# WHY IS BIOSAFETY IMPORTANT

- Laboratories recognize hazards of processing infectious agents
- Guidelines developed to protect workers in microbiological and medical labs through engineering controls, management policies, and work practices.

NOT PERMITTED IN LABORATORIES:

- Eating
- Drinking
- Smoking
- Handling contact lenses
- Pipetting by mouth
- Storing food and drink

# STANDARD MICROBIOLOGICAL PRACTICES

- Limit access to the laboratory to trained personnel only.
- Assume all patients are infectious for all blood-borne pathogens.
- Use appropriate barrier precautions to prevent skin and mucous membrane exposure, including wearing gloves at all times and masks, goggles, gowns, or aprons if splash or droplet formation is a risk.
- Thoroughly wash hands and others skin surfaces after removing gloves and immediately after any contamination.
- Take special care to prevent injuries with sharp objects, such as needles and scalpels.
- The biohazard symbol should be prominently displayed on laboratory doors and any equipment (refrigerators, incubators, centrifuges) that contain infectious materials.

The air-handling system of microbiology laboratory should move air from lower to higher risk areas, never the reverse.

- Ideally, the microbiology laboratory should be under negative pressure, and air should be re-circulated after passing through microbiology.
- Infectious diseases, including the plague, tularemia, brucellosis, tuberculosis, may be contracted through inhalation of infectious particles present in a droplet of liquid.

- Subculturing blood cultures by puncturing the septum with a needle should be performed behind a barrier to protect the worker from droplets.
- Several other common procedures used to process specimens for culture, notably mincing, grinding, vortexing, and preparing direct smears for microscopic examination, are known to produce aerosol droplets= procedures must be performed in a biosafety cabinet.

# BIOLOGIC SAFETY CABINET

- Air that contains the infectious materials sterilized, either by heat, ultraviolet light or, most commonly, by through a HEPA filter that removes most particles larger than 0.3μm in diameter.
- These cabinets are designated as class I through 3, according to the effective level of biologic containment.
- Class I cabinets allow room (unsterilized air to pass into the cabinet and around the area and material within, sterilizing only the air to be

exhausted.

- They have negative pressure, are ventilated to the outside, and are usually operated with an open front.
- Class II cabinets sterilize air that flows over the infectious material, as well as air to be exhausted.
- The air flows in “sheets” which serve as barriers to particles from outside the cabinet and direct the flow of contaminated air into the filters.
- Depending on their inlet flow velocity and the percent of air that is HEPA filtered and recirculated, class II cabinets are further differentiated into type A or B.
- Most hospital clinical microbiology laboratory scientists use class IIA cabinets.
- Class III cabinets afford the most protection to the worker.

- Air coming into and going out of the cabinet is filter , sterilized, and the infectious materials within is handled with rubber gloves that are attached and sealed to the cabinet.

# PERSONEL PROTECTIVE EQUIPMENT (PPE)

- Plastic shields or goggles to protect workers from droplets ,
- Disposal containers for sharp objects, such as needles, slides, etc.
- Holders for glass bottles,
- Tray in which to carry smaller hazardous items (e.g. blood culture bottles).
- Handheld pipetting devices,
- Impervious gowns, laboratory coats, disposal gloves and masks,
- Safety carriers for centrifuges ( especially those used in the acid fast bacteria (AFB) laboratory),
- HEPA respirators.

# BIOSAFETY LEVELS

- Precautions so people researching or trying to identify organisms do not become infected.

- While handling or testing clinical specimens, workers could accidentally infect themselves or coworkers.
- Labs must adhere to very specific safety regulations to work with organisms that pose a threat to human health

## BARRIERS—PRIMARY BARRIERS:

- Physical barriers or personal protective equipment between lab worker and pathogen. e.g. gloves, masks, special breathing apparatuses

## SECONDARY BARRIERS:

- Structural aspects of the laboratory that make working environment
- Sinks for handwashing, special containment areas, and special air ventilation patterns.

# LABORATORY BIOSAFETY LEVELS

There are four (IV) biosafety levels in the laboratory

## BIOSAFETY LEVEL I (BSL-I)

Agents not known to cause disease in healthy adults

- Some organisms may cause disease in immunocompromised individuals
- Agents include bacillus subtilis, Naegleria gruberi, infectious canine hepatitis virus, nonpathogenic E. coli species

Standard practices required:

- Doors that can be kept closed when working:
- Limits on access to the lab space when working:
- Care to minimize splashes and actions that may create aerosols (tiny droplets):
- Decontamination of work surfaces after every use after any spills;

- Decontamination of laboratory waste;
- Use of mechanical pipettes only (no mouth pipetting);
- “Sharps” precautions, including special containers for disposing of needles and other sharp objects;
- Maintenance of insect/rodent control program;
- Use of personal protective equipment (lab coats, latex gloves, eye protection or face shields).

# DISPOSAL OF HAZARDOUS WASTE

- Sharp objects, including scalpels and needles, are placed in sharps containers and then autoclaved or incinerated

BIOSAFETY LEVEL II (BSL-II)

- Agents associated with human disease
- Generally required for any human-derived blood. Bodily fluids, tissues in which infectious agent may be unknown

Agents include:

- Measles virus,
- Salmonella species,
- Toxoplasma,
- Clostridium botulinum,
- Hepatitis B virus

PRIMARY HAZARDS:

- Accidental needle sticks
- Exposure to eyes and nose (mucous membranes)
- Ingestion of infectious materials
- Agents do not cause lethal infections, are not transmissible via airborne route= inhaled, which might occur if the material were spattered)

- Extreme care should be taken with contaminated needles and sharp lab instruments.
- Policies to restrict access to lab;
- Biohazard warning signs posted outside lab;
- Surveillance of laboratory personnel with appropriate immunizations offered;
- Biosafety manual with definitions of needed waste decontamination or medical surveillance policies;
- Supervisory staff that have experience working with infectious agents and specific training for laboratory personnel in handling these agents.

- Personal protective equipment; lab coats, gloves, face protection as needed
- Protective clothing removed when personal leave laboratory area
- Cabinets thoroughly decontaminated daily and monitored for radiation for personal protection
- Secondary barriers; BSL-I barriers plus autoclave for glassware.

# BIOSAFETY LEVEL III (BSL-III)

- Microorganisms that cause serious disease, transmitted by inhalation
- Mycobacterium tuberculosis, yellow fever virus, hantavirus, y. pestis (plague)

Containment lab:

- Double door entry;
- Directional airflow; all work in biosafety cabinet.
- Agents with potential for respiratory transmission, may cause serious and potentially lethal infection

- Strictly controlled access to the lab;
- Specific training for lab personnel in handling potentially lethal agents;
- Decontaminating all waste;
- Changing contaminated protective lab clothing,
- Decontaminated lab clothing before laundering;
- Institutional policies regarding specimen collection and storage from workers to establish exposure.