Laboratory Management of a Quality System

Module 10: Safety and Facility Management

ACKNOWLEDGEMENTS

- Ministry of Health and Social Welfare – Tanzania
- Muhimbili University of Health and Allied Science
- World Bank
- ECSA- HC

Learning Objectives

- Describe the importance of laboratory design and safety aspects
- Learn the safety risks in the workplace: what, where, when
- Learn the components of a laboratory safety management plan and emergency procedures
- Understand the meaning of work practice controls

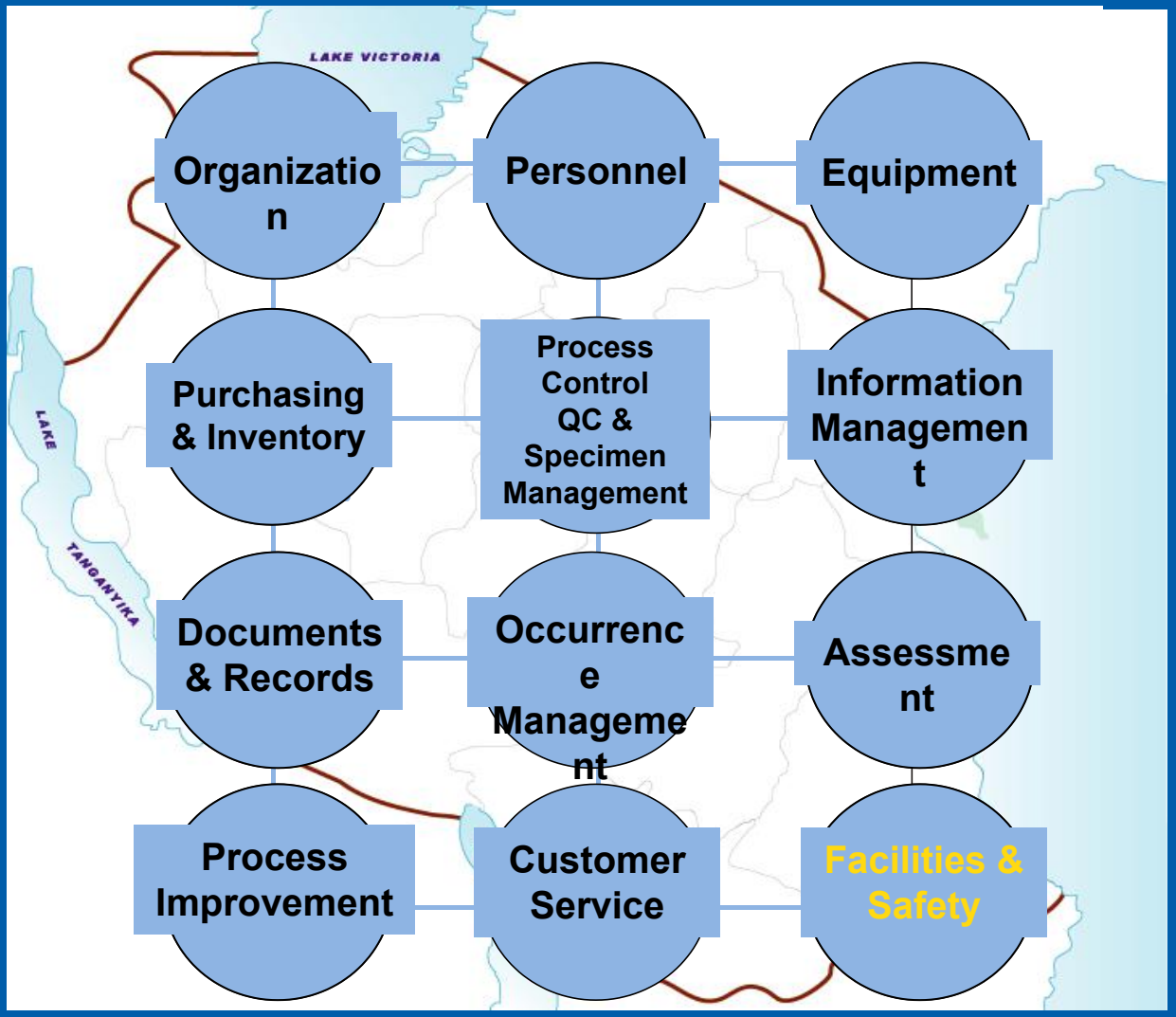
Learning Objectives (Continued)

- Describe the importance of using protective measures including appropriate safe work practice measures
- Learn the procedures for handling physical and chemical hazards
- Describe the importance of keeping appropriate biosafety documentation

Today's Agenda

- The Quality System
- Importance of Laboratory Design
- Laboratory Safety Management Plan
  - Managing Risks and Safety Gap Analysis
  - Biosafety Work Practice Controls
  - Safe Work Practices
  - Physical and Chemical Hazards
- Other Safety Concerns
- Incident Investigation
- Module Sum

The Quality System



Laboratory Facility & Safety

- A quality system assures that facilities, testing and storage areas are:
  - Adequate in order to produce reliable testing
  - Provide an adequate and safe work environment
  - Meet all regulatory and environmental

