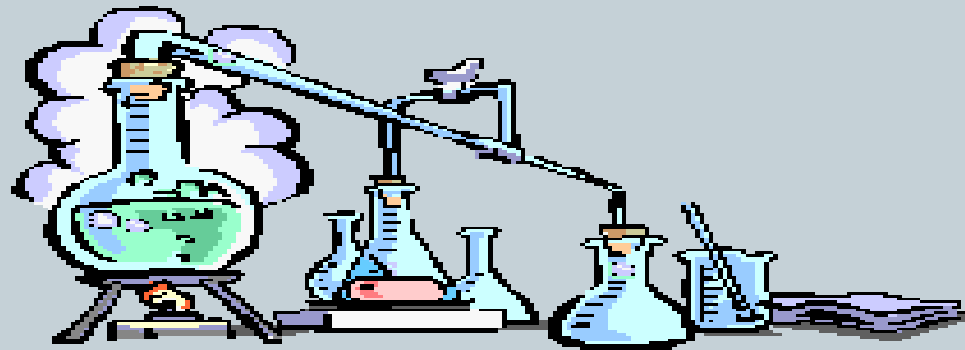


Sino-American Cancer Foundation 2023 Summer Research Program Health and Safety in the Laboratory



This material was produced under grant number SH-17035-08-60-F-11 from the Occupational Safety and Health Administration, U.S. Department of Labor. These materials do not necessarily reflect views or policies of the U.S. Department of Labor, nor does mention of any trade names, commercial products, or organizations imply endorsement by the U.S. Government.

Objectives



After this session, you will know:

- How to identify health and safety hazards of laboratory work
- Health and safety measures your lab should have in place
- How best to protect yourself from hazardous exposures
- The requirements of OSHA's Laboratory Standard

Lab Safety Topics

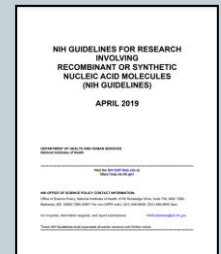
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- 1. Guiding Regulations(Cal/OSHA, Biosafety Guidelines, California Medical Waste Management Act**
- 2. Additional NFPA and HMIS slides for Label Types**
- 3. SDS Details**
- 4. Laboratory acquired infections**
- 5. Risk Groups and Biosafety Levels**
- 6. BSL Practices and Labeling**
- 7. Biosafety Cabinet Practices (BSC)**
- 8. Centrifuge Use and Procedures**
- 9. Biological Spills within the BSC**
- 10. Biological Spills within the Open General Lab space**
- 11. Decontamination and Disinfection Practices**
- 12. Exposure Controls and Procedures**
- 13. BBP (Blood-borne Pathogens introduction) and IIPP (Injury, Illness, and Prevention Plan)**
- 14. Universal Lab Precautions**
- 15. Sharps Precautions**
- 16. Chemical Storage Practices**
- 17. Chemical Handling**
- 18. Exposure to Hazardous substance**

Guiding Regulations



- Cal/OSHA Bloodborne Pathogens Standard
 - <https://www.dir.ca.gov/title8/5193.html>
- Biosafety Guidelines
 - Biosafety in Microbiological & Biomedical Laboratories (BMBL) 6th Edition
 - NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules (NIH Guidelines 2019 Edition)
- California Medical Waste Management Act; California Health and Safety Code Sections 117600 – 118360:
 - <http://www.cdph.ca.gov/certlic/medicalwaste/Pages/default.aspx>



OSHA's Hazard Communication Standard requires that ALL Containers Must be Labeled With:

Chemical Name & Physical/Health Hazards

SODIUM HYDROXIDE 50 %

CAS NO. 1310-73-2

WARNING! CAUSES SEVERE BURNS AVOID BREATHING VAPOR-USE WITH ADEQUATE VENTILATION
Avoid contact with skin or eyes. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes; for eyes, get medical attention. Wash clothing before re-use.

