means a process by which all forms of microbial life, including spores, viruses, and fungi, are destroyed.

A. WHAT IS REGULATED BIOHAZARD WASTE

The following items are usually considered to be regulated biohazard waste.

1. Microbiological laboratory waste (cultures derived from clinical specimens and pathogenic microorganisms, disposable laboratory equipment that has come into contact with the cultures, etc.).
2. Samples containing recombinant or synthetic DNA
3. Tissues, bulk blood, or body fluids from humans.
4. Tissues, bulk blood, or body fluids from animals that have the potential to carry an infectious agent that can be transmitted to humans.
5. Sharps (needles, broken glass, etc.).

Organisms carrying regulated recombinant DNA and exotic or virulent plant and animal pathogens also require decontamination before disposal.

The following are usually not included in the definition of infectious waste, but should be placed in containers such as plastic bags prior to disposal to contain the waste. If these items are mixed with infectious waste, they must be managed as though they are infectious. For this reason, you should **segregate regulated biohazard waste from other waste**.

1. Items soiled or spotted, but not saturated, with human blood or body fluids.
Examples: blood-spotted gloves, gowns, dressings, etc.
2. Containers, packages, waste glass, laboratory equipment, and other materials that have had no contact with blood, body fluids, clinical cultures, or infectious agents.

3. Noninfectious animal waste, such as manure and bedding, and tissue, blood, and body fluids or cultures from an animal that is not known to be carrying an infectious agent that can be transmitted to humans.

B. PACKAGING OF WASTE

Laboratory materials used in experiments with potentially infectious microorganisms, such as discarded cultures, tissues, media, plastics, sharps, glassware, instruments, and laboratory coats, must be either handed off to a contractor licensed as an infectious waste treatment facility, or be decontaminated before disposal or washing for reuse. Collect contaminated materials in leak-proof containers labeled with the *Universal Biohazard Symbol*; autoclavable biohazard bags are recommended.

There are several ways this is dealt with at UC:

1. Many labs and buildings collect biohazard waste in red bags and/or red bins with the biohazard symbol. This waste is picked up by people from Environmental Services or Environmental Health and Safety and is ultimately carried away by an outside group (e.g., Stericycle) where it is managed as regulated medical waste and it is decontaminated off-site before it is disposed in the environment.
2. As an added precaution, some labs choose to autoclave their bags first before it gets picked up as in (1) above.
3. For labs that choose to autoclave their own biohazard waste and discard in the general waste afterward, it is necessary (and legally required by the Illinois Environmental Protection Agency) to periodically test your autoclaves with bio-indicators or an equivalent. Please contact the Office of Biological Safety if this is an option that your lab wants to use.

Uncontaminated sharps and other noninfectious items that may cause injury require special disposal even if they need not be decontaminated. Sharps need to be collected in rigid puncture-proof containers to prevent wounding of coworkers, custodial personnel, and waste handlers. If a package is apt to be punctured because of sharp-edged contents, double bagging or boxing may be necessary.

C. METHODS OF DECONTAMINATION

Choosing the right method to eliminate or inactivate a biohazard is not always simple. The choice depends largely on the treatment equipment available, the target organism, and the presence of interfering substances (e.g., high organic content) that may protect the organism from decontamination. A variety of treatment techniques are available, but practicality and effectiveness govern which is most appropriate.

Biohazardous waste should be decontaminated before the end of each working day unless it is to be collected for treatment off-site. In the latter case, the waste should be packaged

and stored until the scheduled pick-up by the off-site contractor. Biohazard waste should never be compacted. Ordinary lab wastes should be disposed of as routinely as possible to reduce the amount requiring special handling.

1. STEAM STERILIZATION

Decontamination is best accomplished by steam sterilization in a properly functioning autoclave that is routinely monitored with a biological indicator such as spores of *Bacillus stearothermophilus*. The tops of autoclavable biohazard bags should be opened to allow steam entry. For dry materials, it may be necessary to add water to the package.

Usually a standard autoclave cycle of 121 °C, 15 psi for 45 minutes to an hour is sufficient, the nature of the waste in a batch should determine cycle duration. For example, if the waste contains a dense organic substrate, such as animal bedding or manure, a longer cycle may be necessary. Since there is a practical limit to the time that can be spent autoclaving waste, in such a case alternative treatment options may be more effective and economical. However, as with most generalizations, it is difficult to prescribe methods that meet every contingency. Such decisions are best left to the personnel directly involved, provided they are well informed and prepared to verify the effectiveness of the treatment.

Use extreme caution when treating waste that is co-contaminated with volatile, toxic, or carcinogenic chemicals, radioisotopes, or explosive substances.

Autoclaving this type of waste may release dangerous gases (e.g., chlorine) into the air. Such waste should be chemically decontaminated, incinerated, or sent to a hazardous waste landfill. Consult Environmental Health and Safety at safety@uchicago.edu (773) 702-9999 for more information.

