Western University: Biosafety Training

Presented by:
Human Resources, Occupational Health and Safety

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Learning Objectives

To be familiar with safety legislation
To understand Biohazardous risks in the laboratory
To be able to understand the difference between 4 Biological Risk Groups
To have a good working knowledge of Containment Levels (1-4)
To understand the application and limitations of Biological Safety Cabinets (Types I, II, and III)
To understand what to do in a spill

Learning Objectives

To understand the recommended Universal Precautions techniques
Participants will learn about UWO Sharps Management protocols
Participants will learn the safe procedures when working with human and animal material
To understand the risk of bloodborne pathogens
Know who to contact if you have to transport dangerous goods
Waste procedures

Human Resources, Occupational Health and Safety

Contact:
• http://www.uwo.ca/hr/
• Support Services Building, Room 4190
**Quiz**

“Answer before course” column

- First page, multiple choice questions

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**What is a Biohazard?**

A biohazard is a biological agent or condition that constitutes a hazard to humans, animal, plants or the environment.

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**Potential Biohazards at Western**

- Bacteria, viruses, fungi, parasites, plant or mammalian cells, including genetically modified strains
- Unfixed human tissues, blood and cell lines (bloodborne pathogens)
- Infected animals, carcasses and tissues
- Animals capable of carrying zoonotic diseases, their organs and tissues
- Genetically modified organisms
- All lab ware in contact with the above

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**What is a Risk?**

A risk is the probability of an adverse health effect as a result of exposure to a hazardous substance.

Risk is a function of hazard and exposure.
Personal Factors Influencing Risk
Health Factors
• Immunosupression
• Illness or disease present
• Pregnancy
• Allergies

Contact Workplace Health, UCC 25, if you have concerns

How to Assess Your Risk in the Lab

Infectious agent?
• Organism?
• Pathogenicity?
• Stability in the environment?
• Genetically modified?
• Well known or unknown?
• Route of infection? (inhalation, injection, absorption, ingestion)
• Infectious dose?
• Medical therapy available?
• Origin: Indigenous or imported?

How to Assess Your Risk in the Lab

Animals used

Quantity and concentration used

Zoonotics?

Other issues (skill level, experience)

Risk Assessment Documents

Biosafety Manual
• http://www.uwo.ca/hr/safety/topics/biosafety/policies.html

Laboratory Biosafety Guidelines (Health Canada)
• http://canadianbiosafetystandards.collaboration.gc.ca/index-eng.php

Containment Standards for Veterinary Facilities (Canadian Food Inspection Agency)
• http://www.cfia-accia.ca/english/lab/misc/
Biosafety

The containment principles, technologies and practices that are implemented to prevent the unintentional exposure to biological agents and toxins, or their accidental release.

Goal

To protect laboratory workers, community and the environment.

What is Biosafety?

Biosafety Governance: outside Western

- Public Health Agency of Canada (PHAC)
- Canadian Food Inspection agency (CFIA)
- Environment Canada, Ontario Ministry of the Environment and Energy
- Transport Canada
- Ministry of Labour
- Others

Biosafety Governance: at Western

- University Health and Safety Committee
- Biosafety Committee
  - Biohazards Subcommittee
  - Biosecurity Subcommittee

Biosafety Governance in the lab

- Biosafety officer: inspections, consultations
- Supervisor: day-to-day operations
WHMIS requirements for Biohazards

- Right to know
- Training for personnel/hazard awareness
- Labeling – room/area, sample
- Biohazard sign and Risk Level of agent
- MSDS - Health Canada Office of Biosafety or supplier
- WHMIS training: http://www.uwo.ca/hr/learning/required/index.html
  WebCT, available 24/7

Biological Risk Groups

Health Canada + CFIA

- There are 4
  - Lowest risk – 1
  - Highest risk – 4

Must use containment at or above the risk level

Risk Group 1

- Biological agents unlikely to cause disease in healthy workers or animals
  - Examples:
    - Non-invasive E. Coli
    - Many established cell lines

