

Biorisk Management Basic-level Materials



Biorisk Management Principles

Involves the use of measures designed to reduce potential exposures or laboratory personnel, the community and the environment to hazards in present in the laboratory

- **Biosafety** : containment principles, technologies and practices that are implemented to **prevent the unintentional exposure** to the biological agents and toxins, or their accidental release

- **Biosecurity** : protection, control and accountability for biological agents and toxins within laboratories, in order to **prevent their loss, theft, misuse, diversion of, unauthorized access or intentional unauthorized release** (sometimes stressing protection of assets)

Biorisk: combination of

- 1) the probability of occurrence of harm
- 2) the severity of harm where the source of harm is a biological agent or toxin



Biorisk Management Model

3 Key Components

1. Biorisk **A**ssessment
2. Biorisk **M**itigation
3. Biorisk **P**erformance



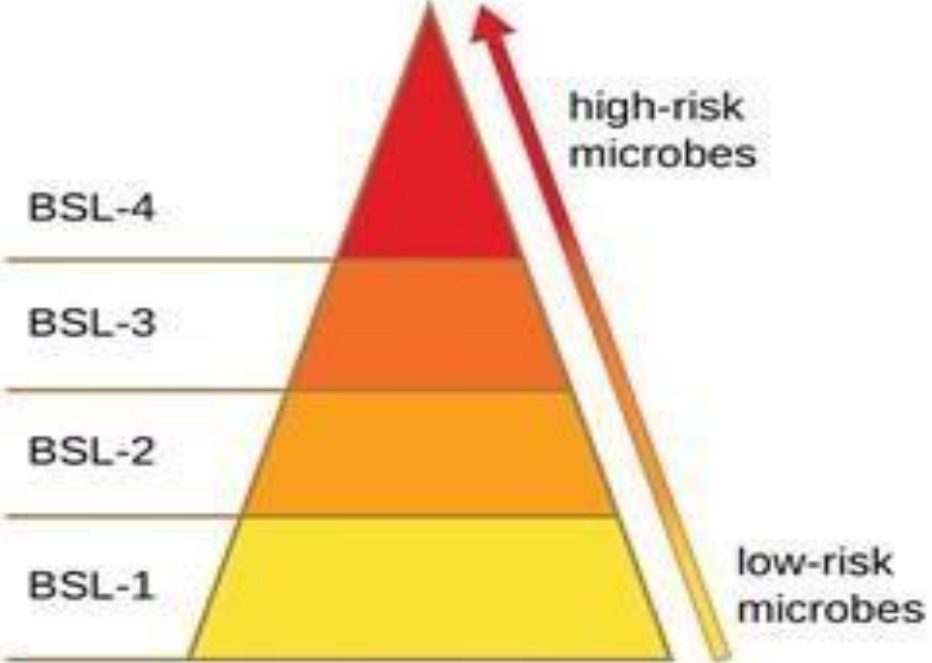
Biosafety

- **Barriers that protect worker from biorisk**
 - ❑ Primary - equipment
 - ❑ Secondary – design of the infrastructure/building
 - ❑ Personnel – qualities of workers (training, vetting)
 - ❑ Procedural – working techniques (general and specific work practices)
- Laboratory biosafety levels (BSL)
 - standards for biosafety stringency
 - Containment Levels 1-4
 - Different containment required for work with pathogens of different risk
 - Provides guidelines on:
 - Facility design
 - Engineering controls
 - PPE
 - General work practices
 - Specific work practices

Biosafety levels established by the CDC at NIH are an important tool in determining risk management strategies in biological laboratories

These levels indicate the type of laboratory facilities and practice required based on the type of material being used, the laboratory techniques employed, the safety equipment available for use with the material and the design and construction of the facility in which the material is being manipulated. Biological safety levels are ranked from 1 to 4 and are selected based on the agent or the organism on which the research or work is being conducted.

Each level up builds on the previous one adding constraints and barriers

Biosafety Levels			
Biological Safety Levels	Description	Examples	CDC Classification
BSL-4	Microbes are dangerous and exotic, posing a high risk of aerosol-transmitted infections, which are frequently fatal without treatment or vaccines. Few labs are at this level.	Ebola and Marburg viruses	
BSL-3	Microbes are indigenous or exotic and cause serious or potentially lethal diseases through respiratory transmission.	<i>Mycobacterium tuberculosis</i> <i>St. Louis encephalitis virus</i>	
BSL-2	Microbes are typically indigenous and are associated with diseases of varying severity. They pose moderate risk to workers and the environment.	<i>Staphylococcus aureus</i> <i>hepatitis B virus</i> <i>HIV</i> <i>salmonella species</i> <i>and toxoplasma species</i>	
BSL-1	Microbes are not known to cause disease in healthy hosts and pose minimal risk to workers and the environment.	Nonpathogenic strains of <i>Escherichia coli</i> <i>Bacillus subtilis</i> , <i>Naegleria species</i>	

Biosafety Levels (BSL)

Level 1 (BSL-1):

This level is assigned to work involving well-characterized agents that are not known to consistently cause disease in healthy adults. These agents pose minimal potential hazards to laboratory personnel and the environment. Standard microbiological practices are sufficient for handling such materials.

Level 2 (BSL-2):