DO NOT LOAD WITH EXPLOSIVES OR HEAR ARTICLES BEARING OXIDIZER LABELS

CONTAINER HANDLING AND STORAGE:
Before moving container be sure closure is securely fastened. Keep out of sun and away from heat. Completely drain container before returning. Never use pressure to empty. In case of spillage, flush with plenty of water.

IMPORTANT: All products are sold without warranty of any kind and purchasers will, by their own tests, determine suitability of such products for their own use.

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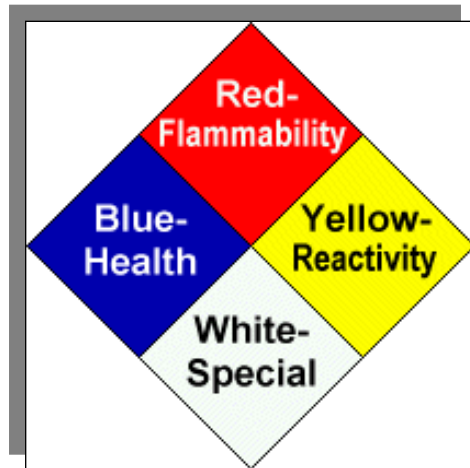
_____ LBS. NET WT.

ABC Chemical Company
100 Main St., Philadelphia, PA
1-800-555-1212

WHEN HANDLING WEAR GOGGLES OR FACE SHIELD. DO NOT ADD WATER TO CONTENTS WHILE IN A CONTAINER BECAUSE OF VIOLENT REACTION. WHEN DILUTING, ADD CONTENTS TO WATER SLOWLY.

Name & Address of the Manufacturer & Emergency Contact Numbers

Types of Labels



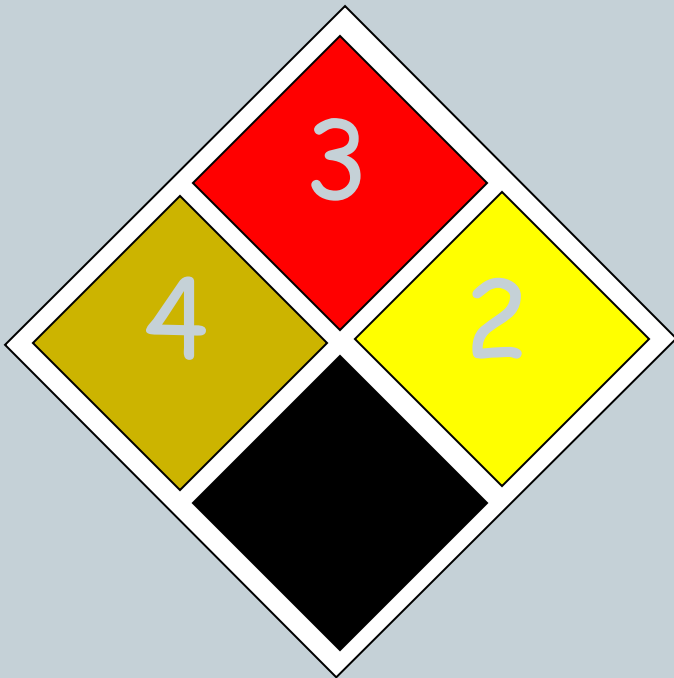
NFPA Diamonds and **HMIS** Bars are Color & Number Coded with Hazard Information



DOT Symbols Are Usually Found on Shipping Cartons

Color and Number Coded Label Systems

NFPA-type label



Colors represent kind of hazard

- Red = fire
- Yellow = instability
- Blue = health
- black = specific hazard & personal protection

Numbers show degree of hazard

- 0 = Minimal
- 1 = Slight
- 2 = Moderate
- 3 = Serious
- 4 = Severe

Safety Data Sheets (SDS)



- An SDS Must Be on File & Available for Each Chemical in the Lab.
- An SDS lists:
 - **Product Identity**
 - **Hazardous Ingredients**
 - **Physical Data**
 - **Fire & Explosion Hazard Data**
 - **Reactivity Data**
 - **Health Hazard Data**
 - **Precautions for Safe Handling & Use**
 - **Control Measures**