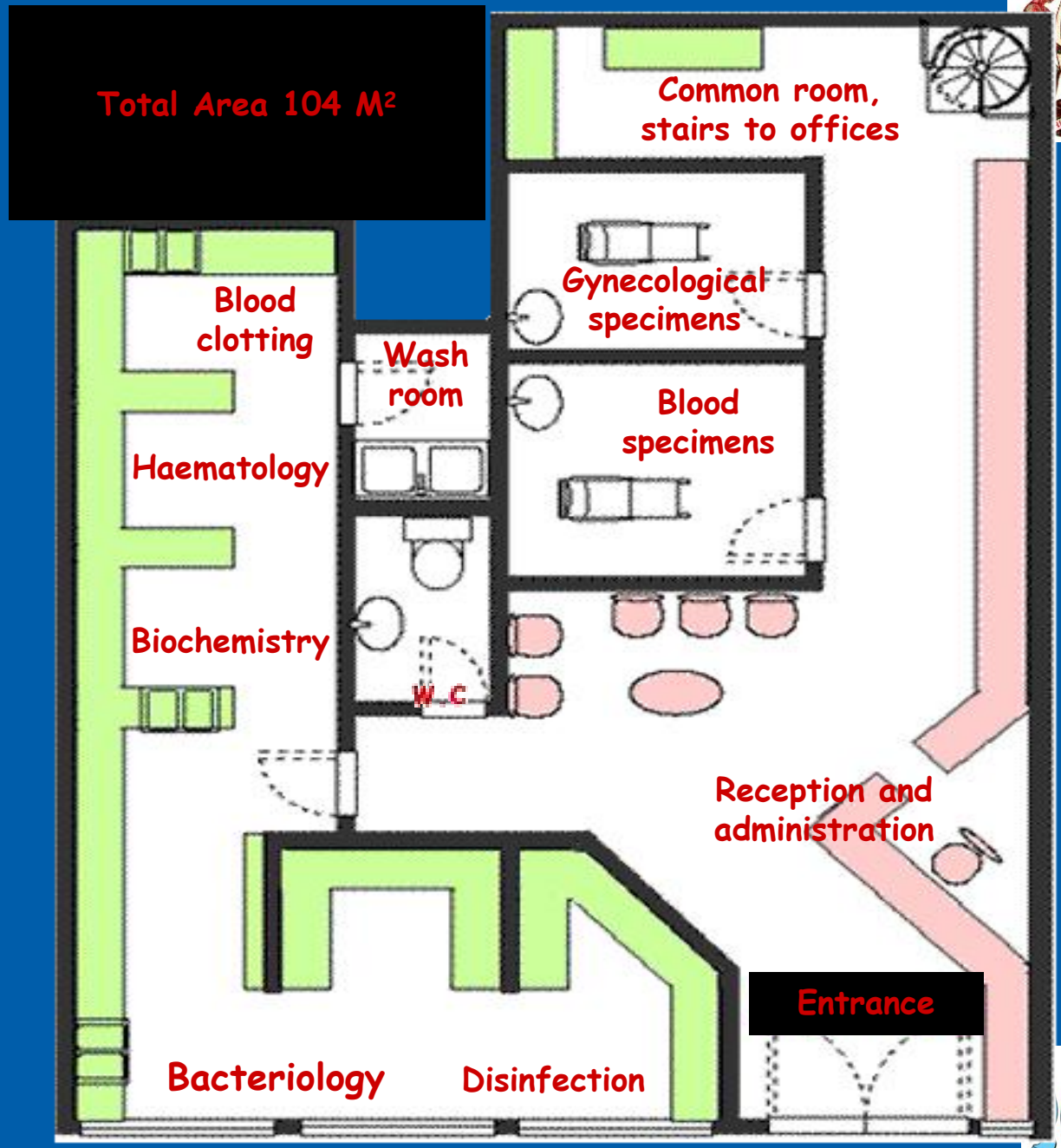
Today's Agenda

- The Quality System
- Importance of Laboratory Design
- Laboratory Safety Management Plan
  - Managing Risks and Safety Gap Analysis
  - Biosafety Work Practice Controls
  - Safe Work Practices
  - Physical and Chemical Hazards
- Other Safety Concerns
- Incident Investigation
- Module Summary