Risk Group 2

- Pathogens that can cause disease in humans or animals but not a serious hazard; effective treatment is available; limited risk of spread
  - Example: Salmonella
Risk Group 3

- Pathogens that can cause serious human or animal disease but do not spread by casual contact OR diseases treatable by antimicrobial or antiparasitic agents
- Examples: Rabies, HIV, tuberculosis

Risk Group 4

- Pathogens that produce very serious human or animal disease, often untreatable, and may be readily transmitted
- Examples: Ebola virus

Biological Containment Levels

- Takes into account multiple factors and how organism is used in workplace
- Details PHYSICAL requirements
- Details OPERATIONAL practices

Containment Level 1

- Containment Level (CL1)
- No special lab design features
- Work may be done on an open bench top.
- Risk Group 1 agents only
**CL1 Physical Requirements include:**

- No special air handling requirements
- Biological Safety Cabinet not required
- Separated from public areas by door
- Hand washing sinks
- Eyewash
- Separate hanging areas for street and lab clothes
- Windows that can be opened protected by fly screens
- Floors, walls and lab furniture must be washable

**CL1 Operational Requirements include:**

- Standard microbiological techniques
- Disinfection of wastes
- Effective disinfectants, concentrations
- Hand washing
- No eating or drinking in lab

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**Containment Level 2**

**Containment Level 2 (CL2)**

- Applies to Risk Group 2 agents. Primary exposure through ingestion, injection, and mucous membranes.
- Agents requiring CL2 are not usually transmitted by airborne route, but avoid generation of aerosols.
- Acceptable for Risk Group 1 and 2

**CL2 Physical Requirements include:**

- Centrifugation procedures must be contained
- Signage
- Doors should be self-closing
- Coat hooks for lab coats near exit
- Lab located away from public areas, general areas, patient care areas
- Floors, walls and furniture must be impervious for disinfection
- An autoclave must be in or near lab
- Inward directional airflow recommended
CL2 Physical requirements include:

- Class II biological safety cabinets required for procedures generating aerosols
- Certified annually
- HEPA-filtered air can be re-circulated

CL2 Operational Requirements include:

All CL1 requirements plus:

- PPE: Gloves, lab coat, and eye protection as required
- Emergency plan (i.e. spills)
- Vacuum lines protected by HEPA filters or equivalent
- Contaminated glassware can not leave facility
- Cleaning staff aware of hazards
- Medical surveillance program as required:
  - http://shsweb.shs.uwo.ca/sfhs/position.htm

Containment Level 3

CL3 Physical Requirements include:

Includes CL2 requirements plus:

- Inward directional air flow required with alarms
- Controlled access
- Sealed penetrations
- Backflow prevention on utilities such as water, plumbing requirements
- Hands free sinks
- Windows sealable and unbreakable
- Back-up power to critical equipment such as biological safety cabinets
- Autoclave in facility
- Body showers in the facility
CL3 Operational Requirements include:
Includes CL2 requirements plus:

- Facility must be tested and certified annually
- Clothing change required for entry
- Specialized training
- Other PPE as required (head covers, foot covers, dedicated front lab coat, respirators)
- No personal effects

Containment Level 4

- Is an isolated unit, sealed facility
- Researcher wears positive pressure unit, or, contain pathogen in a class III BSC, etc.
- Examples: Ebola virus

Engineering Protection

- Clean bench
- Chemical Fume Hood
- Biological Safety Cabinets

Clean Bench

- HEPA filtered air flow towards worker
- Provides protection for work but none for worker or environment
- **NOT** to be used for infectious, toxic or sensitizing material
**Chemical Fume Hood**

- Offers personal protection from gases and vapors
- Ventilation is directed away from the worker
- No protection for product or environment
- No filters used and does not protect against biohazard particulates

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**Biological Safety Cabinets (BSC)**

- Uses HEPA filters and containment to protect worker against exposure to aerosols containing infectious agents and particulates.
- Product, worker & environment protection possible

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**BSC Types**

- **Class 1**
  - Some protection to worker and environment, no product protection. CL1, CL2, CL3 if no product protection required.