SDS (cont'd)

Hazards Identification

- **Inhalation**: Respiratory tract (lungs) through inhalation
- **Ingestion**: Digestive tract through eating or smoking with contaminated hands or in contaminated work areas
- **Absorption through the skin or eyes**: Dermatitis or damage to the liver, kidney, or other organ systems
- **Injection**: Percutaneous injection of a toxic substance through the skin

SDS (cont'd)



Specific possible health hazards:

- **Acute poisoning** (rapid assimilation of substance, i.e., carbon monoxide)
- **Chronic poisoning** (prolonged exposure, i.e., lead poisoning)
- **Cumulative poisons** (numerous chronic exposures, i.e., heavy metals)
- **Substances in combination** (synergistic effect, i.e., exposure to alcohol and chlorinated solvents)

SDS (cont'd)



Potential Health Effects

- Eye irritation
- Nausea
- Dizziness
- Skin rashes
- Headache
- Existing medical conditions possibly aggravated by exposure

SDS (cont'd)



- Emergency/first-aid procedures to follow
- **Accidental Release Measures**
 - ✓ What to do if substance spills and leaks
 - ✓ How to correctly dispose of substance
 - ✓ Equipment/procedures for cleaning up spills and leaks

MSDS (cont'd)



Handling and Storage

- How to handle and store substance safely
- Any other precautions (i.e., grounding containers during transfer of flammables)

SDS (cont'd)



- **Exposure Controls, Personal Protection**
 - ✓ Respirator
 - ✓ Gloves
 - ✓ Eye protection
 - ✓ Protective clothing
 - ✓ Ventilation
- **Special work and hygiene practices that should be followed**

Laboratory Acquired Infections



- The main concern when working with biohazardous substances is the capacity for infection and illness.
- Theragent works with human/sourced cell lines
- Theragent also works with viral vectors. These are characterized as non-pathogenic prior to use.



Infection can be transferred in multiple ways, and it isn't always clear once an infection happens where the source came from.

- Splashes/Spills
- Sharps Exposure (ie. Needlesticks)
- Aerosol Inhalation

Aerosols



Aerosols are microscopic droplets hanging in the air. They can be generated through many practices in the bio lab:

- Blending
- Mixing
- Centrifuging
- Pipetting
- Even disturbing the surface of a liquid can be enough to release droplets into the air.
- Over 80% of documented cases of lab acquired infection are assumed to come from aerosol inhalation.



Aerosol Control - A Common Biosafety Theme



- Biohazardous materials should not be forcibly discharged from pipettes.
- Use "to deliver" liquids from pipettes and do not depress completely to "blowout" the last few drops.
- Most modern pipettes are calibrated so that the last few drops are not part of the accurate measurement.
- Do not discharge biohazardous material from a pipette at a height.
- Whenever possible allow the discharge to run down the container wall.

Risk Groups & Biosafety Levels



- Biohazards are placed into Risk Groups (RG) which are set by the NIH
- Risk Groups 1 through 4 mostly align with Biosafety Levels 1 through 4 (some exceptions)

**BSL-
1**

No risk of infection for healthy adults. Examples: Animal cells/cell lines, E-coli K12

**BSL-
3**

Life-threatening risk to humans, but treatment is available. Examples: Tuberculosis, West Nile Virus

**BSL-
2**

Can cause infection in healthy adults but not life-threatening of debilitating. Examples: Human materials, viral vectors, multiple common illnesses

**BSL-
4**

Pathogens with life-threatening risk with no treatment available. Examples: Ebola, Marburg, Lassa

Biosafety Levels at Covina



- Our labs and Production areas are currently restricted to:

**BSL-
2**

Can cause infection in healthy adults but not life-threatening or debilitating. Examples: Human materials, viral vectors, multiple common illnesses

*Human source material must be handled in a BL2 setting until processing eliminates possibility of viable infectious agents (generally after DNA, RNA or protein purification)