Lab Design

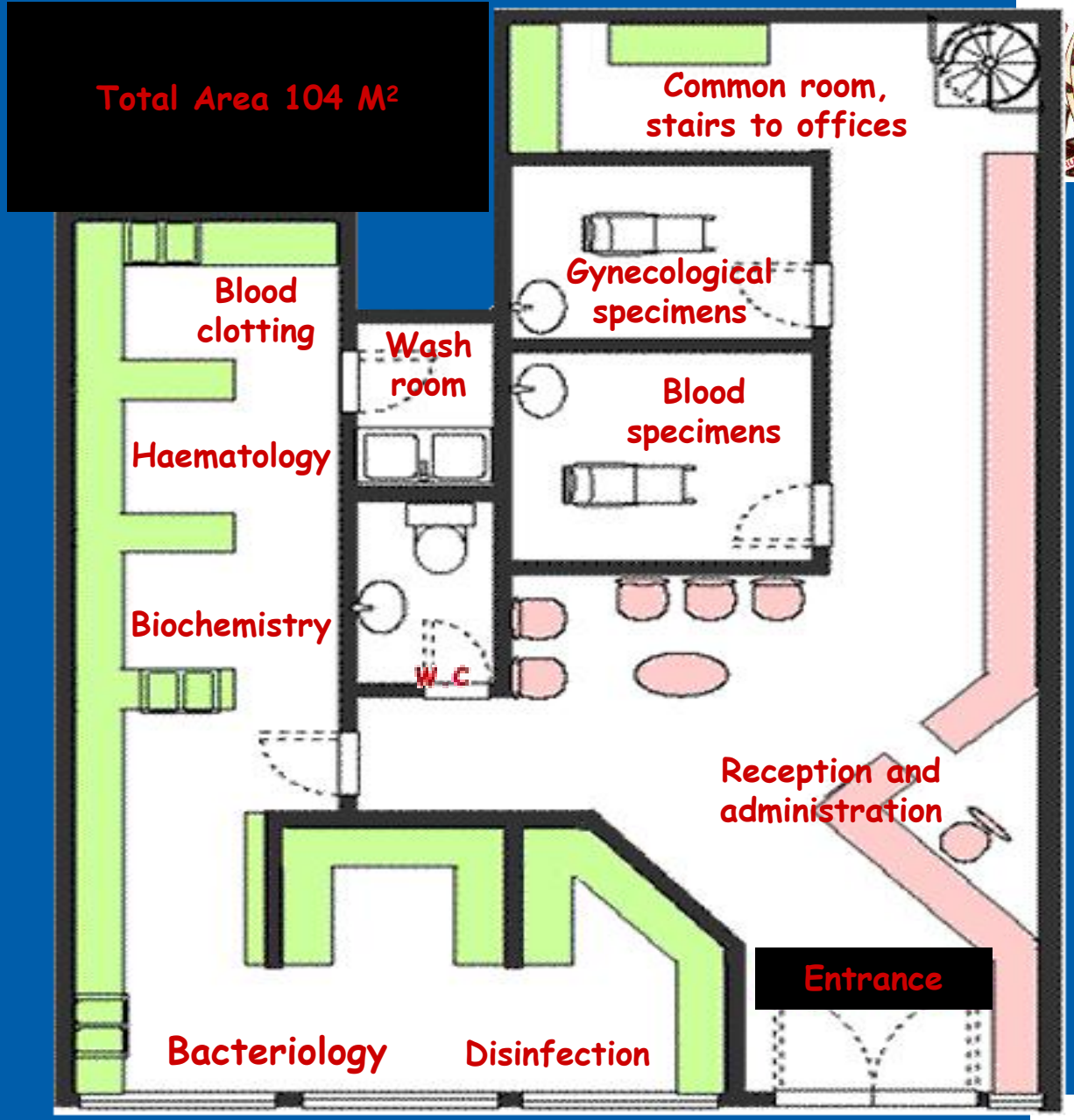
Path followed by the sample:

- § Reception and registration of patients
- § Sampling rooms
- § Dispatch between laboratories
- § Analysis of samples



Lab Design

- Results
  - Delivery and filing of results
  - Related services: administration office, wash room (toilet); preparation and sterilization, storage, cold room.