- **Class 3**
  - Gas tight absolute containment systems offering protection to worker and environment. CL1, CL2, CL3, CL4.

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**BSC Class 2**

- Most common type of BSC used suitable for risk group 1, 2 agents.
- Product, worker, and environmental protection
- Type A and B
- Some are ducted to exhaust systems, suitable for volatile chemicals, radioisotopes
- Some ducted to exhaust systems, suitable for volatile chemicals, radioisotopes.
BSC Safety Techniques

- Don’t overload
- Locate away from doors, high traffic areas, vents
- Keep in/out movement of arms to a minimum
- Don’t block exhaust grids
- Disinfect before and after use
- Window at proper level

BSC Use and Safety

- Gas Burners are not permitted in Class II BSC. If flame is out gas build up could cause an explosion. Heat will also disrupt laminar air flow pattern breaking barrier.
- Filters must be tested and recertified annually
- Procedures for the Effective Use of Biological Safety Cabinets: http://www.uwo.ca/hr/safety/topics/biosafety/policies.html

Biohazard Spill Control Procedure

- PROTECT people, environment, property
- COVER the area with paper towel
- BLEACH
- If you and your supervisor are not comfortable handling the spill, seek help/advice

If you need help,...
Biohazard Spill and Medical Emergency

- Call 911
- Personal Protective Equipment
- Lifesaving measures
- Send info with person to doctor/hospital
- Notify Supervisor

Importing Biohazardous Agents

- Human Pathogens/cell lines require Health Canada import approval
- Animal Pathogens/animal cell lines or zoonotic agents require CFIA import approval
  
  Transportation of Dangerous Goods requirements

If Animals are being used:

- Animal Use Subcommittee Protocol approvals
  
  ACVS training on animal use

Animal Bites: Medical Surveillance
**UNIVERSAL PRECAUTIONS**

- What are universal precautions?
- When are they used?

**Universal Precautions**

These are recommended physical requirements, procedural actions and precautions for safe work with human pathogenic materials or microbes in healthcare, laboratory and other work environments.

Because the potential for infectivity of any blood and body fluids is unknown, Universal Precautions should be adhered to for all specimens regardless of evidence of infectious material.

**Universal Precautions applies to these fluids:**

- Blood
- Tissues
- Body fluids that contain visible blood
- Semen
- Vaginal secretions
- Cerebrospinal (brain & spinal cord)
- Synovial (joint)
- Pleural (lung)
- Peritoneal (abdominal)
- Pericardial (heart)
- Amniotic
- Breast milk

**Protection Techniques**

Type of barrier protection must be appropriate for the activity being performed.

It is the responsibility of supervisor staff to inform and instruct workers on the type of protective equipment required for a given situation.
What is the most common route of transmission of pathogens?

...via the hands!

According to the CDC...

“Handwashing is the simplest, most effective thing people can do to reduce the spread of infectious diseases”

- Julie Gerberding, CDC

1. Hand washing

Wash with soap and water

- after removing gloves
- completion of all work or procedures
- before eating, drinking, washroom, etc.
- if visible contamination with blood or body fluids

Handwashing

67% of adults wash their hands after using the restroom

- 75% of women
- 58% of men
2. Gloves

Wear gloves if:
- contact with blood or body fluids is expected
- if touching mucous membranes or non-intact skin of patients is expected
- if contact with contaminated equipment is anticipated (equipment which has been in contact with above)

Change between clients/species
Ensure integrity of gloves before use
Do not reuse
Use aseptic technique to don and remove

3. Eye Protection

- Mandatory in all UWO laboratories
- Safety glasses - protection of splash from the front
- Safety goggles - full protection for eyes
- Face shields - full protection for eyes, mouth and nose

4. Respiratory Protection

- Mandatory if risk of airborne infections
- Disposable respirator/mask
- Half face respirator and cartridges
- Full face respirator and supplied air

Respirators: What’s wrong with this picture?
Respirators: What’s wrong with this picture?