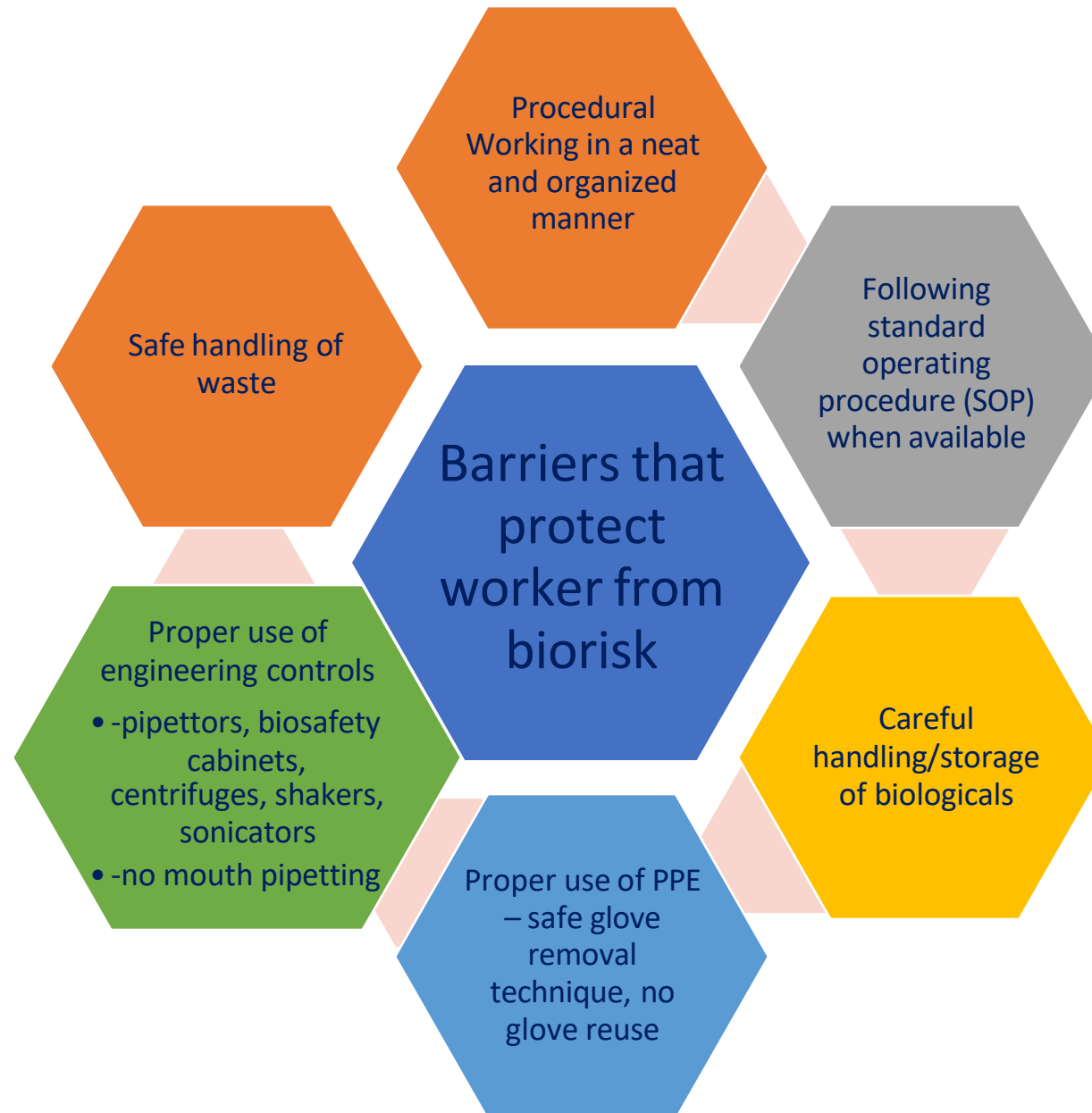
This level applies to work with infectious agents that can cause disease in humans and pose a moderate hazard to personnel and the environment. Examples include *Hepatitis B virus (HBV)*, *Human Immunodeficiency Virus (HIV)*, *Salmonella* species, and *Toxoplasma* species. Procedures that may produce aerosols or involve infectious materials require the use of biological safety cabinets and other containment equipment.

Level 3 (BSL-3):

This level is designated for work with indigenous or exotic agents that may cause serious or potentially lethal diseases through inhalation. Examples include *Mycobacterium tuberculosis* and *St. Louis encephalitis virus*. All manipulations involving infectious materials must be conducted in a biological safety cabinet or equivalent containment device. BSL-3 laboratories require special engineering and design features to ensure containment and safety.

Level 4 (BSL-4):

This level is reserved for work with dangerous and exotic agents that pose a high risk of aerosol-transmitted infections and life-threatening diseases. BSL-4 laboratories must be completely isolated from other areas, preferably located in a separate building. They require advanced engineering controls, specialized ventilation systems, and rigorous entry/exit protocols. Laboratory personnel must receive extensive training in handling extremely hazardous pathogens and must fully understand primary and secondary containment principles, specialized practices, and facility design features.



DIFFERENCE BETWEEN DISINFECTION AND STERILIZATION



DISINFECTION

DISINFECTION IS THE PROCESS OF ELIMINATION OF PATHOGENIC MICROORGANISMS. HOWEVER, THE PROCESS IS NOT EFFECTIVE IN CASE OF VEGETATIVE SPORES



STERILIZATION

STERILIZATION REFERS TO ANY PROCESS THAT ELIMINATES, REMOVES, KILLS, OR DEACTIVATES ALL FORMS OF LIFE AND OTHER BIOLOGICAL AGENTS PRESENT IN A SPECIFIED REGION



- Sterilization inactivates all microbes (often done with steam autoclave)
- Disinfection inactivates all or most *harmful* microbes
 - Chemicals are often used on surfaces for disinfection
 - Effectiveness depends on:
 - Chemical (alcohols, chlorine compounds, hydrogen peroxide, others)
 - Concentration of chemical
 - Contact time between chemical and microbe
 - Pasteurization, ultraviolet radiation

Biological Safety Equipment

- Specialized equipment helps reduce risk when working with biomaterials
- Barriers that protect worker from biorisk
 - Primary – equipment
- Personal Protective Equipment (PPE)
 - Gloves
 - Lab coats – washing schedule or disposable
 - Respirators (e.g. N95, not surgical masks) – protect respiratory tract from aerosols
- Liquid pipetting devices
- Instruments
- Sharps containers
- Biosafety cabinets



Primary Means of Physical Containment:

The main methods of physical containment in laboratories include the use of proper laboratory practices and containment equipment. Safety equipment helps remove or minimize exposure to hazardous biological materials and includes biosafety cabinets, personal protective equipment (PPE), enclosed containers, and other engineering controls.

Personal Protective Equipment (PPE):

Personal protective equipment refers to specialized clothing or gear worn by laboratory personnel to provide an additional layer of protection while handling infectious agents or toxins.

PPE is used in **all biological laboratories across all biosafety levels (BSL-1 to BSL-4)** to minimize the risk of exposure.

Biosafety Cabinets (BSCs):

Biosafety cabinets are containment devices designed to handle infectious agents or toxins safely. They are routinely used for a variety of applications such as:

- Cell and tissue culture
- Bacterial and viral work
- Handling clinical samples

Biosafety cabinets protect both **laboratory workers** and the **environment** from exposure to infectious materials. This is achieved through **directional airflow** and **High-Efficiency Particulate Air (HEPA) filtration**.

In addition, they also protect biological products from contamination during handling.

It is important to recognize that **chemical fume hoods** and **biosafety cabinets** are designed for **different purposes**.

•**Chemical fume hoods** protect users from chemical vapors and fumes but **do not protect against infectious agents or toxins**.

•**Biosafety cabinets**, on the other hand, are engineered specifically to contain biological hazards and are **not interchangeable** with chemical fume hoods.

Surgical Masks vs. N95 Respirators:

Surgical masks are **not respirators**. They protect the wearer from **splashes and large droplets**, but **not from aerosols**.