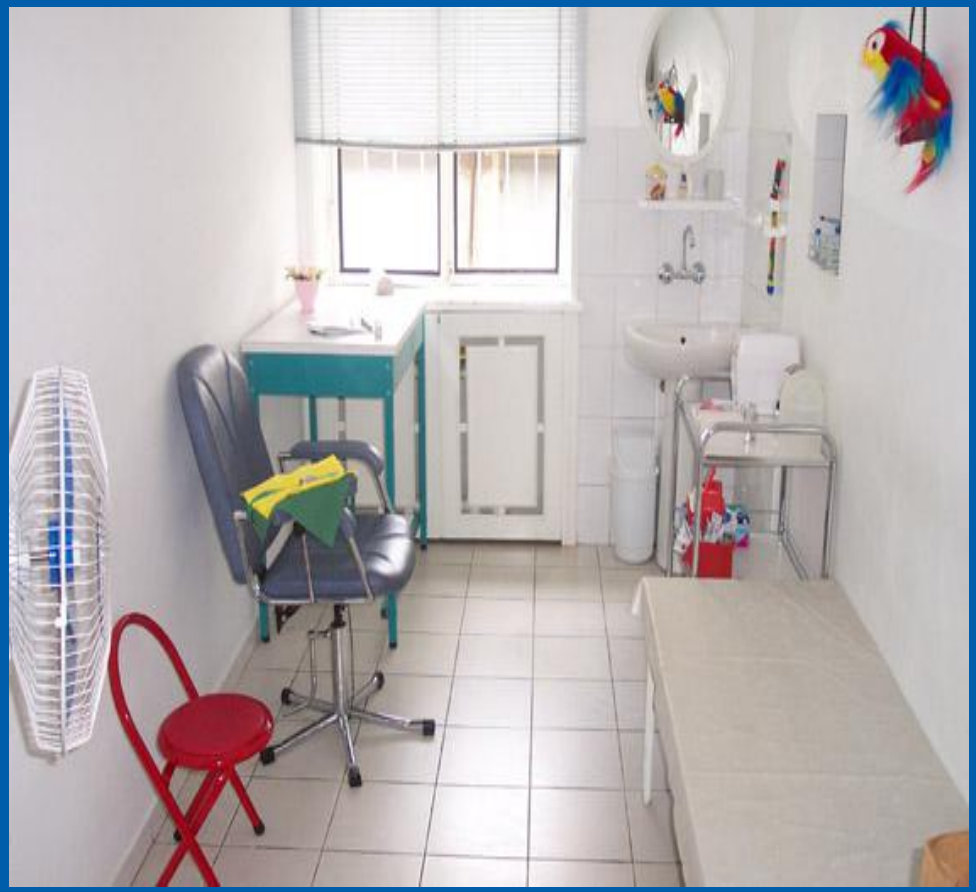


Laboratory Design
(Continued)

- The reception desk where the registration of the patients and the samples will be done

Laboratory Design (Continued)

- Specimen collection area
- Draw station
- Sink to wash hands
- Sharps container for disposal of glassware and needles



Laboratory Design (Continued)

- Toilet for collection of urine and stool specimens

Laboratory Design (Continued)

- Bench Surface
  - Non-porous covering, e.g., glass or ceramic tiles
  - Wood or steel is not recommended
  - Easy to clean and resistant to chemicals and disinfectants, e.g. chlorine bleach

Laboratory Design (Continued)

- Ceramic bench with assigned sections for specific testing and for different types of pathogens
- Evaluate height, width and depth of counterspace to accommodate equipment and/or work processes

Laboratory Design (Continued)

- Biological safety hood

Laboratory Design

(Continued)

- All diagnostic and healthcare laboratories must be designed and organized for Biosafety Level 2 or above
- Biosafety Level 2 means it has Class II biosafety cabinet plus controlled access and negative pressure
- Biosafety Level 2 is for containment of indigenous or exotic agents with potential for aerosol transmission (Ex. TB) and serious or lethal consequences

Elements of Containment

- Primary containment
  - Protection of personnel and the immediate laboratory environment
  - Use of laboratory practices, techniques, safety equipment
- Secondary containment
  - Protection of the environment external to immediate laboratory

Exercise

- Draw a rough floor plan of your current lab
- Check the floor plan against the guidelines for a good lab design workflow
- Identify areas for improvement in the floor plan and what the work effort would be to make the necessary improvements

What questions do you have on laboratory design?

Today's Agenda

- The Quality System
- Importance of Laboratory Design
- Laboratory Safety Management Plan
  - Managing Risks and Safety Gap Analysis
  - Biosafety Work Practice Controls
  - Safe Work Practices
  - Physical and Chemical Hazards
- Other Safety Concerns
- Incident Investigation
- Module Summary

Safety Management Plan

- Elements of an effective safety management plan
  - Designation of a safety officer
  - Assessment of risks in the workplace
  - Development of exposure control plan
  - Development of safety guidelines and procedures
  - Employee training/hazard communication
  - Documentation and record-keeping

Safety Management Plan

- The laboratory manager/lead technologist is responsible for the laboratory safety plan
- Everyone in the laboratory is responsible for following the laboratory safety plan and incorporating good safety practices in their work environment

Elements of an Exposure Control Plan

- Safe work practice controls
- Use of Personal Protective Equipment (PPE)
  - Written procedures on the proper way to use/remove PPE and when to use it

Exposure Control Plan (Continued)

- Engineering controls- example, properly-functioning biosafety cabinets and fume hoods
- Proper waste handling and disposal
- Decontamination protocols
  - Spills
  - Surface
  - Instruments

What questions do you have on safety management and exposure control plans?

Today's Agenda

- The Quality System
- Importance of Laboratory Design
- Laboratory Safety Management Plan
  - Managing Risks and Safety Gap Analysis
  - Biosafety Work Practice Controls
  - Safe Work Practices
  - Physical and Chemical Hazards
- Other Safety Concerns
- Incident Investigation
- Module Summary

Assess Risks – What

- Assessment of risks in the workplace
  - Identify chemical risks by taking chemical inventory and reviewing material safety data sheets on all chemicals
  - Identify, and where possible, eliminate risk-prone chemicals and activities
  - Identify staff at risk of blood-borne pathogens and TB exposures
  - Identify risk-prone procedures

Assess Risks – Where

- Risk of infection is defined as:
  - The chance of exposure to a hazard or exposure to the chance of injury
- Risk of infection may be quantitative or qualitative
- Laboratory manager/head technologist responsibility to manage risk

Assess Risks – When

- Inhalation of aerosols from agents generated by accident or by work practices
- Contact of agents between mucous membranes and contaminated material
- Spills and sprays of specimens or hazardous materials and chemicals
- Injuries with broken glass or other sharp object
- Injuries with needles and syringes
- Aspiration through pipette

Safety Management Risk Analysis

- Who could be exposed or at risk to biological, chemical, or other hazardous exposure?
- How will we prevent exposure?
- What happens if exposure occurs?
- What engineering/work practice controls are in place?

