Biotechnology Waste
Autoclaving & Management

Training created from the UT Health Science Center Biosafety Officer Training course materials, and (bio) medical waste regulations found in:

- 30 TAC 330 Subchapter Y – TCEQ
- 25 TAC 1 Subchapter K – TDSHS
- 49 CFR 173.134(5) – DOT

Types of Medical Waste from biomedical research and educational institution research laboratories

- **Animal Waste** – carcasses, parts, blood & blood products, and bedding of animals intentionally exposed to pathogens
- **Microbiological Waste** – discarded
  - Cultures and stocks of infectious agents and associated biologicals
  - Cultures of specimens from research labs
  - Live and attenuated vaccines, excluding empty containers
  - Used disposable culture dishes and used disposable devices used to transfer, inoculate or mix cultures
- **Pathological Waste** – human materials
- **Human blood, blood products, and body fluids**
- **Sharps** – see next slide
Sharps

Any object contaminated with a pathogen or that may become contaminated with a pathogen and also capable of cutting or penetrating skin or a packaging material.

Sharps include, but are not limited to the following items when contaminated:

- Razor blades, Scalpel blades, Disposable razors and scissors
- Glass pipettes, specimen tubes, microscope slides
- Broken glass

Hypodermic needles and syringes with needles attached are considered sharps with or without contamination.

Treatment Methods (onsite)

All Regulated waste must be rendered non-infectious prior to disposal. They should be placed in properly labeled containers and then treated by:

1. Chemical disinfection-on inanimate surfaces, usually done with liquid waste and reusable equipment
2. Moist heat disinfection - microwave radiation of internally shredded waste with most heat; or sealed containers with radiowaves & then shredding
3. Thermal Inactivation - dry heat, which requires a much higher temperature than Steam disinfection.
4. Steam Disinfection/Sterilization- Subjecting waste to steam under pressure, which is the typical autoclave use.
Chemical Disinfection

Chemical disinfection is generally used for liquid wastes

- EPA registered disinfectant
  - 1:10 bleach solution (fresh container)
  - 70-100% Isopropanol
  - Phenols / Lysol – can be added to wash
- Immerse Completely for 10-15 minutes
- Disinfectant must be thoroughly drained prior to disposal if used on solids.
- Human and animal parts need to be macerated after disinfection.

Steam Disinfection/Sterilization via Autoclave

- Autoclaving provides an economical process of killing pathogenic microorganisms through saturation with moist heat (steam) under pressure, and is also called Steam Sterilization.

- This process makes the microorganisms nonviable by destroying (denaturing) essential proteins and structures

- Effective method of treatment if **All Three** factors are met:
  1. Time
  2. Temperature
  3. Pressure
## Steam Disinfection/Sterilization

### Autoclave Parameters for effective treatment:

<table>
<thead>
<tr>
<th>Autoclave Parameters</th>
<th>Temp.</th>
<th>Press.</th>
<th>Time</th>
<th>QC Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>121°C (250°F)</td>
<td>15 psi</td>
<td>15 min, or longer depending on load size</td>
<td>Geobacillus stearothermophilus, SteamPlus Sterilization Integrator</td>
</tr>
<tr>
<td>Prions (highest resilience)</td>
<td>132°C (270°F)</td>
<td>30 psi</td>
<td>4.5 hrs</td>
<td>same</td>
</tr>
<tr>
<td><strong>Dry Heat Tabletop Autoclave</strong> (when steam is not working or items cannot be penetrated by steam) May have to be approved for Pathological &amp; Sharps</td>
<td>170°C (338°F)</td>
<td>1 hr</td>
<td>Bacillus Atrophaeus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>140°C (284°F)</td>
<td>3 hrs</td>
<td>Same</td>
<td></td>
</tr>
<tr>
<td></td>
<td>121°C</td>
<td>16+ hr</td>
<td>Same</td>
<td></td>
</tr>
</tbody>
</table>

Parameters depend on the microorganism being treated

## Waste Collection Containers

### Rigid Container that is leak resistant
- Impervious to moisture (the bio bag) and strong enough to prevent tearing and bursting
- Orange heat resistant bags for Autoclave
- Absorbent to capture any free liquids*
- Closed collection container for aerosols

### Proper labeling
- Biohazard Symbol Labels on Containers
- If you can’t treat it immediately and need to leave the waste, place a tag on the bag labeling it with the following:
  - Contact Name
  - Contents – agent and materials
  - Date generated (bag filled)
Biohazardous waste materials to be autoclaved must be placed in a properly labeled, heat resistant, autoclavable bag.