N95 masks, however, are **respirators** designed to filter out at least **95% of airborne particles down to 0.3 microns**, which is smaller than most aerosols.

- They must fit snugly against the user's face to be effective.
- N95 masks typically have **two straps** and a **metal tab** to adjust around the nose.
- Masks that appear similar but have **only one strap** are **not true N95 respirators** and do not provide the same level of protection.

Although N95 masks significantly **reduce inhalation risk**, they **do not eliminate it completely**.

General Principle:

Biosafety cabinets function using the principles of **laminar airflow** and **HEPA filtration**.

These systems help:

- Keep hazardous materials **contained within the cabinet**, and
- Prevent contaminants from escaping into the laboratory environment.

Different **classes (levels)** of biosafety cabinets exist, each applying these principles to varying degrees of protection depending on the biosafety level and type of work performed.

Biorisk Assessment

- Objective assessment of conditions and the level of risk they present to biosafety and biosecurity
 - Identify hazards and methods to control them
 - Evaluate risks



Biorisk Assessment

A **biorisk assessment** of infectious agents and the procedures to be performed is used to determine the **appropriate containment level, equipment, and work practices** that will ensure the safe conduct of a research project.

It is important to note that there are **significant differences between risk assessment criteria** used for *public health and worker protection* versus those applied in *animal, plant, and agricultural containment* settings.

Definition and Purpose

A **biorisk assessment** is a systematic process used to:

1. **Identify** the hazardous characteristics of a known or potentially infectious agent or toxin.
2. **Determine** the laboratory activities that may lead to exposure.
3. **Estimate** the likelihood that such exposure could result in infection or intoxication.
4. **Evaluate** the probable **consequences** of that infection or exposure.

The **importance of biorisk assessment** cannot be overstated.

The information obtained through this process is essential for:

- **Selecting appropriate microbiological practices**
- **Choosing the correct safety equipment and containment facilities**
- **Implementing safeguards** that can effectively **prevent exposure** and **significantly reduce the incidence of laboratory-acquired infections**

Overall Role in Risk Management

Biorisk assessment represents the **first and most critical step** in the overall **risk management process**.

By identifying potential hazards and evaluating exposure risks, it provides the foundation for developing effective strategies to protect **laboratory personnel, the environment, and the community** from biological threats.

What steps are performed during biorisk assessment ?????

Allows risks to be prioritized

Allows effective plans to mitigate (reduce) and monitor risk

Allows decision of whether risk is acceptable or not

What constitutes the hazard severity and its likelihood of occurrence are different for every situation. A matrix of situations should be used when conducting a risk assessment of the lab and to identify methods to reduce risk for both biosafety and biosecurity.

Biorisk Assessment

- Common Risk Matrix

Is a matrix used during risk assessment to define the level of risk by considering the category of probability or likelihood against the category of consequence severity

This is a simple mechanism to increase visibility of risks and assist management decision making a risk matrix is a chart that's plots the severity of an event occurring and one axis and the probability of its occurring in the other axis

You can also format The matrix as a table where the rest likelihood and impacts are columns and the risks are enlisted in rows

The risky score is the result of your analysis calculated by multiplying the risk impact rating by risk probability

Note: the video in the next slid represents in shortly the risk and how to use risk matrix

Risk Matrix

		Likelihood of Occurrence			
		Very Unlikely Little or no chance of occurrence	Unlikely A rare combination of factors would be required for an incident to result.	Possible Not certain to happen but an additional factor may result in an accident	Probable More likely to occur than not
Hazard Severity	Minor No or minor injury (first aid)	CARE	CARE	CARE	CAUTION
	Moderate Off-site medical treatment or DAFW*	CARE	CARE	CAUTION	ALERT
	Serious More than one DAFW, long-term absence	CARE	CAUTION	ALERT	STOP!
	Major Permanent disability or harm, fatality	CAUTION	ALERT	STOP!	STOP!

*DAFW – Day Away From Work

CARE	Minor harm possible, serious harm very unlikely to occur; implement controls and ensure care is taken when performing activity.
CAUTION	Minor harm probable, major harm unlikely to occur; follow all control measures, increased level of competence required and ongoing self-assessment of risks identified.
ALERT	Moderate degree of harm probable but major harm unlikely; critically assess the risks and appropriate controls. Specific competence required and ongoing assessment of risks by individual and/or supervisor.
STOP!	Serious or major harm will probably occur; stop the activity and critically assess the risks, review safety aspects of activity and implement further, appropriate controls. Consider referencing HSE or other Best Practice, consider involving HSS.

Risk Matrix

<https://www.youtube.com/watch?v=-E-jfcoR2W0>

Risk Assessment for Containment Laboratories

- Assessment for containment laboratories
- Barriers that protect worker from biorisk
 - Secondary – design of the infrastructure/building
- Risk assessment - consideration of factors important for containment
 - Locking doors, security
 - Laboratory layout and workflow
 - Air handling and filtration
 - High Efficiency Particular Air (HEPA) filters
 - Handwashing access
 - Biosafety cabinet accessibility and maintenance
 - Sterilization (e.g. autoclave) access
 - Proper signage – post biosafety/biosecurity warnings
 - Containment suits

The facility design and physical features of biological laboratory provide barrier protection from The accidental release of infectious agents or toxins outside the lab or to the environment

The design and construction of the facility contribute to the lab workers protections it's also provides a barrier to protect people animals and the environments outside the lab from the infectious agents or toxin that may be accidental released from the lab

Laboratory design is one element of engineering controls used in the laboratory biosafety

Old biological laboratories incorporate specific design elements gold engineering controls to protect Labs workers and communities from infectious agents and toxins

Risk Assessment for Lab Animal Facilities

- Assessment for lab animal facilities
- Animal biosafety levels mirror concepts for standard biosafety levels
 - ABL1-4
- Small animal housing can represent containment for infected rodents
 - Disposable cages
 - HEPA filtered racks
- Large animals requires:
 - special facilities, equipment
 - knowledge of their behavior



When working with animals, **biorisk assessment** must also consider **animal welfare** and **factors that may compromise experimental validity or research outcomes**.

Animal biosafety is classified into **four levels (ABSL-1 to ABSL-4)**, and each level includes specific facility design and operational requirements to ensure both human and animal safety.

Animal Biosafety Facility Requirements

Separation and Access Control:

Animal facilities should be separated from areas accessible to unrestricted personnel.

External facility doors must be **self-closing, securely locked, and kept closed** whenever experimental animals are present.

Design and Maintenance:

Facilities should be **designed, constructed, and maintained** to allow easy cleaning and proper housekeeping.