Biosafety Levels at Covina



- Our office and support areas are currently restricted to:

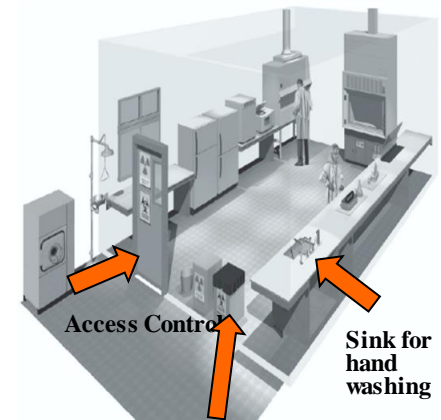
NR

Not restricted.

BSL-1 Practices



- Restricted access to the labs (keycard access only after you've received training)
- No eating, drinking or smoking
- No mouth pipetting
- Minimize splashes and aerosols
- Decontaminate work surfaces daily
- Control flow of waste to biohazard disposal containers
- Wash hands frequently, between glove changes, and before leaving the lab if touching potentially hazardous materials
- Must adhere to our PPE policy anytime you enter designated laboratory space.
- Dispose of gloves or other contaminated debris according to our waste program - do not reuse!!

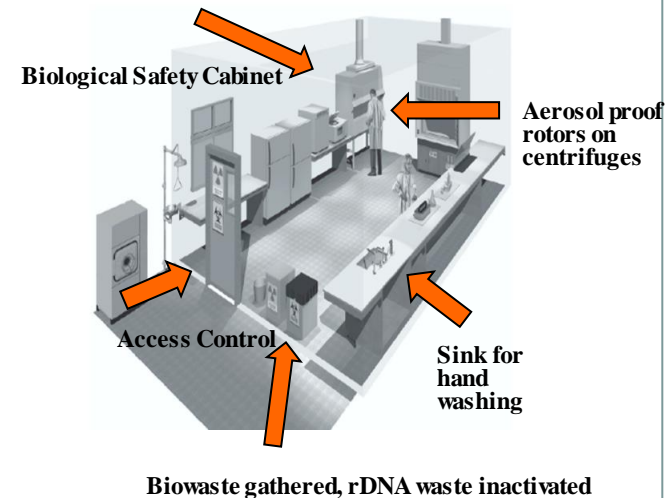


Biowaste gathered, rDNA waste inactivated

BSL-2 Practices

In **addition** to BSL-1 practices:

- Potentially infectious materials must be placed in a durable, leak proof container during collections, handling, processing, storage, or transport within the facility
- Sharps are discouraged – organize your workstation to place the sharps container at the point of sharps waste generation
- Equipment must be decontaminated before repair, maintenance or removal from the lab
- Use a BSC when:
 - Procedures with a potential for creating infectious aerosols or splashes are conducted; or
 - High concentrations or large volumes of infectious agents are used.



Biosafety Labeling



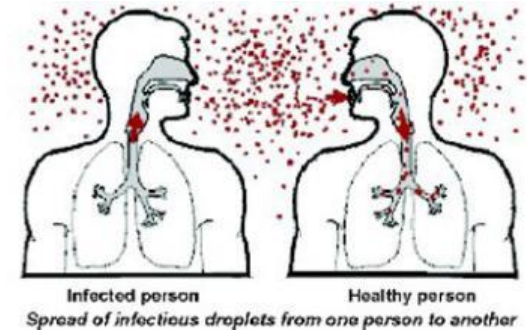
The Universal Biohazard Symbol is required to be posted on the following:

- Medical waste secondary containers
- BSCs, centrifuges, refrigerators, freezers, or any other equipment that contains biohazardous materials
- Storage areas
- Work areas



Aerosol Control (continued)