- Too big?
- Exhalation valve?
- One strap not used
- Upside-down

Respirator Program includes:

- Fit testing for N95 masks
- Training
- Maintenance, cleaning if required
- Variety of masks available

5. Protective Clothing

- Plastic aprons
- Overgowns
- Laboratory coats
- Surgical scrub suits
- Shoe covers
- Head covers

Biosafety Laboratory

Required in areas depending on procedures/policies of the area
### Accidental Exposures
- Needlestick injuries, cuts, abrasions
- Infected animal bites, scratches
- Mucous membrane exposure to splash, splatter or spilled infectious materials
- Skin contamination through damaged gloves
- Exposure to infectious aerosols
- Indirectly through animal bedding, contaminated surfaces

### Procedures Generating Aerosols
- Pipetting liquids
- Centrifugation
- Sonicating tissues
- Vortexing or mixing liquids
- Opening pop-top tubes
- Penetrating rubber septum vials
- Others

### Pipetting Infectious Material Safely
- Never mouth pipette
- If CL2, biological safety cabinet must be used
- Pipette must be plugged with cotton to prevent aerosol transmission
- Do not mix infectious liquid cultures by expelling air through the liquid or by alternating suction and expulsion
- Discharge pipette as close to medium as possible

### Safe Procedures for Centrifugation
- Centrifugation must be carried out in closed containers
- Well balanced
- Load the tubes into the rotor in the biosafety cabinet
- Surface disinfect the containers
- Decontaminate the centrifuge
How do Needlestick Injuries Occur?

- Disposing of needles
  - Overfilling container
  - Emptying sharps container rather than disposing once filled
- Administering injections
- Drawing blood
- Recapping needles
- Handling trash and dirty linens
- Improper disposal in regular garbage

BLOODBORNE PATHOGENS

Bloodborne pathogens are the microorganisms that are present in human blood and can cause disease in humans.

Blood represents a high risk of infection, however all human source material - body fluids, tissues and human cell lines, etc. can potentially transmit infection.

Needlestick Injuries

What diseases are you at risk of getting following a needlestick injury?

- AIDS virus (HIV), hepatitis B virus and hepatitis C virus pose a serious risk
- Health hazard of a needlestick injury is transmission of more than 20 pathogens

Risk of infectivity with HIV, HBV and HCV

Risk after exposure needlestick injury:
- HBV up to 30% or 300 in 1000
- HCV ~3% or 30 in 1000
- HIV ~0.3% or 3 in 1000
Human Immunodeficiency Virus (HIV)

- HIV is believed to cause AIDS, symptoms of the infection range from asymptomatic to severe immundeficiency state
- There is no cure or immunization
- Post exposure drug treatments available (effectiveness at preventing infection unknown)
- HIV has been found in almost all body tissues, highest in blood

Workplace transmission of HIV in Canada

3 reported cases of occupationally transmitted HIV in Canada*
- Biochemist in Ontario (1980s)
- Quebec lab technician culturing virus (1990s)
- Caregiver in B.C. (~ 1996)

*Health Canada, 1996

Exercise 1:

HIV in the workplace

Transmission of HIV in the Workplace

- Cuts from contaminated sharp objects, needlestick injuries
- Bites and scratches from infected animals
- Not transmitted by casual contact
- No airborne transmission
- Risk of transmission is 0.1%
  - mucus membrane exposure to HIV (eye, nose, mouth) infected blood
  - skin exposure to HIV infected blood (greater if large area and/or damaged skin)
Hepatitis A

Hepatitis A (HAV):
- transmission through fecal/oral route often through dirty water
- Vaccine available