- These are usually orange. Not all biohazard bags are made heat resistant for autoclaving (i.e., red ones meant for off-site incineration and disposal).
- *Do not put bleach in the bags, nor bleach waste first as this damages the autoclave metal and gasket seals.*
- If waste does not contain moisture, add \( \frac{1}{2} \) cup of water for required* steam
- Keep the bags open or loosely taped *while autoclaving** so that steam can get in

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**Color change tape only detects that the temperature was met, not if the pressure or length of time was met.**

**Bags should be left to cool for several minutes before removing from autoclave.**

**Once cool, securely close biohazard bag and place into opaque black bag which has (large white trash bin pictured) secondary containment.**
## Autoclave Use Log

University of Houston Clear Lake

### Minimum Values Required for Effective Treatment

<table>
<thead>
<tr>
<th>Treatment Date</th>
<th>User</th>
<th>PI</th>
<th>Waste Type (Agent, Materials)</th>
<th>Amount Treated (lbs)</th>
<th>Time In (hr:min)</th>
<th>Time Out (hr:min)</th>
<th>Temp. (121°C/ 250°F)</th>
<th>Pressure (15psi)</th>
<th>Comments (report problems to PI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/28/16</td>
<td>Lin, C.</td>
<td>Mathews</td>
<td>growth media, etc.</td>
<td>3.5</td>
<td>11/14-11/20</td>
<td>11/22</td>
<td>121°C</td>
<td>15psi</td>
<td></td>
</tr>
</tbody>
</table>
Efficacy Monitoring

Methods for Quality Control, Parameter Monitoring:

- Autoclave temperature tape - tells desired temperature reached, not time or pressure
- Parameter monitoring - pressure, time and temperature
- Record every load on autoclave use log
- Perform Efficacy monitoring (Biological activity check)
  - 50-99 lbs total generated on campus/month - monthly
  - 100 - 200 lbs/month - biweekly
  - >200 lbs/month - weekly
- Routine parameter monitoring may be substituted for biological monitoring for autoclaves which have a continuous readout and record of operating parameters. If this is done, cut and tape readout to autoclave log with other required information (date, initials, weight…)

Parameter monitoring is required to ensure autoclave is working properly.

This is done using SteamPlus Integrator strips.

**Time, Temperature, and Steam Pressure** are monitored

**Indicator should be placed in the bag with the waste to verify waste treatment, not near the door.**

Autoclaves with pinwheel plots require biological monitoring with **Verify** biological monitoring vials containing live GeoBacillus Stearothermophilus
## Efficacy Test Log

**University of Houston Clear Lake**  
**Auto clave efficacy testing**

<table>
<thead>
<tr>
<th>Autoclave Number</th>
<th>Treatment Date</th>
<th>Name</th>
<th>Initials</th>
<th>Time (min)</th>
<th>Temperature (°C)</th>
<th>Pressure (psig)</th>
<th>Month</th>
<th>Monthly Total Treated (Stips)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For compliance with AJHC Chapter 347. Special Written Tests or Sterilization Failures. For questions, call 713.522.2222. Report each result or sample call 713.522.2222.

## Autoclave Parameter Log Example

**University of Houston Clear Lake**  
**Auto clave testing log**  
*SteamPlus Sterilization Integritys strips*

**Minimum values required for effective treatment:**
- Time: 30 min
- Temperature: 121°C
- Pressure: 15 psig

**QC Monitoring Results:**
- Place strip in bag with waste. Attach Indicator Strip to sheet.

<table>
<thead>
<tr>
<th>Autoclave Number</th>
<th>Treatment Date</th>
<th>Name</th>
<th>Initials</th>
<th>Time (min)</th>
<th>Temperature (°C)</th>
<th>Pressure (psig)</th>
<th>Month</th>
<th>Monthly Total Treated (Stips)</th>
<th>Place Strip in Bag with waste. Attach Indicator Strip to sheet</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>9/10/18</td>
<td>Lisa</td>
<td>Cm</td>
<td>30</td>
<td>121</td>
<td>15</td>
<td>Sept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>9/10/18</td>
<td>Lisa</td>
<td>Cm</td>
<td>30</td>
<td>121</td>
<td>15</td>
<td>Sept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>9/10/18</td>
<td>Lisa</td>
<td>Cm</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>Sept</td>
<td></td>
<td>Rate clane not working</td>
</tr>
</tbody>
</table>
Autoclave Rooms are BSL-2

- It is important to remember that all autoclave rooms are BSL-2 (biosafety level 2) rooms per the CDC’s BMBL.
- Indicates a biohazard is present such as Hepatitis B virus, HIV, the salmonellae, and Toxoplasma spp. Also includes human-derived blood, body fluids, tissues, or primary human cell lines where the presence of an infectious agent may be unknown [include applicable verbage]
- Indicates that NO FOOD/DRINKS or cosmetics are allowed in the room

Autoclave Limitations

Can’t autoclave:
- Toxins
- Chemicals or disinfectants
- Non-heat stable materials / some plastics will melt
- Radioisotopes
- No animal carcasses or feces
- Must have water in bag to work or add water and loosely tie to allow steam to penetrate bag.
- Must do periodic indicator testing with Geobacillus stearothermophilus or tape or vial chemical indicator
Personal Protective Equipment

Personal Protective Equipment (PPE) is required by OSHA, Lab Prudent Practices, the State Office of Risk Management, and the Bloodborne Pathogens Standard (BBP) if exposure to chemicals, hazardous materials, or blood/OPIM is anticipated and where occupational exposure remains after institution of engineering and work practice controls.