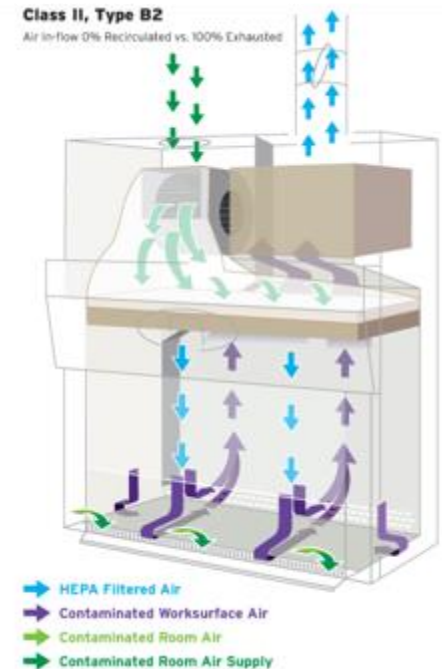
- Aerosol exposure requires increased biosafety levels.
- Aerosols are microscopic particulate droplets caused when the surface of a liquid is disturbed.
- Due to their small size they can remain suspended in the air for minutes and can be inhaled deeply into lungs past primary mucosal barriers.



Biosafety Cabinets (BSCs)

General

- Protects personnel, product, environment
- Recirculated air (no chemical use other than disinfectant)
- Work 6 inches behind sill
- Avoid heat sources
- Avoid rapid movement (flow disturbance)
- Do not use for storage of any materials
- Do not use if blower is malfunctioning (indicated by airflow indicator on unit) – notify Facilities/or lab manager for further action



Biosafety Cabinets (BSCs)



Protocol

- Prevent airflow problems – never work in a BSC if the alarm is sounding. Avoid rapid movement that could disturb airflow thereby exposing you to the hazards within.
- Separate clean and dirty items – work left to right to avoid contamination
- Keep the intake air grille clear – disturbs flow and could risk contamination of the worker
- Disinfect items before removing them from the cabinet
- Dispose of waste properly – removing disinfected waste from the cabinet frequently cuts down on clutter
- Use the correct sash height – indicated on side. Don't raise above!
- Use UV lights safely – activate only if sash is closed
- No open flames allowed in a BSC
- Decontaminate before/after w/ 70% Ethanol
- No storage permitted in BSC
- Turn blower on 15 min prior to use

Centrifuge Use



General

- Safety cups allow you to centrifuge in an open lab space – use when working with BSL-2 materials and whenever possible
- They contain aerosols and prevent exposure – also allow safe transport to another location

Procedure

- Check tubes for cracks/chips
- Use matched sets of tubes, buckets etc.
- Tightly seal all tubes and safety cups
- Ensure that rotor is locked to spindle and bucket seated
- Close lid during operation
- Allow to come to complete stop before opening



Biological Spills – Inside the BSC



- Wait at least five minutes to allow the biosafety cabinet (BSC) to contain aerosols
- Allow cabinet to run during cleanup
- Apply disinfectant and allow a minimum of 30 minutes contact time
- Wipe up spillage with disposable disinfectant-soaked paper towel
- Wipe the walls, work surface, and equipment in the cabinet with a disinfectant-soaked paper towel. 10% bleach solution or other (e.g. bleach solution, 70% ethanol)
- Discard contaminated materials using appropriate biohazardous waste disposal procedures
- Run cabinet 10 minutes after cleanup before resuming work or turning cabinet off



Biological Spills – Open Lab



- Apply spill pads directly
- Add 10% bleach solution to the spill pad
- Encircle the spill with additional disinfectants being careful to minimize aerosolization while assuring adequate contact
- Decontaminate all items within the spill area
- Allow 30 minutes contact time to ensure germicidal action of disinfectant
- Wipe equipment with appropriate disinfectant after spilled material is removed
- Discard contaminated disposable materials using appropriate biohazardous waste disposal procedures
- Disinfect reusable items
- Complete an incident report form (as directed in IIPP training)

Decontamination / Disinfection



Decontamination is required:

- Before equipment is serviced
- Before equipment is moved out of the labs (i.e. for trash or moving purposes)
- After spills
- Before/after certain procedures as covered previously (e.g. BSC use, centrifuge use); and
- After lab procedures are complete (e.g. benchtops, materials, equipment)

Approved Disinfectants Onsite:

- 70% Ethanol (spray bottles)
- Bleach (10% solution, below sinks)

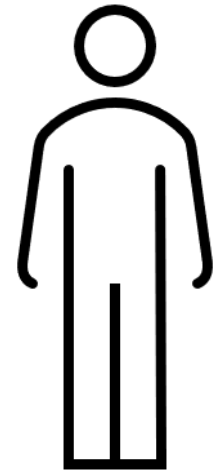


Exposure



For any exposure from a sharps injury or direct contact with a mucous membrane:

- Wash the wound immediately with soap and water
- Notify Supervisor/Manager and/or the Emergency Coordinator immediately – determine microorganism involved
- If the IIPP Administrator recommends, go to the walk-in clinic for evaluation. This is necessary for those exposures that involve potentially infectious materials (discussed later in this training)
- Complete incident report after initial care is complete



Exposure – Specific Contamination Procedures



If you are contaminated:

- Remove contaminated items
- If eye contaminated has occurred, rinse eyes in eyewash for 15 min, have eyes examined by physician – then proceed to remove contaminated items
- Fold contaminated area inward and place in biohazard bag for autoclaving
- If skin is contaminated, use sinks or safety shower to wash affected area for 15 minutes (antimicrobial soap provided at major lab sinks)

If you are exposed via puncture by sharp object:

- Immediately wash area with soap and water for at least 3 minutes except in uncontrolled bleeding situation.
- Some bleeding is appropriate in cleansing the wound.
- Place contaminated items into compatible waste streams

Bloodborne Pathogens

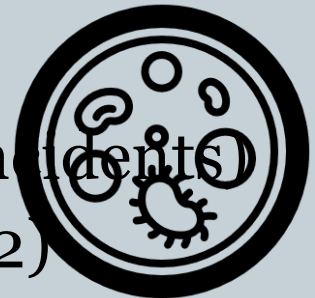


What are they?

- Pathogenic microorganisms present in human blood that may cause disease in humans.
- They can be found in blood, blood products, or other potentially infectious materials (OPIM).
- OPIM: any body fluid that is visibly contaminated with blood, unfixed tissue or organ, etc.

What's Onsite?

- Human Blood (potential for blood-related incidents)
- Primary Human Cell Lines in the Lab (BSL-2)
- Viral Vectors in the Lab (BSL-2)

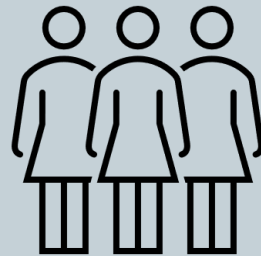


Bloodborne Pathogens



Who is Potentially “at risk” of Exposure to Bloodborne Pathogens at Theragent?

- All who are cleared to enter the designated laboratory area (given access after training)



Bloodborne Pathogens of Concern



HIV

- Destroys immune system
- Isolated from: blood, semen, saliva/tears, urine, cerebrospinal fluid, amniotic fluid, breast milk, cervical secretion, and tissue of infected persons
- HIV is transmitted through sexual contact, percutaneous or mucous membrane exposure to blood or transfusion of HIV contaminated blood
- No vaccines available
- Unstable when exposed to air

Hepatitis B

- Inflames the liver
- HBV can cause severe damage to or failure of the liver in some persons
- Transmitted by direct contact with blood or body fluids
- Most common symptom is yellowing of the eyes
- Vaccine available

Hepatitis C

- Stable on dried surfaces for 7 days
- 0.5% lethality
- Routes of exposure include transmission via needles/lacerations
- No vaccine available
- Most dangerous of the Hepatitis viruses

Routes of Exposure (Reminder)



- As covered previously, please remember the routes of exposure:
- Laceration (most common route of exposure to BBP)
- Exposure via non-intact skin (no gloves or covering)
- Mucous membrane contact (mouth, nose, eye, etc.)
- Accidental ingestion (incomplete disinfection / hand-washing)

Important: exposure events to BBPs can often be seemingly insignificant in the moment and symptoms may not immediately present themselves, often only showing later in life or during other severe illnesses.