2. SEWAGE TREATMENT

Most fluid waste, including human blood or infectious cultures that have been decontaminated by the appropriate method, can be discarded by pouring into the sanitary sewer, followed by flushing with water. Care should be taken to avoid the generation of aerosols. The routine processing of municipal sewage provides chemical decontamination. However, if the fluid is contaminated with infectious agents or biological toxins, it must be rendered safe by chemical or autoclave treatment before sewer disposal.

3. CHEMICAL DISINFECTION

Where autoclaving is not appropriate, an accepted alternative is to treat material with a chemical disinfectant that is freshly prepared at a concentration known to be effective against the microorganisms in use. The disinfectant of choice should be one that quickly and effectively kills the target pathogen at the lowest concentration and with minimal risk to the user. Other considerations, such as chemical

compatibility, economy and shelf life, are also important. Allow sufficient exposure time to ensure complete inactivation.

Halogens such as hypochlorite (household bleach) are the least expensive and are also highly effective in decontaminating large spills. Their drawbacks include short shelf life, easy binding to non-target organic substances, and corrosiveness, even in dilute forms. Household bleach is typically diluted 1:10 to 1:100 such that the available halogen is approximately 0.05%-0.5% (chlorine concentration of 500 ppm-5000 ppm). A 1:10 dilution of household bleach is generally effective for most biohazardous agents (the exceptions are prions and certain biological toxins). If a hypochlorite compound is used as a disinfectant, it is recommended that the decontamination step is followed by a wipe-down using 70% alcohol or water to mechanically remove corrosive residue. Also, be aware that using chlorine compounds to disinfect substances co-contaminated with radioiodine may cause gaseous release of the isotope.

Alcohol (ethanol or isopropanol), usually used at 70%, is effective against vegetative forms of bacteria and fungi, and enveloped viruses, but will not efficiently destroy spores or non-enveloped viruses. Please note that 70% alcohol is the optimum concentration. 100% alcohol is less effective than 70%. Characteristics limiting its usefulness are its flammability, poor penetration, presence of protein-rich materials, and rapid evaporation, making extended contact time difficult to achieve.

It is important to be aware that common laboratory disinfectants can pose hazards to users. For example, ethanol and quaternary ammonium compounds may cause contact dermatitis. Further information about chemical disinfectants can be obtained from the Office of Biological Safety.

Large volume areas such as fume hoods, biological safety cabinets, or rooms may be decontaminated using vapors or gases such as hydrogen peroxide, ethylene oxide, chlorine dioxide, or peracetic acid. These gases, however, must be applied with extreme care. **Only experienced personnel who have the specialized equipment and protective devices to do it effectively and safely should perform gas decontamination.**

Properties of common classes of disinfectants are summarized in Table 3a and 3b.

Table 3a.

	Active Against						Dilution
	Fungi	Bacteria (Gram- positive and negative)	Myco- bacteria	Spores	Lipid Viruses	Non- lipid Viruses	Optimal working concentration
Phenolic Compounds	+++	+++	+++	-	+	v	1-5%
Hypochlorites	+	+++	++	++	+	+	0.05-0.5% free chlorine (1:10 dilution of household bleach)
Alcohols	-	+++	+++	-	+	v	70-85%
Formaldehyde	+++	+++	+++	+++ ^a	+++	+	2-8%
Glutaraldehyde	+++	+++	+++	+++ ^b	+	+	2%
Iodophores	+++	+++	+++	+	+	+	0.5%

+++, good; ++, fair; +, slight; -, nil; v, depends on virus.

^a above 40 °C.

^b above 20 °C.

Table 3b.

	Inactivated by			Toxicity			Stable? ^a	Corrosive?	Flammable ?
	Protei n	Hard water	Detergen t	Ski n	Eyes	Lung s	>1 week		
Phenolic Compounds	+	+	C	Y	Y	N	Y	Y	N
Hypochlorites	+++	+	C	Y	Y	Y	N	Y	N
Alcohols	+	+	-	N	Y	N	Y	N	Y
Formaldehyde	-	+	-	Y	Y	Y	Y	N	Y/N
Glutaraldehy de	-	+	-	Y	Y	Y	Y	N	N
Iodophores	+++	+	A	Y	Y	N	Y	Y	N

+++, good; ++, fair; +, slight; -, nil; C, inactivated by cationic detergent; A, inactivated by anionic detergent; Y, yes; N, no;

Y/N, depends on physical form and other conditions.

^aStability may be effected by exposure to light and/or air.

Adapted from *Laboratory Safety Monograph. A Supplement to the NIH Guidelines for Recombinant DNA Research*, pp 104-105.

National Institutes of Health, Office of Research Safety, National Cancer Institute, and the Special Committee of Safety and Health Experts, Bethesda, MD (January 1979).