Interior surfaces (walls, floors, and ceilings) should be **water-resistant** and **free of cracks**.

Windows are **not recommended**, but if present, they must be **break-resistant**.

Drainage and Disinfection:

Floor drains, if installed, should have **traps filled with appropriate disinfectants** to prevent contamination or pest entry.

Ventilation:

Adequate ventilation must comply with the **Guide for the Care and Use of Laboratory Animals**, ensuring **no recirculation of exhaust air**.

Air should flow from **clean to contaminated areas** to reduce infection risk.

Sanitation and Equipment:

Hand-washing sinks should be easily accessible.

Cages must be washed manually or in a **mechanical cage washer** capable of a **final rinse temperature of at least 180°F (82°C)**.

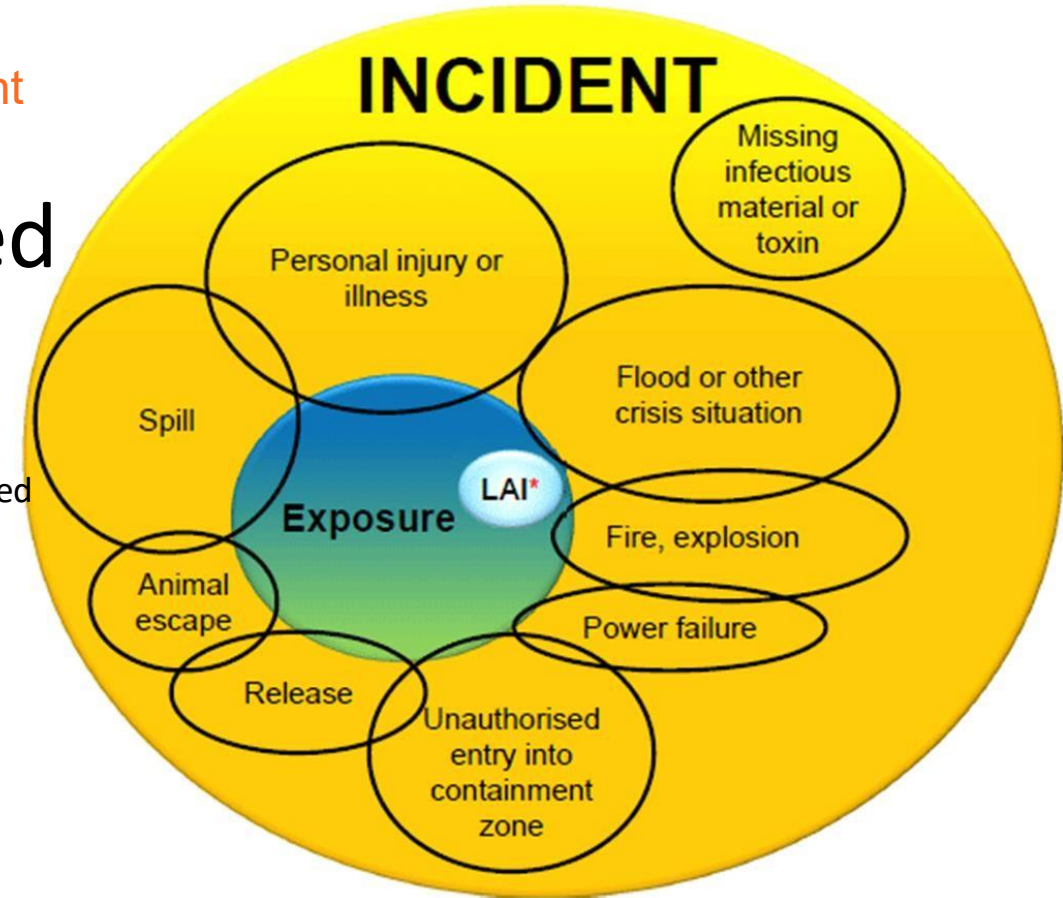
To prevent contamination, **disposable cages** or **HEPA-filtered rack systems** are recommended.

An **autoclave** must be available for the **decontamination of infectious waste**.

All of these lab hazards that shown in the picture such as personal injury or illness animal escape and authorized and interview contaminate zone fire or explosion missing infectious material toxin and etc have risk associated with them and may be problems for both fire safety and biosecurity

The list above is not complete and the perceived probability of each hazard should be taken into account based on the facility and what is going on the world

- Graphic of risks and perceived probability
- Biorisk is dynamic must be continually updated to take into account new information and changing environments
- Assessment is continuous



Biorisk Administration and Management Best Practices

- Biorisk management requires ethics, diligence, transparency
 - Establish and implement management policies
 - Monitoring and reporting (compliance)
 - Oversee training schedule
 - Record-keeping
 - Biological Agent Use Registration – keep track of biological agents
 - Biomedical waste management

Biorisk management systems, should be able to:

1. establish the *principles* that enable the management and staff of laboratories to achieve their biosafety and biosecurity objectives
2. define the essential *components* that integrate biosafety and biosecurity processes into the laboratory's overall governance, strategy and planning, management, quality management system, reporting processes, policies, values, and culture;
3. describe a comprehensive biorisk management *process* that identifies biorisks (both biosafety and biosecurity risks) and reduces and/or maintains them at acceptable levels.

Biorisk Mitigation

Mitigation = reduction/alleviation

- Biorisk mitigation - practices and equipment that will help reduce the biological risk (e.g. risk of infection)
 - Include all measures to increase biosafety and biosecurity
 - Work practices, PPE, equipment, infrastructure, etc.
- Mitigation of a specific risk - based on the pathogen and the experiments that will be conducted
 - risk assessment helps direct a specific mitigation
 - mitigation can change with scenario



Workplace Immunization

Important step

- Immunization to mitigate biorisk
- Risks associated with receiving vaccine must be clearly told to employee
- Storage and testing of pre-immune serum (was the person previously exposed to the agent?, have they been exposed since starting work on or near the agent?)
- Work in certain labs may mandate vaccination against the pathogen (employee has right not to work in the lab)
- Serum antibody titers to be retested at relevant intervals
- If required, must meet vaccination schedule (booster shots)
- Should use federally approved, safety and efficacy tested vaccines, administered by health professional



Transport of Biological Materials

- Biological material must be transported in a safe way to reduce biorisk
- Containment, marking, and transparency is key
- Mailing or shipping of hazardous materials (‘dangerous goods’) is Regulated, and subject to local and international rules and standards
 - Only trained and certified individuals can ship hazards
 - Permits/Licenses required – Agriculture, Health, Trade
- Biological hazards = a hazardous material (i.e. a biorisk)
- Different biological hazards = different shipping requirements
 - Toxins, Infectious, Medical, Genetically modified – different hazard classes
 - Different permits/approvals
 - Different packaging – ensure containment of biologic material
 - Different shipping requirements (routes, transport, contacts, tracking)
- **Rules ensure safety** of the public, environment, agriculture
- Improper shipping of hazards is a Crime (fines, prison)