This is why we add special precautions for handling potentially infectious materials...

Universal Precautions



- Treat all specimens and samples as if they are infectious
- Wear proper PPE
- Must be observed in all situations where there is a potential for contact with blood or other potentially infectious materials
- Adhere to proper disinfection techniques
- Report all potential exposure immediately to your supervisor/manager and/or the IIPP Administrator

**UNIVERSAL
PRECAUTIONS**

Special Precautions - Sharps



- Dispose at or near point of generation
- Sharps containers are rigid, leak-proof, closable (provided in several sizes: benchtop and large floor bins)
- Do not recap needles
- Do not bend, break or shear needles
- Use sheath razors
- Please contact the Lab Manager if you'd like to discuss safer sharps alternatives



How to Recognize an Exposure Incident



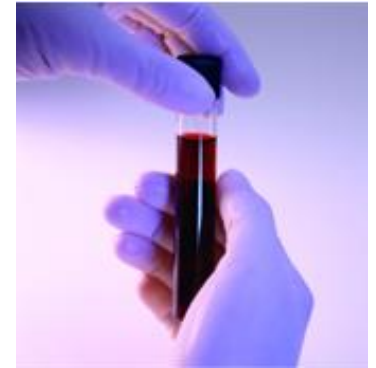
- A specific incident of contact with potentially infectious bodily fluid
- Only considered an “occupational exposure” if mucous membranes or open skin surfaces are infiltrated
- Regardless, report all accidents involving blood or bodily fluids
- Post-exposure medical evaluations are offered via the walk-in clinic & occupational health center



Post Exposure Evaluation



- Performed in cooperation with our occupational healthcare provider
- Confidential medical evaluation
- Route of exposure is documented
- Source individual is identified (if applicable)
- Source individual's blood is tested (with their consent)
- Results of evaluation are provided to exposed employee



No cost to employee (including follow-up evaluations, appointments, treatment, counseling, related therapy, etc)

Bloodborne Pathogens Takeaway



- You're at risk for occupational exposure to bloodborne pathogens in the lab
- Necessary steps to reduce infection risk are outlined in our written policy
- If exposed, prompt evaluation is necessary
- Records are kept on employees' vaccination and training status
- Prevention is key
- You're entitled to confidential evaluations and to acquire copies of your exposure records upon request at any time

Match the Extinguisher to the Risk!



Fire Extinguishers Must Be:

- ❖ Clearly labeled to indicate the types of fire they are designed to extinguish.
- ❖ Visibly **inspected** monthly and maintained annually.

❖ **Class ABC** Extinguishers Should Be Located:

- At the Laboratory Exit
- Within 50 Feet of Any Point in the Lab.

❖ **Class D** Extinguishers Are Required for Combustible Metals.

Chemical Storage



Safe Storage of Chemicals is a Necessity in Every Laboratory!

- ❖ Minimizes Exposure to Staff for Corrosive and Toxic Chemicals
- ❖ Lessens the Risk of Fire
- ❖ Prevents the Mixing of Incompatibles & the Creation of an Emergency Situation

The “Don’ts” of Chemical Storage!



- ❖ Avoid storing any chemical above eye level
- ❖ Don't store incompatible chemicals together
- ❖ Don't store chemicals near sources of heat or sunlight
- ✓ Don't store chemicals in the hoods or acids on metal shelves
- ✓ Avoid storing anything on the floor, especially glass bottles

Handle Chemicals with Care



- **Dispose** of chemicals, broken glass, and other waste in approved containers
- **Clean up** broken glass and spills immediately
- **Keep** the lab clean and neat
- **Store** incompatible chemicals in separate storage areas