Hepatitis A in London, ON

Grocery store, September, 2002
Daycare, June, 2004

Hepatitis B

Hepatitis B (HBV):
- Chronic liver disease and cancer
- Needlestick injuries
- Indirect transmission from surfaces
- Splashes into mucous membranes
- Contamination of damaged skin
- Vaccine available
- Post exposure treatment

Transmission in the Workplace: Hepatitis C virus (HCV)

- Chronic liver disease worldwide
- Needlestick injuries are probably the most common cause of occupational HCV exposure
- No vaccine
- No effective post-exposure treatments known
Transmission in the Workplace: Hepatitis C virus (HCV)

According to the CDC:

- 1% of U.S. healthcare workers infected (1.8% in general population)
- Occupational acquired infections unknown
- Case reports of transmission following blood splash to eyes
- No reports of transmission from skin exposure to blood

UWO Medical Surveillance Program

- Administered by Workplace Health
- Position Hazard Form - to identify use of human source materials and biohazards
  - http://shweb.sh.uwo.ca/shhs/position.htm
- Pre-employment or new Pre-procedure check-up and immunization
- Post-exposure care and counseling

Transportation Requirements

Follow IATA (International Air Transport Association) or TDG (Transportation of Dangerous Goods) Regulations

Person must have specific training to do this!

- Classification
- Labelling requirements & supplies
- Documentation
- Reporting of Dangerous Occurrences
- Etc...
- Contact Occupational Health and Safety

Biohazardous Waste Disposal

- As per Occupational Health and Safety
**Biohazardous Waste Disposal**

- Waste decontaminated before leaving the lab, then labelled & treated as regular waste

**Possible methods of decontamination**

- Chemical disinfectant
- Autoclave

- Carcasses, sharp containers, etc. may be labelled for incineration

- Course on Laboratory Waste Disposal

**Biomedical Waste Disposal**

**Requirements at UWO - Step 1**

- Refer to UWO "Hazardous Waste Management Manual"
- [http://www.uwo.ca/hr/safety/topics/hazardous_waste.html](http://www.uwo.ca/hr/safety/topics/hazardous_waste.html)

**Biomedical Waste Disposal Requirements at UWO – Step 2**

- Decontaminate waste
- Validated decontamination
- Record of decontamination process

**Biomedical Waste Disposal Requirements at UWO - Step 3**

- After decontamination: appropriately packaged wastes may enter regular garbage stream.
- Bags of waste must be placed into a plastic bag and sealed
- Bags must be labeled as ‘Treated Biomedical Waste’
Decontamination by Incineration

The following MUST be Decontaminated by Incineration

- Human tissues and organs
- Animal carcasses, animal wastes if animal is infected
- Animal carcasses and wastes if hazard of zoonotic infection exists
- Sharps excluding glass (i.e. Syringes, scalpels, etc.)
- Biomedical waste from buildings on campus which do not have an autoclave

Preparation for delivery to incinerator....

- Bag and seal waste in the lab
- Bags must be labeled as ‘WASTE MATERIAL FOR INCINERATION’
- Place coloured (red/orange/yellow/blue) incinerator classification tape on outside of bag
- Take to MSB cold room, 6th floor for disposal

Decontamination by Autoclaving

Follow Standard Operating Procedures

Ensure you understand how the autoclave operates. Must have hands on, autoclave specific training by department.

‘STANDARD OPERATING PROCEDURES FOR AUTOCLAVING’ available from OHS

Must post contact name for each autoclave in case of problem and/or operating concerns.
Tests using biological indicator ampoules to prove that autoclaving has rendered the laboratory waste non-hazardous must be conducted on a representative load.

Detailed instructions on UWO ‘Autoclave Cycle Verification Testing using Biological Indicator Ampoules’ - October 2003 available from OHS@UWO.

Waste cannot be discharged unless test negative result is obtained.