Safety Management Gap Analysis

- Is Personal Protective Equipment (PPE) available for all employees?
- Are proper waste disposal practices in place for infectious waste and sharps?
- Are employees offered immunization or prophylaxis upon exposure

Exercise

- Work in pairs
- Conduct a safety management risk assessment and gap analysis for your laboratory
- What could you implement today?

Tuberculosis Exposure Control Plan

- Who could be at risk?
  - Laboratory staff working in phlebotomy, microbiology, core lab, and autopsy suite
- What will we do if exposure occurs?
  - Medical surveillance and post-exposure follow-up
- How will we prevent exposure?
  - PPE: gowns, gloves, and N-95 particulate filter masks for patient contact
  - Employee training

Tuberculosis Exposure Control Plan (Continued)

- How will we prevent exposure? (Continued)
  - Identify at risk patients and initiate air-borne precautions
  - Work practice/Engineering controls
    - Airborne precautions and isolation rooms for high risk groups until TB is ruled out
    - Determine AFB status with 24 hours
    - Class II B Biologic Safety Cabinet for all TB work and sputum cultures
    - Control aerosols during centrifugation
    - Appropriate disinfection procedures
    - TB testing

What questions do you have on assessing risks in the workplace?

Today's Agenda

- The Quality System
- Importance of Laboratory Design
- Laboratory Safety Management Plan
  - Managing Risks and Safety Gap Analysis
  - Biosafety Work Practice Controls
  - Safe Work Practices
  - Physical and Chemical Hazards
- Other Safety Concerns
- Incident Investigation
- Module Summary

Biosafety

- The application of a combination of laboratory practices and procedures, laboratory facilities and safety equipment when working with potentially infectious microorganisms

Good Biosafety Practice

- Awareness of hazards
- Knowledge of how laboratory infections occur
- Knowledge of procedures and techniques to reduce hazards
- Good laboratory practices

Biosafety Process

- Awareness
  - Advise workers of possible exposures, safeguards and responsibilities
- Training
  - Inform workers of hazards of their work, and use of appropriate practices, techniques and procedures
- Vigilance
  - Maintain vigilance to guard against safety procedure compromises or errors

Biosafety Requirements

- A supervisor is required for oversight
- Standard Operating Procedures must be written (SOPs)
- Training of personnel must occur
  - Awareness of potential hazards
  - Work practices and techniques
- Biosafety manual specific for each laboratory area

Blood-borne Pathogens Exposure Control Plan

- Who could be exposed?
  - Classify all staff with possible exposure to blood and/or body fluids
- How will we prevent exposure?
  - Employee training, safety devices, gloves, disinfection, no eating/drinking, SOP for each work practice with risk, Hepatitis B vaccine
- What happens if exposure occurs?
  - Post-exposure medical follow-up and treatment

Using Biosafety Equipment

- Use appropriate biosafety equipment correctly because each and every biological sample is potentially infectious
- Staff are at risk:
  - During sampling
  - During transport of sample
  - At the opening of the sample
  - During handling of the sample in the laboratory

Precautions During Sample Collection

- Clean the outer tube with 10% diluted household bleach (hypochlorite)
- Wear gloves
- Wear lab coat, mask, and protective glasses appropriately
- Use evacuated tubes (vacutainers) for blood sampling

Precautions During Sample Collection (Continued)

- Organize and disinfect bench space with 10% hypochlorite
- Clean spills with chlorine 10%
- Decontaminate equipment and materials by soaking in chlorine 10%
- Incinerate all waste

Precautions During Sample Collection (Continued)

- Wear gloves, lab coat, (mask, glasses)
  - Dispose of needles in sharps containers without re-capping,
  - Disinfection (sodium hypochlorite %),
  - Incineration
- Do not recap, bend, or manipulate needles in any way

Precautions During Testing

- Use gauze to cover tubes when removing stoppers
- Centrifuge tubes with stoppers on
- Wear gloves and lab coats
- Wear goggles when changing instrument tubing or probes
- Disinfect work areas and equipment surfaces carefully per guidelines
- Perform high risk procedures under a biologic safety cabinet

Biosafety Cabinet

Decontamination

- Process or treatment that renders a medical device, instrument, or environmental surface safest to handle
- A decontamination procedure can range for sterilization to simple cleaning with soap and water
- Sterilization, disinfection and anti-sepsis are all forms of decontamination

Biosafety Resources

- Biosafety in Microbiological and Biomedical Labs
  - BMBL 4th Edition
  - CDC/NIH
  - In country safety guidelines
  - WHO Biosafety Guidelines
  - ISO 15 190
  - Documentation on disinfectants

Exercise

- Work in pairs
- Create a biosafety audit checklist for your laboratory

What questions do you have on biosafety practices?

