Management of Quality, Biosafety & Biosecurity in veterinary laboratories

Mehdi EL HARRAK, DVM, PhD
Member of OIE Laboratory Commission
R&D Director MCI Sante Animale MAROC
Presentation outline

General procedures
Laboratory access
Personal protective equipment
Hands washing
Biosafety Cabinets
Common mistakes
Transport and storage
A. Standard Microbiological Practices

1. The laboratory supervisor must enforce the institutional policies that control access to the laboratory.

2. Persons must wash their hands after working with potentially hazardous materials and before leaving the laboratory.

3. Eating, drinking, smoking, handling contact lenses, applying cosmetics, and storing food for human consumption must not be permitted in laboratory areas. Food must be stored outside the laboratory area in cabinets or refrigerators designated and used for this purpose.

4. Mouth pipetting is prohibited; mechanical pipetting devices must be used.

5. Policies for the safe handling of sharps, such as needles, scalpels, pipettes, and broken glassware must be developed and implemented. Whenever practical,
Standard Laboratory practices

Laboratory supervisors should adopt improved engineering and work practice controls that reduce risk of sharps injuries.

Precautions, including those listed below, must always be taken with sharp items. These include:

- Careful management of needles and other sharps are of primary importance. Needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal.

- Used disposable needles and syringes must be carefully placed in conveniently located puncture-resistant containers used for sharps disposal.

- Non disposable sharps must be placed in a hard walled container for transport to a processing area for decontamination, preferably by autoclaving.

- Broken glassware must not be handled directly. Instead, it must be removed using a brush and dustpan, tongs, or forceps. Plasticware should be substituted for glassware whenever possible.

6. Perform all procedures to minimize the creation of splashes and/or aerosols.

7. Decontaminate work surfaces after completion of work and after any spill or splash of potentially infectious material with appropriate disinfectant.
8. Decontaminate all cultures, stocks, and other potentially infectious materials before disposal using an effective method. Depending on where the decontamination will be performed, the following methods should be used prior to transport:

   a. Materials to be decontaminated outside of the immediate laboratory must be placed in a durable, leak proof container and secured for transport.

   b. Materials to be removed from the facility for decontamination must be packed in accordance with applicable local, state, and federal regulations.

9. A sign incorporating the universal biohazard symbol must be posted at the entrance to the laboratory when infectious agents are present. The sign may include the name of the agent(s) in use, and the name and phone number of the laboratory supervisor or other responsible personnel. Agent information should be posted in accordance with the institutional policy.
10. An effective integrated pest management program is required. See Appendix G.

11. The laboratory supervisor must ensure that laboratory personnel receive appropriate training regarding their duties, the necessary precautions to prevent exposures, and exposure evaluation procedures. Personnel must receive annual updates or additional training when procedural or policy changes occur. Personal health status may impact an individual’s susceptibility to infection, ability to receive immunizations or prophylactic interventions. Therefore, all laboratory personnel and particularly women of child-bearing age should be provided with information regarding immune competence and conditions that may predispose them to infection. Individuals having these conditions should be encouraged to self-identify to the institution’s healthcare provider for appropriate counseling and guidance.
GENERAL LABORATORY SAFETY GUIDELINES

- Mostly common sense, but you must understand the hazards you face in the laboratory and be adequately trained to deal with them.
- Basic must be known for all labs.
GOOD MICROBIOLOGICAL PRACTICE (GMP)

- Basic code of practice that should be applied to all types of work involving microorganisms.

- Objectives:
  - prevent contamination of laboratory workers and the environment
  - prevent contamination of the experiment/samples

- Application of aseptic technique, minimization of aerosols, contamination control, personal protection, emergency response
Controlling access
Physical barriers/ Vehicular Control
Personnel Monitoring
Access

Personnel
  Clearances?
  ID badges (checked?)

Visitors
  open to the public?
  visiting fellows, post-docs, students
All workers wear photo ID badges with name & expiration date.

Use color coding to indicate clearance to enter restricted areas.