**Validation of Autoclave Cycle Time**

**Final Disposal of Autoclaved Waste (after verification)**

Bags of waste cannot be discharged unless results indicate no growth.

Records must be kept.

Bags must be stored in appropriate place until test completed.

Place validated autoclave bags into garbage bags and seal with tape.

Label as ‘Treated Biomedical Waste’

Place in garbage.

Bags of waste cannot be discharged unless results indicate no growth.

Records must be kept.

Bags must be stored in appropriate place until test completed.

Place validated autoclave bags into garbage bags and seal with tape.

Label as ‘Treated Biomedical Waste’

Place in garbage.
Choose valid disinfectant

Guard®
- liquid pine disinfectant cleaner • sanitizer • deodorizer
- DISINFECTANTS – DIN
- Excellent for PREVENTING AND DESTROYING ODOURS caused by the growth of bacteria, mold, mildew and fungi. A fresh pine odour permeates the area as it cleans. Truly a unique, broad spectrum disinfectant cleaner - sanitizer - deodorizer. Specifically designed to kill the following organisms:
  - Staphylococcus aureus - Pseudomonas aeruginosa - Salmonella choleraesuis - Aspergillus niger - Salmonella typhi - Escherichia coli - Trichophyton interdigitale - Streptococcus faecalis - Salmonella Schottmuelleri - Klebsiella pneumoniae - Proteus mirabilis - Enterobacter aerogenes - Shigella flexneri - Bacillus cereus - Brevibacterium ammoniagenes - Herpes simplex - Vaccinia - Influenza A2 (Hong-Kong 68).

Disinfectants

Correct dilution must be used

Disinfectants are not as effective in presence of heavy soil or protein

When to Use a Chemical Disinfectant

To decontaminate growth medium at CLS
To decontaminate pipettes before disposal or reuse
To decontaminate equipment that cannot be autoclaved
Liquid wares
What is wrong with this picture?

A visitor throws a used protective mask into a garbage bin outside a SARS clinic at Women's College Hospital in Toronto.

Exercise 2:

• Case Study

Helpful documents & Information

Website:

• [http://www.uwo.ca/hr/](http://www.uwo.ca/hr/)
• Procedures for the Effective Use of Biological Safety Cabinets
• Containment Level 1 Safety Practices
• Containment Level 2 Safety Practices
• Biohazardous Agents Report Form
• Biosafety manual

UWO Biosafety Program Components

- Biosafety Database
- Laboratory Biosafety Manual
- Containment Level 2 and 3 Inspections & Permits
- Animal Use Subcommittee Safety Forms & Biohazardous Agents Registry Forms
- Purchasing
- Biohazardous Waste Management
- Medical Surveillance
- Biosecurity Plan
- Training
Summary

- Know risk of biohazard you are working with
- Treat all material as if infectious
- Use appropriate containment level
- Assume accidents will occur and plan for managing those events safely
- Use appropriate disinfectants
- Medical surveillance
- Follow regulations/procedures

Additional Information

- Biosafety website
  http://www.uwo.ca/hr/safety/topics/biosafety/index.html
- Health Canada
  http://www.hc-sc.gc.ca
- Canadian Food Inspection Agency (CFIA)
  http://www.cfia-acia.ca/english/lab/bioe/

Personal Action Plan

Check out our website for information & courses available

Location of first aid kit & emergency
- Mike Mosley x 84747, scjmjm@uwo.ca
- BSC is certified
- Tony Hammoud x 88730, ahammoud@uwo.ca

Signage on the lab
- Supervisor, Tony Hammoud

Biosafety Agent Registry Form
- Notify BSC

Biosafety Agent Registry Form
- Staff/Faculty Health Services
- Location of MSDS
- Supervisor

Print off certificate

WebCT (UWO)

https://owl.uwo.ca/portal

- If you have any problems contact Saboor Fazelyar x80315 (sfazelya@uwo.ca)
Questions and Discussion