Today's Agenda

- The Quality System
- Importance of Laboratory Design
- Laboratory Safety Management Plan
  - Managing Risks and Safety Gap Analysis
  - Biosafety Work Practice Controls
  - Safe Work Practices
  - Physical and Chemical Hazards
- Other Safety Concerns
- Incident Investigation
- Module Summary

Safe Work Practice Controls

Safe work practice controls reduce the risk of exposure by performing an activity in the safest way possible. They include:

- Washing hands
- No eating or drinking in the laboratory
- Use of Personal Protective Equipment
- Proper disposal of contaminated sharps and glassware

Safe Work Practice Controls
(Continued)

- Use of closed toed shoes
- Centrifuging closed tubes
- Proper work posture when sitting or standing
- Lifting or moving objectives appropriately
- Rest periods/breaks
- Proper storage of hazardous materials including heavy items

Washing Hands- When to Wash Hands

- After every patient contact including phlebotomy
- When visibly contaminated with blood, body fluids, or tissues
- After removing gloves and other protective wear
- Before leaving the clinical work area

Washing Hands- When to Wash Hands

- After every patient contact including phlebotomy
- When visibly contaminated with blood, body fluids, or tissues
- After removing gloves and other protective wear
- Before leaving the clinical work area

How to Wash Hands

1. Wet hands with lukewarm water then add soap
2. Use friction to generate lather and wash hands for at least 15 seconds
3. Rinse well under a stream of water
4. Dry hands thoroughly
5. Turn off tap/faucet with paper towel

No Eating or Drinking

- Do not eat or drink in laboratories or anywhere that body fluids or other potentially infectious materials are present
- Be aware of hand-to-face contact to avoid contamination of mucous membranes of your eyes, mouth, and nose

Warning Signs

- “Eating, Drinking, Smoking, and Applying Cosmetics are Prohibited In This Area”
- Provide separate room for eating, drinking etc

Personal Protective Equipment (PPE)

- Used as barriers to protect the employee's skin, clothing, and mucous membranes against contact with body fluids
  - Gloves
  - Laboratory coats
  - Aprons
  - Face shields
  - Goggles
  - Safety masks

Gloves

- Most common protective clothing worn in the laboratory
- Should be worn when:
  - Hand contact with body fluids or tissue is expected
  - During all phlebotomy and testing procedures
  - When handling contaminated items or surfaces
  - When cleaning up after a body fluid spill

Gloves

Should be taken off when :

- Answering personal telephones
- Entering non-contaminated areas like offices
- Entering eating areas
- When soiled and between patients

How To Safely Remove Gloves

Laboratory Coats

- Wear disposable or reusable coats that repel fluids if there is a potential for splashing or spraying of infectious materials
- Reusable lab coats should be laundere facility
- Minimize contamination of skin or street clothes by wearing long sleeved garments
- Remove and leave protective clothing in the laboratory before leaving the laboratory areas

Face Protection

- For anticipated splashes, sprays or other splatters of infectious or other hazardous materials to the face, wear:
  - Goggles or safety glasses with solid shields in combination with masks, or chin length face shields
  - Splash guards may be used

Other Protective Measures

- Waste containers
- Biosafety cabinets
- Impervious needle boxes labeled with biohazard stickers for disposal of sharp objects
- Automatic pipettes for use when pipetting potentially infectious body fluids
- Centrifuge with caps on tubes to prevent the production of aerosols
- Plastic vs. glass tubes when possible

Waste Containers

- Secondary containers for disposal of specimens if the primary container leaks, is contaminated, or is accidentally punctured

Infectious Waste Disposal

- Human blood
- Blood products
- Body fluids

Should all be incinerated

Infectious Waste (Sharps)

- Sharps are:
  - Needles, syringes (with or without attached needle)
  - Pasteur pipettes
  - Scalpel blades
  - Blood vials
  - Culture dishes
  - Slides, cover slips
  - Other broken or unbroken glass
  - Plasticware that have been in contact with infectious agents or used in patient care or treatment

Biohazard Sharps Containers

Be Careful with Sharps and Needles

Sharps and Sharps Containers for Disposal

Disposing of Sharps in Sharps Containers

- The nurse in this picture is appropriately discarding the needle she used for an injection into the sharps container
- Proper disposal of sharps in sharps containers is a safe laboratory practice

Glassware Precautions

- General cautionary note when using glassware
  - Make every effort to discard chipped or broken glassware so it doesn't cause injury to lab staff
  - Be sure to work with glassware safely
  - Substitute plastic wherever possible

Disposing of Glassware

Syringes and Needles

- Bending, recapping, or removal of needles from syringes is prohibited
- If you must recap or remove a contaminated needles from a syringe, use a mechanical device, e.g., forceps, or the one-handed scoop method
- Used disposable needles and syringes must be placed in appropriate sharps disposal containers and discarded as infectious waste

E.g. UNSAFE
Recapping Needles on Syringes

- This is **NOT** an acceptable safety practice
- This may cause injury to the laboratory professional
- Specimens should be placed in appropriate tubes for testing

Pipettes and Pipetting

- Pipettes are used for volumetric measurements and transfer of fluids that may contain infectious, toxic, or corrosive agents
- Exposure to aerosols may occur when liquid from a pipette is dropped on to a work surface
- A pipette may become a hazardous piece of equipment if improperly used
- Safe pipetting techniques must be followed to minimize the potential for exposure to biologically hazardous materials