Laboratory Biosecurity Principles

- Must protect, control and be accountable for biological agents and toxins within laboratories, in order to prevent their loss, theft, misuse
- versus “biosecurity” as referring to protection of assets, e.g. national assets
- Important concepts:
 - Access control – keep out unauthorized individuals
 - Inventory – keep track of biomaterials
- Implementation
 - Door locks
 - Freezer locks
 - Freezer inventories – formal, detailed, current
 - Proper signage

- DURC recognizes that some materials used in research can also be used for additional (i.e. dual) purposes that are of concern, and ideally avoided

Dual Use
Research of
Concern
(**DURC**)

- **Dual Use Research of Concern (DURC): Subset of research that has the greatest potential to generate knowledge, information, or products that could be readily misused to pose significant threat to public health and national security.**



Microbial examples: increasing pathogenicity or transmission, altering host range, reducing host resistance or immunity, reviving extinct microbes

*Should facilitate
beneficial biological
research while
mitigating the risks of
misuse*

Recombinant or Synthetic Nucleic Acid Molecules

- Mankind has increasing ability to modify genetic material of organisms, including combining material from different sources (i.e. recombining) and creating material in (synthetically)



molecules that are constructed by joining nucleic acid molecules and can replicate in a living cell (i.e. recombinant nucleic acids);



nucleic acid molecules that are chemically or by other means synthesized or amplified, including those that are chemically or otherwise modified but can base pair with naturally occurring nucleic acid molecules (i.e. synthetic nucleic acids)

- Novel genetic material which can change biological properties of organisms is generally considered a biorisk, especially when the biological properties are unknown or different in ability to cause disease

- **Recombinant/synthetic molecules are given special consideration in order to manage their biorisk**
 - Approvals
 - Handling/storage/tracking

Institutional Biosafety Committees (IBCs)

What is an Institutional Biosafety Committee IBC?

Institutional Biosafety Committees (IBCs) were established under the NIH Guidelines to provide local review and oversight of nearly all forms of research utilizing recombinant or synthetic nucleic acid molecules. Infectious agents and toxins , Stem cells and Bio-technologies that could pose a threat,

What is the role of the Biosafety Committee?

The **Biosafety Committee** is a standing **committee** established by the Provost to: Ensure that all activities involving biohazardous materials are conducted in compliance with federal, state and local regulations and applicable University policies.



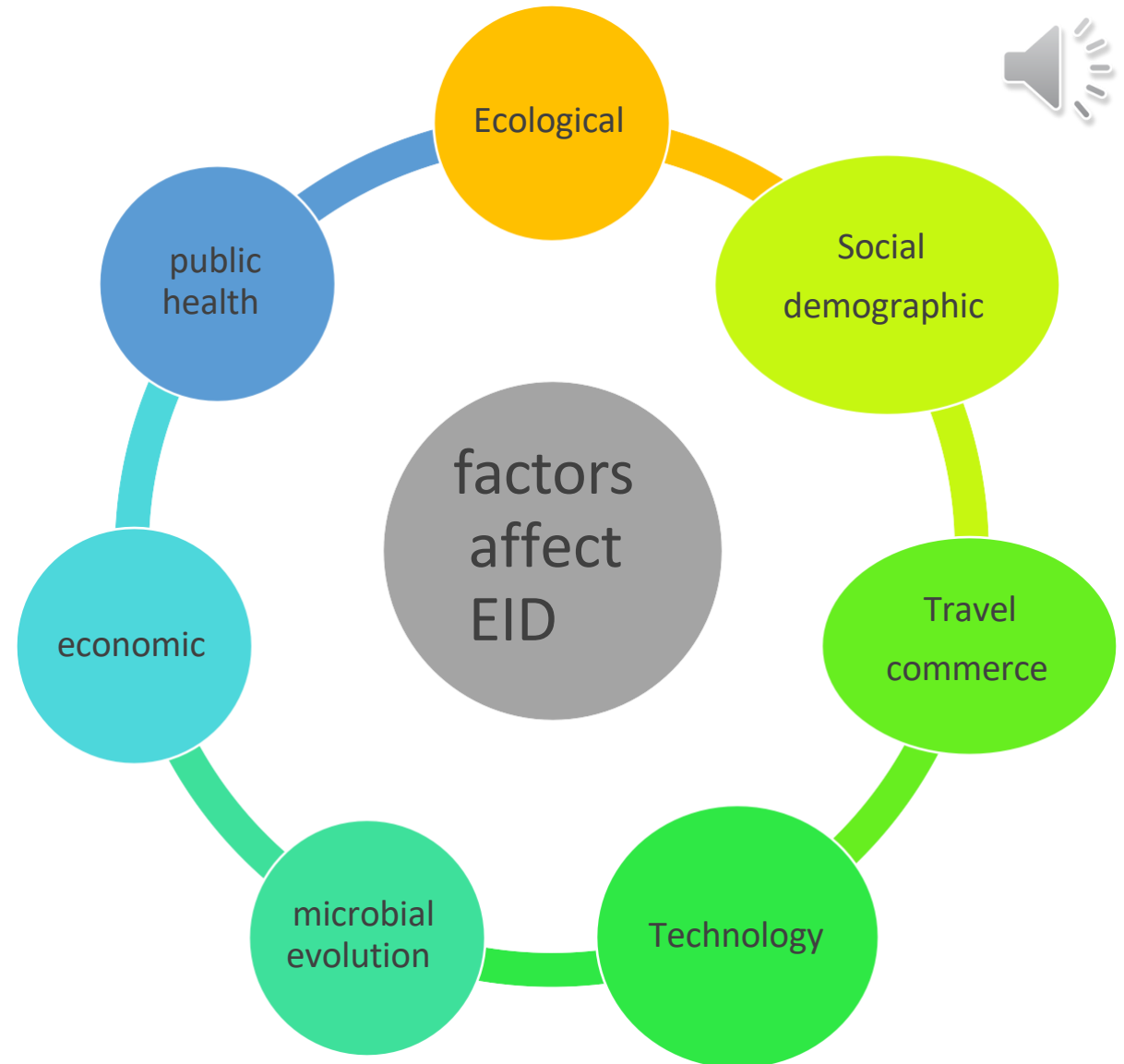
What is IBC protocol?

IBC protocols are intended to ensure compliance with Federal Regulations outlined in the NIH Guidelines for Recombinant DNA, which ensure that novel, dangerous organisms are not created by genetic engineering.