Storage Cabinets

- Not more than 60 gal of Class I and/or Class II liquids, or not more than 120 gal of Class III liquids permitted in a cabinet
- Must be conspicuously labeled, “Flammable - Keep Fire Away”
- Doors on metal cabinets must have a three-point lock (top, side, and bottom), and the door sill must be raised at least 2 inches above the bottom of the cabinet



Be Prepared for Small Incidental Spills



Chemical Categories Found in Most Laboratories Include:

- **Organic Solvents**
- **Acids**
- **Alkalis (Bases)**
- **Mercury**

Proper Incidental Spill Control Equipment Includes:

- ❖ Spill Control Materials Such As Spill Control Pillows, Pads, Booms, etc.
- ❖ Scoops, Brooms, Pails & Bags
- ❖ Absorbent – such as Diatomaceous Earth
- ❖ Neutralizers – for Acids & Alkalis
- ❖ Mercury Spill Control Kit

Certain Spills Aren't for Quick Clean-up



- As a lab employee, you should **only** respond to incidental chemical releases, or small spills.
- For large or especially hazardous spills:
 - Report to your EHS department
 - Assess whether there are any injured persons and attend to any person who may have been contaminated.
 - Follow the notification, evacuation and emergency medical treatment procedures for your facility.
 - Evacuate the immediate area until the hazardous release has been characterized and controlled.

If Overexposed to a Hazardous Substance



- **Get medical help immediately!**
- **Inform** your lab supervisor
- **Check SDS** for first-aid instructions.
- Some **general guidelines** are
 - ✦ **Eyes:** Flush with water for 15 minutes
 - ✦ **Ingestion:** Follow label and MSDS instructions
 - ✦ **Skin Contact:** Stand under emergency shower and remove contaminated clothing immediately
 - ✦ **Inhalation:** Get to fresh air and get prompt medical attention

Biological Wastes Section



**SAFETY TRAINING
FOR ALL LAB
EMPLOYEES**

Waste Chemical Disposal

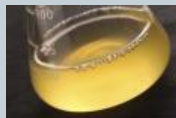


- **Requires:**
 - **Proper storage** – same rules apply – make sure waste chemicals are compatible
 - **Proper labeling** – tags should be placed on bottles name of chemical
 - **Pre-planning** – know what waste you're creating prior to carrying out experiments; minimize purchases
 - **Record-keeping** – of all waste chemicals on hand and those already picked up for disposal

Liquid Biowaste Disposal



- Bleach before sink disposal
- Use 10% bleach, mix well, let sit 20 minutes, dispose
- Do not mix bleach with other disinfectants or in compatible chemicals, bleach may react violently with other chemicals.
- Standard under BSCs – fixed to vacuum lines
- Only sink dispose if end solution is non-hazardous.
- Rinse sink with water when finished.



Solid Biowaste Disposal



- Please move full biowaste containers to the biohazardous waste storage area when full – Triumvirate Environmental sets periodic pickups with the Biosafety Officer
- As lab employees, your role is to recognize when the biowaste containers are ready for disposal.
- At that time, move the biowaste to the Biowaste Storage Room and collect a fresh liner/container.
- Bags must be intact. No sharps in biowaste bags!

Container Setup

1. Set up your medical waste container.
2. Line your medical waste container with the red bag.
3. Dispose of only medical waste in the red bag.
4. Gather, twist, and tie the red bag.
5. Seal your medical waste container.
6. Check the medical waste container's markings.



Sharps Disposal



- Collect biologically contaminated sharps in a red sharps container
 - Needles & syringes
 - Razor blades and scalpels
 - Used Pasteur pipettes
 - Glass slides/cover slips used in wet mounts
 - DON'T Overfill!
 - Never fill a container more than 2/3 of the way full. Close the lid securely before disposal.
- If your lab has the DISPOSABLE sharps bins, close the lid and place in biowaste solids bags/containers.
- **NEVER** dispose of a sharp or broken glass in the regular trash!



Thank You!



**SAFETY TRAINING
FOR ALL LAB
EMPLOYEES**