Safe Pipetting Techniques

- The laboratory professional is using appropriate PPE
  - Lab coat
  - Goggles

E.g. UNSAFE
Mouth Pipetting Technique

- This may cause injury to the laboratory professional
- This is not the correct way to pipette
- Must use a bulb for employee safety

Centrifuge Safety

- Centrifuge – ensure caps are on tubes and balance cups
- Centrifuge cover is on bucket
- Open lid only when completely stopped
- Disinfect regularly at least weekly and after breakage/spill

Exercise

- Work in pairs
- Assess safety practices in your laboratory
- Identify areas where you will place controls (PPE, work practice, and engineering controls)

What questions do you have on work practice controls?

Today's Agenda

- The Quality System
- Importance of Laboratory Design
- Laboratory Safety Management Plan
  - Managing Risks and Safety Gap Analysis
  - Biosafety Work Practice Controls
  - Chemical Hazards
- Other Safety Concerns
- Incident Investigation
- Module Summary

Chemical Hygiene Plan

- Who could be exposed to what?
  - Chemical inventory, manufacturer's chemical labels, and environmental monitoring
- How will we prevent exposure?
  - Hazard communication, engineering/work practice controls (fume hoods, environmental monitoring), and personal protective equipment (goggles, gloves, lab coats/gowns

Chemical and Physical Hazards

- Combustible liquids
- Compressed gas
- Explosives
- Flammable Gas
- Flammable Liquid
- Solid Flammable

Flammable Liquid Safety Cabinet

- Store flammable liquids in an appropriate cabinet
- Label cabinet as shown

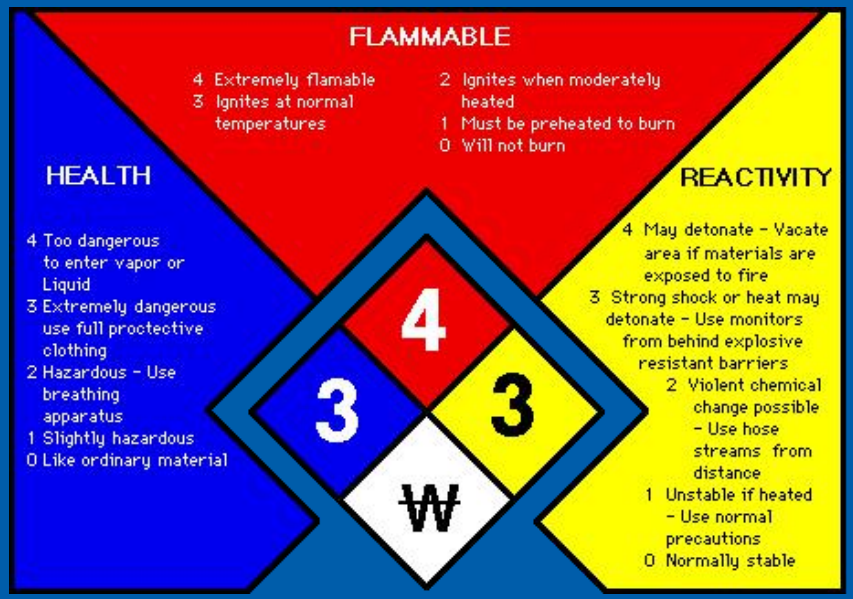
FLAMMABLE

Keep Fire Away

NFPA Chemical Hazard Label

4 Types of Hazards

- The diamond is subdivided into four general categories:
  - Health (blue)
  - Flammability (red)
  - Reactivity (yellow)
  - Special (white)



Material Safety Data Sheets (MSDS

- Identify the hazardous material or compound ingredients
- The physical or chemical characteristics of the substance

Material Safety Data Sheets
(Continued)

- Specifies the fire and the explosive nature of the chemical
- Specific health hazard data
- Personal protective equipment, ventilation, and other requirements
- Lists safe handling, storage, spill and leak control, and disposal methods

Chemical Spill Kit

- Absorbent material
- Protective clothing
- Gloves and goggles

Fires and Extinguishers

- Class A Fires:
  - The most common fire and is usually started by the ignition of a material such as paper or wood. Class A fires can be extinguished with water
- Class B Fires:
  - Consist of flammable liquids, such as alcohols, gases, and solvents. Class B extinguishers contain dry chemicals or CO2, which smothers the fire by depriving it of oxygen

How to Use a Fire Extinguisher

- A simple method to remember how to use a fire extinguisher includes the use of the acronym PASS
  - P - Pull the pin
  - A - Aim at the bottom
  - S - Squeeze the handle
  - S - Spray back and forth

Fire Prevention

- Regular Training & Practice for all staff:
  - Sounding the alarms and making sure help is on the way
  - Decision – thinking about when to fight the fire and when to abandon the site by establishing smoke barriers, (e.g., shutting windows and doors until help arrives)
  - Skill in using fire-extinguishers
  - Techniques for when personal garments catch fire, specifically rolling on the floor to smother the flames
  - Evacuation plan from the work site, as well as from locations throughout the building