Emerging Infectious Disease (EID)

The World Health Organization (WHO) defines an **emerging infectious disease (EID)** as “one that has appeared in a population for the first time, or that may have existed previously but is rapidly increasing in incidence or geographic range”

- Global mobility (travel/trade) can accelerate EID spread
- Zoonosis (diseases affecting both animals and people) important in EID
- Example : **Covid -19**



Different EIDs can have different impacts: health (mortality), economic, social

EID risk can be real, but can also be sensationalized by media

Nature and severity of the EID, impacts severity of control measures

Efficiency of EID Transmission between people: impacts disease spread and control

Example: Covid-19

Emerging Infectious Disease (EID)

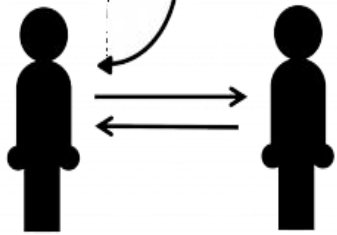
- Disease transmission affects EID impacts

Modes of Infectious Disease Transmission

A. General Transmission

Abiotic environmental factors

- Wind
- Water
- Inhalation of spores
- Entry into skin



Animal vectors

- Mosquitoes (malaria, dengue)
- Fleas (bubonic plague)



B. Human to Human Transmission

Direct Contact



- Pathogen survives best inside the body
- Eg: HIV, Herpesviruses, Ebola

Indirect Contact



- Pathogen survives harsh environment
- Pick up pathogen from surface or air
- Eg Influenza, norovirus

Droplets



- Pathogens are in droplets, but do not survive long this way
- Eg: Ebola, *Bordetella pertussis*

Airborne



- Pathogens aerosolized and stay infective
- Eg: Influenza, Tuberculosis

Fecal - Oral



- Through contaminated water or food
- Eg: Cholera, Norovirus, Shigella

Pathogens can spread through multiple routes:

- **Environmental factors:** such as **wind** and **water**
- **Human-to-animal and animal-to-human transmission**
- **Vector transmission:** by animals like **birds, fish, or insects** that migrate or move through trade routes

Human-to-human transmission can occur through **five main modes**, which are **not mutually exclusive**.

For example, the **Ebola virus** can spread through **direct contact** and potentially through **droplet transmission**.

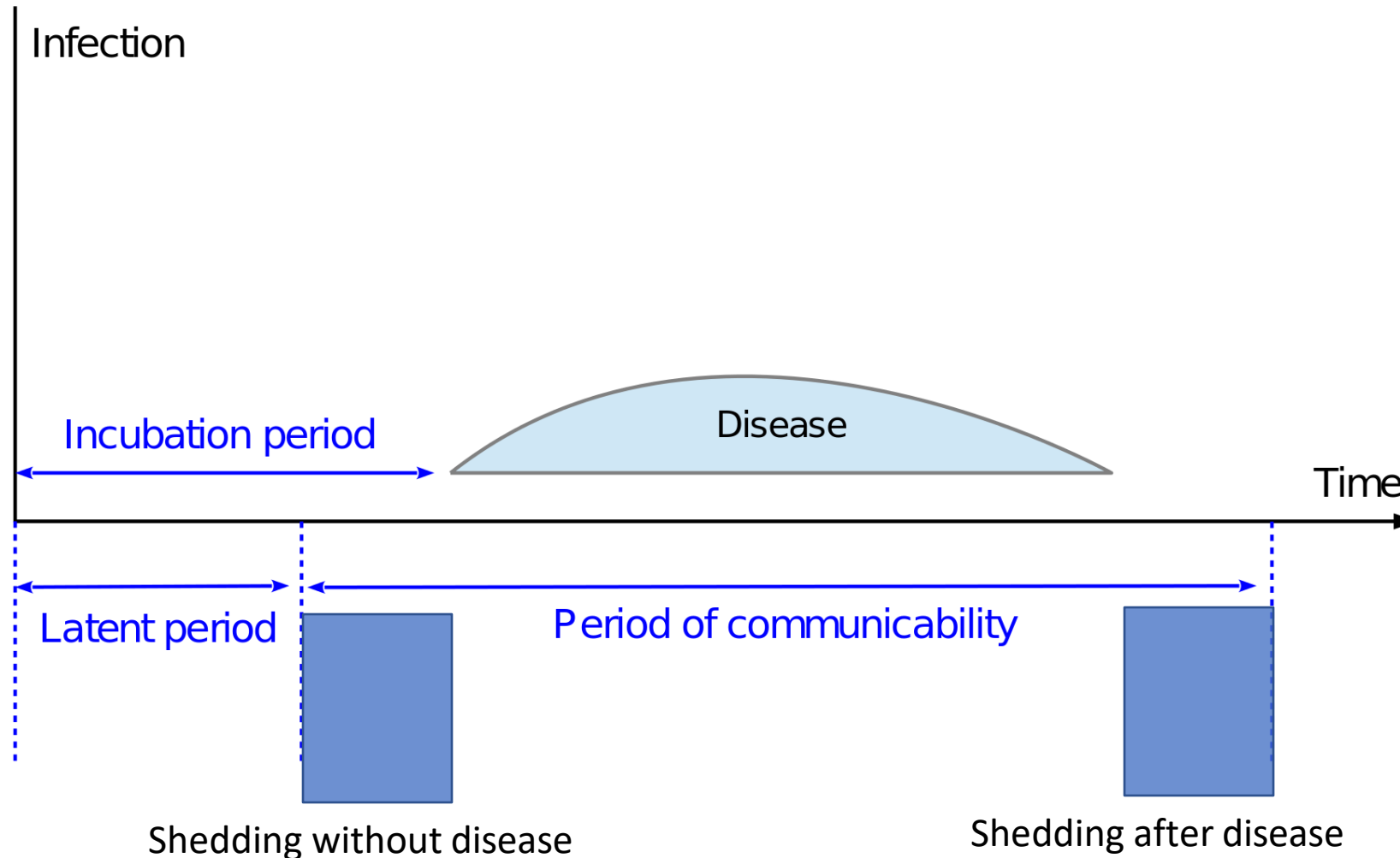
The mode of transmission depends largely on the **pathogen's ability to survive outside the host**:

- Some pathogens cannot survive long outside the body and therefore require **direct contact** or **vector-mediated transmission**.
- Others, like **influenza viruses**, can survive on surfaces for extended periods, making them **highly contagious**.

Additionally, **fecal-oral pathogens** remain a major health problem in **developing countries**, though they are relatively rare in **developed nations** due to better sanitation and public health measures.