- PPE should be replaced immediately if torn
- PPE should not be worn outside the lab area
- Long pants or long skirts and closed toe shoes only,
- NO shorts, short skirts, sandals, or peep toe shoes.

**Lab coats** must be worn to protect clothing/exposed skin from contact with blood/OPIM.

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**Gloves** - must be worn when hand contact with blood or OPIM is anticipated or when handling contaminated items

- Verify gloves are compatible with your specific application, process and materials before using
- Always wear heat resistant gloves and keep your face away from the door when loading and unloading the autoclave

**Safety glasses** (with side shields) to protect the eyes.

**Face shields** to protect mucous membranes, such as the nose, mouth and eyes from contact with any blood or OPIM during sample manipulation

**Surgical mask** to protect the nose and mouth.

- The last 2 PPE should be used in addition during procedures that are likely to generate splashes or sprays of blood or OPIM.
Frequent and effective hand washing are essential in reducing transmission of bloodborne pathogens as well as other bacteria such as Methicillin resistant Staphylococcus aureus (MRSA) and Vancomycin Resistant Enterococcus (VRE). Always wash before leaving work area.

- Sing the Happy Birthday song while rubbing hands together for 20 seconds.
- Demo
- Sanitizer Limitations
**Employee Safety Practices**

- Avoid compressing bags which may create aerosols.
- Waste should be stored *inside* the autoclave room and not in the hallways, in rigid, leak proof containers such as a bag inside a box, bin, or secondary containment tray/tub.
- Sharps (needles, glass pipettes or other pipettes that can puncture bags, broken glass or plastic*, microscope slides, etc.) placed in an autoclavable red sharps container.
- Biological Waste should not be left for “someone else” to autoclave.
- Biological waste containing hazardous chemicals (flammables, disinfectants) should not be autoclaved. Call EH&S at 281-283-2106 for collection of these items.

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**Employee Safety Practices**

- Be a conscientious worker:
  - Keep work areas clean and free of hazards.
- Use **Standard Precautions**:
  - Treat all human blood and body fluids as if known to be infectious.
  - No eating, drinking, or applying cosmetics in the work area.
  - Frequent hand washing.
  - Decontaminate work surfaces daily, and have disinfectant available in the room(s).
Common Biosafety Deficiencies

Common deficiencies include:

- Food or drink consumed or stored in autoclave area
- Autoclave log incomplete (or not present)
- Sterility monitoring not performed
- Training records incomplete
- Minors in the work place
- Absence of disinfectant indicates surfaces are not disinfected

Autoclave Use Instructions:

1. Use heat indicating autoclave bags or place indicator tape on the autoclave bag. Make sure bags are designed for autoclave use or they will melt and you will have to clean up the mess.

2. **Do not store waste for someone else to autoclave.** If you must leave, place a tag on the bag labeling it with all required information:
   - Biohazard logo with specimen/agent name (contents)
   - Name or PI name and room # came from, and the date

   This is necessary because the bag may need opened some to allow both pressure and moisture to penetrate (steam sterilization). Do you want to handle or open someone else’s unknown biohazards?

3. Place waste inside autoclave. Use secondary containment (pan) under the bag. *If waste does not contain any moisture, put ½ cup of water inside bag for steam generation.*
**Autoclave Use Instructions:**

4. Autoclave according to manufacturer’s instructions for a minimum 30 minutes, at a minimum operating temperature and pressure of 250 deg. F and 15 psi. (refer to chart)

5. Log usage activity in the autoclave usage log

6. When cycle is finished, inspect sterilizing tape, and visually check bags to ensure autoclave was working correctly. Check that the bag is open, moisture is present, and for color change of bag text.

7. Wait a few minutes for waste to cool, then remove with heat resistant gloves.

8. Place waste in black opaque bags held steady inside a bucket. Seal autoclave bag, then black bag with tape or tie in a knot.

9. Place waste in trash cans labeled “Autoclaved Waste Only”

10. Perform routine efficacy monitoring and record results in logbook

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**Blood Borne Pathogens (BBP)**

*Slides applicable for Biotechnology Labs Created from:*

- UH Bloodborne Pathogens Training
- UT Health Science Center Houston Bloodborne Pathogen Awareness Training
- OSHA’s Revised Bloodborne Pathogens Standard Training, 2001
Governing Laws & Regulations

**OSHA**
- Needlestick Reduction Act modified it in 2001
  - Education of and selection of sharps injury reduction devices (like self-sheathing needles)
  - Keeping a (contaminated) sharps injury log

**TDSHS** Bloodborne Pathogen Control 25 TAC 96
- Exposure Control Plan required to minimize government agency employee’s exposure to BBP.