Emergency Plans

- Develop Standard Operating Procedures (SOPs) for:
  - Cuts, accidental punctures
  - Ingestion of chemicals/hazardous materials
  - Spills and splashes
  - Broken/leaking containers
  - Fire and other natural disasters
  - Facility emergencies
    - Power outages
    - Ventilation and filters failure
    - Flood
  - Threats

Emergency Response

- What happens if exposure occurs?
  - Emergency procedures for eye splash
    - Safety eye wash station
  - Emergency procedure for splash on body
    - Safety shower in lab with proper drainage
  - Medical treatment/surveillance
    - Go to clinic or ER to see nurse or doctor

Emergency Preparedness

- Be prepared to deal with any accident or emergency that may occur
- Train each employee to treat a personal accident and come to the aid of a co-worker
- Emergency equipment and supplies should be standard in any area that contains potentially hazardous substances, along with easy-to-read instructions

Emergency Equipment and Supplies

- Numerous and conveniently located facilities for hand and body hygiene
- Immediate access to eyewash and overhead showers
- Neutralizing solutions for eye and body care
- Cleanup and confinement supplies and equipment
- Fully stocked first-aid kits or close proximity to medical care

Safety Eye Wash

Safety Shower

Exercise

- Work in pairs
- Create a chemical hazard safety checklist for your laboratory

What questions do you have on physical and chemical hazards?

Today's Agenda

- The Quality System
- Importance of Laboratory Design
- Laboratory Safety Management Plan
  - Managing Risks and Safety Gap Analysis
  - Biosafety Work Practice Controls
  - Physical and Chemical Hazards
- Other Safety Concerns
- Incident Investigation
- Module Summary

Proper Body Mechanics

- Train employees on proper body mechanics
- Provide lifting apparatuses to avoid injury to back, knees, and so forth
- Train employees to follow the steps for proper lifting to avoid injury

Steps for Proper Lifting

1. Stand close to the load with your feet spread apart about shoulder width, with one foot slightly in front of the other for balance
2. Squat down, bending at the knees (not the waist). Tuck your chin while keeping your back as vertical as possible
3. Get a firm grip on the object before beginning the lift

Steps for Proper Lifting (Continued)

4. Begin lifting slowly with your legs by straightening them. Never twist your body during this step
5. Once the lift is complete, keep the object as close to the body as possible. As the load's center of gravity moves away from the body, there is a dramatic increase in stress to the lumbar region of the back

Proper Lifting Techniques

Electrical Safety

- Check with engineers as part of the procurement procedure to make sure that any power needs and requirements are resolved before the equipment arrives
- Check all equipment for compliance with electrical safety standards before use
- Remove all extension cords or outlet adapters

Electrical Safety (Continued)

- Part of the laboratory preventive maintenance program for each piece of equipment are electrical safety checks, e.g., proper grounding, broken, worn, or frayed ends on plugs or cord
- If you feel a shock, remove equipment from service and call the engineer

What questions do you have on body mechanics, lifting or electrical safety?

Today's Agenda

- The Quality System
- Importance of Laboratory Design
- Laboratory Safety Management Plan
  - Managing Risks and Safety Gap Analysis
  - Biosafety Work Practice Controls
  - Physical and Chemical Hazards
- Other Safety Concerns
- Incident Investigation
- Module Summary

Incident Investigation

- Part of the occurrence management program
- A good safety plan includes an effective incident investigation program
- Investigate all accidents promptly regardless of their severity
- Once the the primary cause of the accident have been determined, preventive measures may be taken

Incident or Occurrence Report Form

- Date and person reporting the incident
- Description of the incident
- Assessment of the problem
- Corrective action
- Feedback to staff
- Review by the supervisor/lab manager

Incident Investigation and Prevention

- Who had the incident/accident
- When and where did it happen
- What equipment and supplies were being used
- How did it happen
- Did staff deviate from standard procedures
- What was the level of training and persons involved

Incident Investigation and Prevention (Continued)

- Use of safety protocols
- Any unusual circumstances that may have contributed to the accident (power or equipment failures, variation in the work flow, being rushed)
- Use of necessary precautions
- Additional steps or actions that could be taken to prevent the recurrence of the incident

What questions do you have on incident investigations?

Today's Agenda

- The Quality System
- Importance of Laboratory Design
- Laboratory Safety Management Plan
  - Managing Risks and Safety Gap Analysis
  - Biosafety Work Practice Controls
  - Physical and Chemical Hazards
- Other Safety Concerns
- Incident Investigation
- Module Summary

Module Summary

- safety management
- Laboratory staff must know what, where and when the risks are
- Laboratory staff must know the components of a Laboratory Safety Management Plan and the Emergency Procedures needed
- Laboratory staff must understand biosafety and biosafety practices

Module Summary (Continued)

- It is important to use appropriate Safe Work Practice Controls in the laboratory
- Must have procedures for Physical and Chemical Hazards
- It is important to keep appropriate biosafety documentation

What questions do you have on Safety and Facility Management?

Thank you