Guests are issued Visitor ID badges & are escorted by workers.
Control access to where agents are stored & used

• Labs & animal areas separated from public areas locked at all times

• Card-key or other controlled access

• Visitor entry recorded; restricted to times when staff are available for escort

• Lock storage rooms, cabinets, freezers containing agents
PERSONAL PROTECTIVE EQUIPMENT (PPE)

- PPE can become an important line of defence (last line of defense)
- Responsibility of both the user and the supervisor to ensure that PPE is worn
PERSONAL PROTECTIVE EQUIPMENT (PPE)

Lab Coats/Gowns

- Long-sleeved, knee length with snaps
- Elastic cuffs
- Back-closing gowns
- Periodic cleaning required
PERSONAL PROTECTIVE EQUIPMENT (PPE)

Gloves

- Latex, nitrile & vinyl for work with biological agents.
- Exam gloves should not be reused, change frequently. Utility gloves can be disinfected and reused if they show no sign of degradation.
- Consider tensile characteristics, length of cuff.
- Double gloving.
- Provide assistance finding an alternative for people with allergies.
Eye & Face Protection
- Goggles, safety glasses to protect the eyes
- Full face shield to protect facial skin.

Respirators
- Only personnel who have been fit-tested and trained should wear respirators.
Consider lockboxes
Typical transport carrier
Hand washing

- One of the single effective means of preventing infections if done properly and frequently

- When to wash?
  - Before starting any manipulations
  - Before leaving the lab
  - When hands are obviously soiled
  - Before and after completing any task in a BSC
  - Every time gloves are removed
  - Before contact with one’s face or mouth
  - At the end of the day
Foot Protection

Steel toe safety shoes and boots (rubber or leather) with puncture resistant soles
- from sharp objects
- dropped heavy objects
- heavy livestock stepping on your feet
- chemical hazards (steel toe safety rubber boots)
Types of Cabinets

Fume Hood
Laminar Flow Cabinet/Hood
Biosafety Cabinet
Microbiological Safety Cabinet
Fume Hoods

Removes toxic chemical (ducting sys./ductless)
No HEPA filter -> not for biohazard agents
Laminar Flow Cabinets

Product protection (no personnel protection)
Not for biohazard agents or chemical fumes
Biosafety Cabinets

Class I BSC: Personnel and Environment Protection

Class II & III BSC: Personnel, Product and Environment Protection

HEPA filters (not for chemical vapors)
Class 1 BSC

- Only operator protection (not product).
- Same level of operator protection as Class II BSC
- Biosafety level 1, 2, 3
- Inflow away from operator
- HEPA filtered exhaust to environment
- Current trend: to Class 2
Class 2 A2 BSC

Both operator and product protection
Biosafety level 1, 2, 3
Inflow away from operator
HEPA filtered exhaust to environment
HEPA filtered laminar down flow
Carcinogen in cell culture:
  biological & chemical \(\rightarrow\) need ducting
Class 3 BSC

Biosafety level 1, 2, 3, 4
Product and operator protection
Gas leak tight $1 \times 10^{-5}$ cc/sec leak rate
Internal operations $\rightarrow$ attached glove
Material transfer $\rightarrow$ 2 doors pass box
Negative air pressure $> 0.5$ “WC (120 Pa)
Supply is HEPA filtered
Double exhaust HEPA filter in series  or:
Single exhaust HEPA and an incinerator
Common User Mistakes

Confusing a vertical laminar flow cabinet for a Class II BSC
Failure to identify the type of BSC needed for their operations
Inappropriate choice of installation site / cabinet location
Inappropriate usage / maintenance of the BSC
Proper Installation / Location

Exhaust filter area: Especially susceptible to disruptive air currents. Clearance of 40 cm (minimum) is recommended between the highest point of the cabinet and the ceiling.
Proper Operation

Slow deliberate movements that will not disrupt airflow, minimize arm movement

When an alarm is activated, do NOT use the cabinet

After usage, wipe down the cabinet with cleaning agents (UV lamp)

Work starting from clean to “dirty” objects

Do not block airflow perforations with objects/equipments
WORKING SAFELY IN A BSC

Before using the cabinet:

- Ensure BSC is certified
- Turn off UV lamp; turn on fluorescent lamp
- Disinfect work surfaces with appropriate disinfectant
- Place essential items inside cabinet
- Allow the blower to run for 5-10 min before work
WORKING SAFELY IN A BSC

While using the cabinet:
- Ensure material and equipment is placed near the back of the hood, especially aerosol-generating equipment. Do not block any vents.
- Use techniques that reduce splatter and aerosols.
- General work flow should be from clean to contaminated areas.
- Minimize movement so as not to impede air flow.
- Open flame in BSC’s is controversial.
After using the cabinet:

- Leave blower on at least 5 minutes to purge cabinet
- Remove and decontaminate equipment and materials
- Disinfect cabinet surfaces
- Turn off blower and fluorescent lamp, turn on UV lamp
Maintenance:

- Before and after each use - Work surfaces wiped down
- Weekly - UV lamp should be wiped clean
- Monthly - All vertical surfaces wiped down
- Annually - UV lamp intensity verified
  - Decontamination with formaldehyde
  - Certification
SAFE USE OF CENTRIFUGES

- **Before use**
  - Stress lines? Overfilled? Balanced?
  - Caps or stoppers properly in place?
  - Run conditions achieved?