What is a Bloodborne Pathogen?

Any pathogenic microorganism that is present in human blood, or other potentially infectious materials (OPIM) that can cause disease in humans.

Some examples include:
- Hepatitis B Virus (HBV)
- Hepatitis C Virus (HCV)
- HIV / Aids
- Treponema pallidum (syphilis)
- Herpes Virus
- HTLV-I
- Mycobacterium tuberculosis
Bloodborne Pathogens may be transmitted by:

- Puncture wounds caused by sharp objects
  - Broken glass, misuse of or accidental puncture by needle
- Contact with open wound or broken skin
  - Risk increases with prolonged contact or larger areas of broken/damaged skin
- Splash into the eyes
- Sprayed or aerosolized and into nose or mouth

**BBP – Example Injury Statistics**

- This is a summary of the UT Health Statistics:
  - Percentage of reported potential BBP exposure injury events (out of all reported injuries)
    - Residents 92%
    - Students 87%
    - Employees 26%
  - Of those BBP injuries, these were the types
    - Needlestick 50% of all BBP injuries
    - Cut (Other) 30%
    - Known BBP Exposure 20%
Minimizing or Eliminating Hazards

- Engineering controls
- Safe Work Practices & Universal Precautions
- Signs and labels
- Personal Protective Equipment
- Proper hygiene
- Proper waste disposal procedures
- Spill cleanup
- Exposure Control Plan which identifies the above information

Engineering Controls

Engineering Controls are devices that isolate or remove the BBP from the workplace. They can include:

- Handwashing Facilities
- Leak-proof containers for storage and transportation
- Sharps Injury Reduction Devices such as retractable syringes, self-sheathing needles and needless systems used
- Biosafety cabinet (BSC) with HEPA filter & Directional air flow
Sharps Injury Prevention

- **Eliminate** the use of sharps when possible
- If elimination is not possible, **use engineered sharps devices** that reduce injury (slides following)
- And use **Safe Sharps Practices** at all times:
  - NEVER recap a used needle!
  - NEVER bend or manipulate sharps
  - NEVER pass sharps by hand between people
  - Do NOT attempt to catch falling sharps if dropped
  - Use a **puncture resistant tray** to transport sharps
  - Don’t fill container more than ¾ full

Sharps Injury Reduction Devices

Hypodermic syringes with “Self-Sheathing” or “Retractable Technology”
Safe Work Practices

- **Universal Precautions** - treat all human blood and body fluids as if they are infectious.
- **No smoking, eating, drinking, applying cosmetics or contact lenses in the work area**
- **Decontaminate work surfaces** – frequently, after spills, with 10% bleach or 70% Isopropanol
- **Hand washing** – frequent, adequate
- **NEVER recap needles!!**

Signs, Labels and Color Coding

Observe warning signs in biohazard work areas or on laboratory doors that alert of hazards present. Door signage also shows the appropriate PPE needed in the laboratory.

Inside the lab, warning labels must be placed on all containers of waste, refrigerators, and freezers that contain blood or other potentially infectious material. These labels must have the word "BIOHAZARD" on them.
First-Aid Response

- Remember Universal Precautions
- Encourage self-care
- Use PPE
- Avoid applying pressure without barrier
- Apply routine first aid
- Clean site of injury with soap and flush with warm water for at least 15 minutes
- Flush mucous membranes with water or saline for at least 15 minutes

Spill Clean-Up

If you spill blood or OPIM:
- Place paper towel(s) or other absorbent material on top
- Wet that with disinfectant and let sit for 10 minutes
- Pick up broken glass pieces with tongs or dustpan or piece of plastic
- Then wipe up spill from outward to inward

Never pick up broken glass with your hands, even while wearing gloves.
- Contaminated broken glass should go in a sharps container.
- Disinfected broken glass can go in broken glass container.
Post Exposure Follow-up

- Seek medical treatment
- Employees must report exposure to supervisor and EHS within 24 hrs via Incident Report form
- Risk Management ext. 2106
- Some incidents are reportable to the CDC or the TDSHS within 24hrs, some within a week
- Blood tests
- Post exposure prophylaxis
- Counseling

Resources

UH Biosafety Manual

Occupational Health and Safety Administration

Centers for Disease Control and Prevention
http://www.cdc.gov/niosh/topics/bbp/
Questions?

Environmental Health & Safety Department
ext. 2106

https://www.uhcl.edu/about/administrative-offices/environmental-health-safety/

– Lisa Coen –
(281) 283-2107
coen@uhcl.edu