- **Use sealable buckets (safety cups) or sealed rotors**

- **After run**
  - Centrifuge completely stopped?
  - Spills or leaks?
  - Allow aerosols to settle (30 min) or open in a BSC.
NEEDLES AND SYRINGES

- Avoid use whenever possible
- Use a BSC for all operations with infectious material
- Fill syringes carefully
- Shield needles when withdrawing from stoppers
- Do not bend, shear or recap needles.
- Dispose of all used needles/syringes in yellow sharps containers
PIPETTES

- Mouth pipetting is prohibited.
- Never force fluids out.
- To avoid splashes, allow discharge to run down dispense the receiving container wall.
- Never mix material by suction and expulsion.
- Reusable pipettes should be placed horizontally in a disinfectant filled pan.
INOCULATION LOOPS

- Sterilization in an open flame may create aerosols which may contain viable microorganisms.
- Use a shielded electric incinerator
- Shorter handles minimize vibrations
- Disposable plastic loops are good alternatives
Déchets à Risques Infectieux

• La durée entre la production effective des déchets et leur incinération ou prétraitement par désinfection ne doit pas excéder:
  - 72 heures lorsque la quantité de déchets d’activités de soins à risques infectieux et assimilés produite sur un même site est supérieure à 100 kilogrammes par semaine ;
  - 7 jours lorsque la quantité de déchets d’activités de soins à risques infectieux et assimilés produite sur un même site est inférieure ou égale à 100 kilogrammes par semaine et supérieure à 5 kilogrammes par mois. Par site, on entend tout lieu non traversé par une voie publique où sont installées les activités relevant d’une même personne juridique et génératrices des déchets visés à l’article 1.
Know materials brought into labs & animal facilities

- Only accept packages you expect.

- Screen all packages (visually, x-ray) before transfer into lab.

- Open all packages containing toxins &/or microbiologic agents in safety cabinets or fume hoods.
**Transport:**
Closed, leakproof, primary container
Closed, leak-proof, (durable) secondary container

**Storage of material:**
Well-labeled
Restricted access
Personnel have knowledge of hazards

**Shipping:**
Saf T Pak certification for shippers of diagnostic specimens, infectious waste
All vehicles and buildings should have a first aid kit

- get appropriate first aid training
- in your FA kit include emergency numbers
- check FA kit content every three months
- label all FA kits
- include flares and flash light in your FA kit
- emergency signals - extra help
Safety Signs
Classified according to the use hazards and risk involved

The categories of hazard are:
- Toxicity / Poison
- Explosive Potential
- Flammability
- Corrosive

The categories of risks are:
- Danger
- Warning
- Caution
Have an emergency plan

- Controlling access to labs &/or animal facilities complicates emergency response.
  - Develop plan before the emergency
  - Involve all appropriate parties in planning
  - Inform community-based responders
  - Conduct drills & after-incident reviews
Biosafety Officer (the facilitator)

- Works with investigators to ensure the safe conduct of biological research
- Risk assessment, appropriate containment
- Provides technical advice on research safety and security procedures
- Periodic lab inspections/lab standards
- Develop emergency plans/accidental spills, investigating accidents
Biosafety Program

Principles

• General Lab Requirements
  • Knowledgeable supervisor
  • Knowledgeable personnel
    • Aware of potential hazards
    • Proficient in practices & techniques
  • Lab specific biosafety manual
  • Biosafety Levels (BSLs)
  • Laboratory Practice and Technique
  • Safety Equipment (Primary Barriers)
  • Facility Design and Construction (Secondary Barriers)
  • Biosafety cabinets (BSCs) - BSL 2/3
  • Personal protective clothing
  • Pipetting Devices
  • Safety centrifuge cups and rotors
Conclusions

• Good laboratory biosafety practices reinforce and strengthen laboratory biosecurity systems.
• Risk assessment is essential for effective biosafety and biosecurity programs.
• The commitment to constantly improve biorisk management performance for a facility and its operation through attainable goal-setting and actual goal-achieving should be encouraged and acknowledged at all levels.
Bio

Risk management

Safety of staff and environment

Accidental release

Natural infection

Deliberate use

Biorisk Reduction

Security of valuable biological materials

Responsible biomedical research and development