Emerging Infectious Disease (EID)

- Disease transmission affects EID impacts
- Latent Period vs. Pathogen Shed



To understand the **spreading dynamics** of an infectious disease or epidemic, three important **time periods** must be clearly distinguished:

1.Incubation Period

The incubation period is the **time elapsed between exposure** to a pathogenic organism, chemical, or radiation **and the appearance of the first signs and symptoms** of the disease.

2.Latent (Pre-infectious) Period

The latent period is the **time between infection and the point at which the host becomes infectious**.

During this time, the host **may or may not show symptoms**, but **cannot transmit** the disease to others.

The **latent period**, rather than the incubation period, plays a **greater role** in determining the **spreading dynamics** of an infectious disease or epidemic.

3.Infectious Period

The infectious period refers to the **time during which an infected individual can transmit the disease** to other susceptible hosts.

In some diseases (as shown in epidemiological diagrams), the **latent period is shorter than the incubation period**, meaning a person can **transmit the infection before showing any symptoms**. Such cases are referred to as **subclinical infections**, where transmission occurs **in the absence of visible disease signs**.

Emerging Infectious Disease (EID)

- Disease transmission affects EID impacts



How quickly does it spread?

Basic reproduction value

Mers



0.7

Ebola



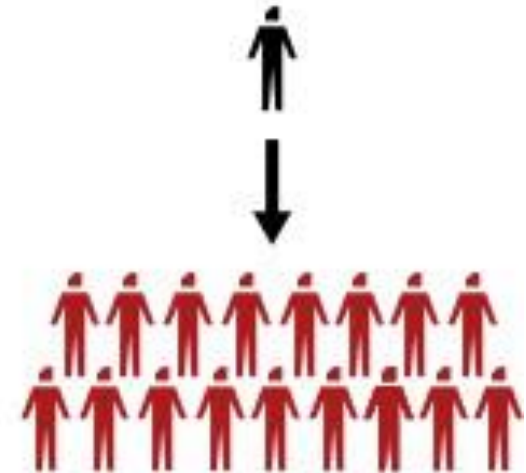
1.7

Small pox



7

Measles



17

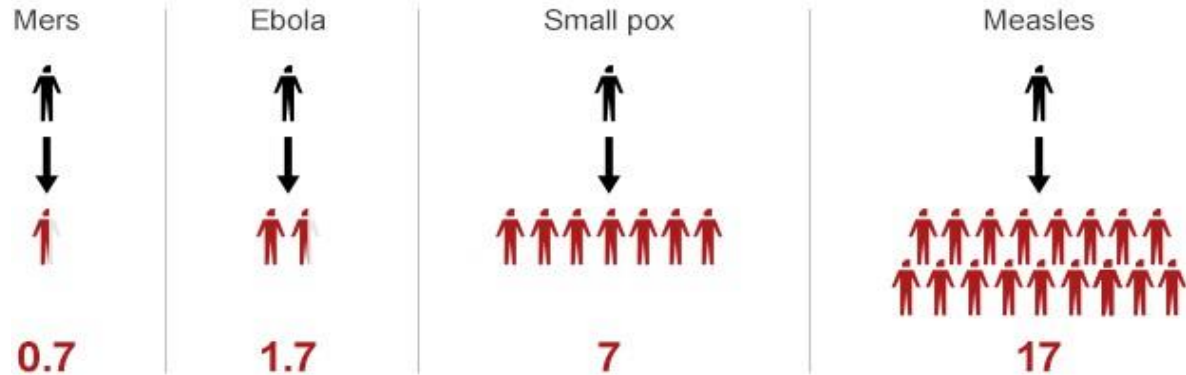
Source: ECDC, UMICH, Lancet

Emerging Infectious Disease (EID)

- Disease transmission affects EID impacts

How quickly does it spread?

Basic reproduction value



Source: ECDC, UMICH, Lancet

Basic Reproduction Number (R_0)

In epidemiology, the **basic reproduction number**, denoted as R_0 (R naught), represents the **expected number of secondary cases** directly generated by **one infected individual** in a completely **susceptible population**.

Key uses of R_0 include:

- Determining whether a newly emerging infectious disease can spread within a population.
- Estimating the **proportion of the population** that must be **immunized (via vaccination)** to **eradicate or control** the disease.

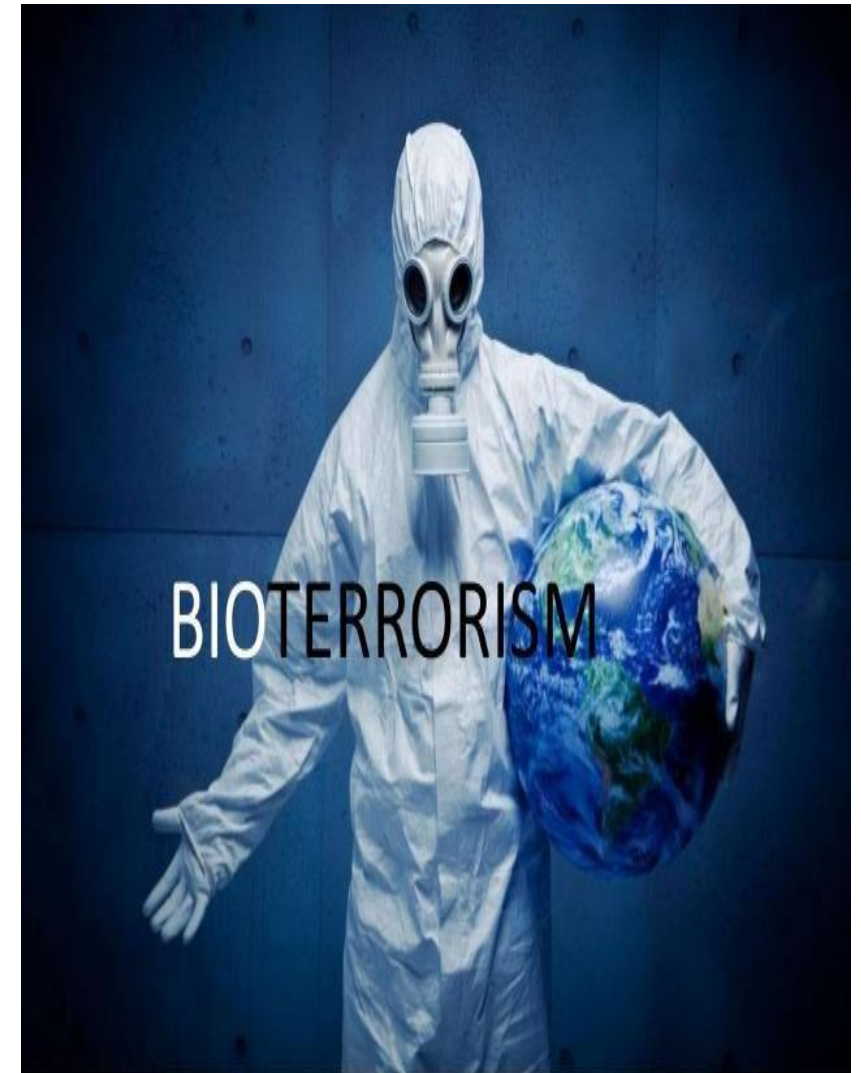
Interpretation of R_0 values:

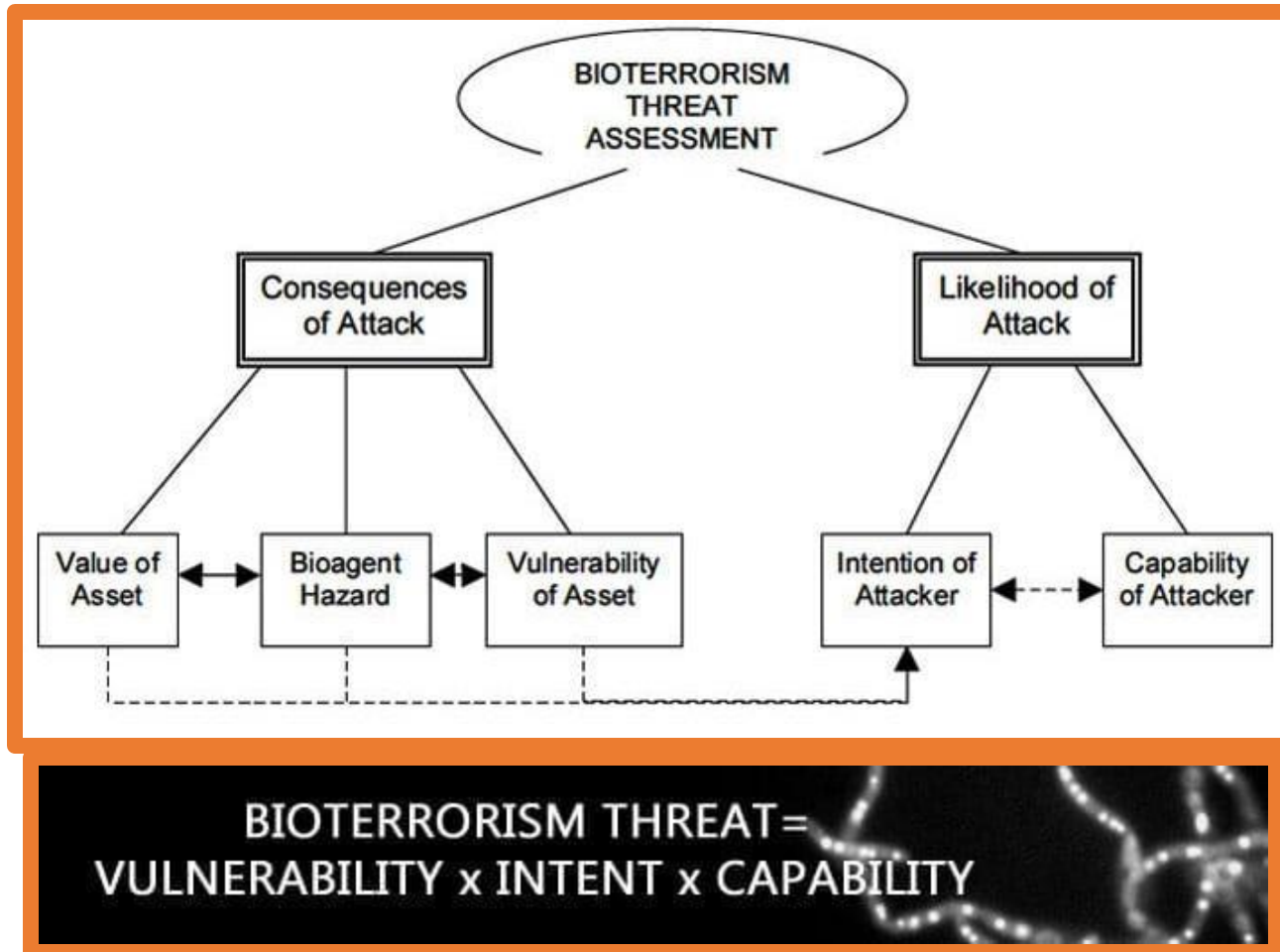
- If $R_0 > 1$, the infection is likely to **spread** within the population.
- If $R_0 < 1$, the infection will **decline and eventually disappear**.

Generally, the **higher the R_0 value**, the **more difficult it is to control** the epidemic through public health measures.

What is bioterrorism?

Bioterrorism is the intentional release or threat of release of biologic agents (i.e. viruses, bacteria, fungi or their toxins) in order to cause disease or death among human population or food crops and livestock to terrorize a civilian population or manipulate the government

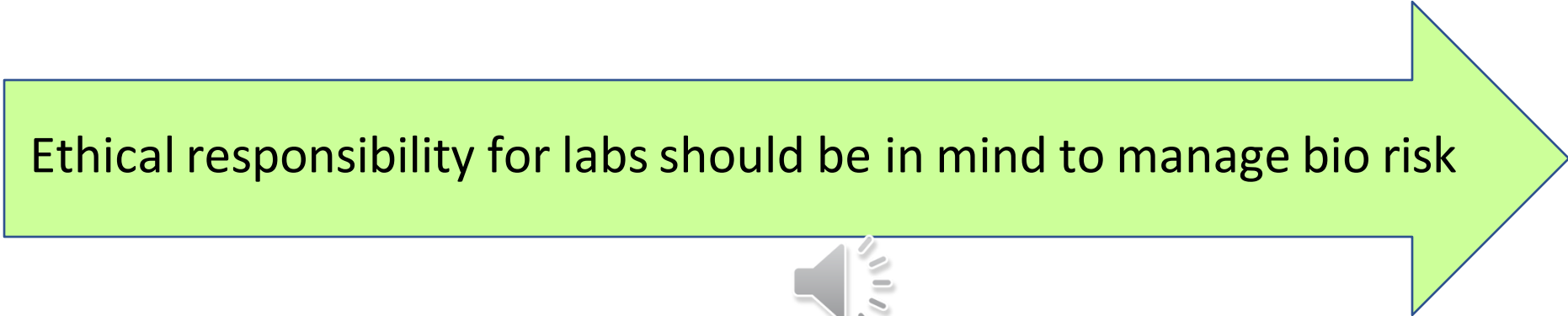




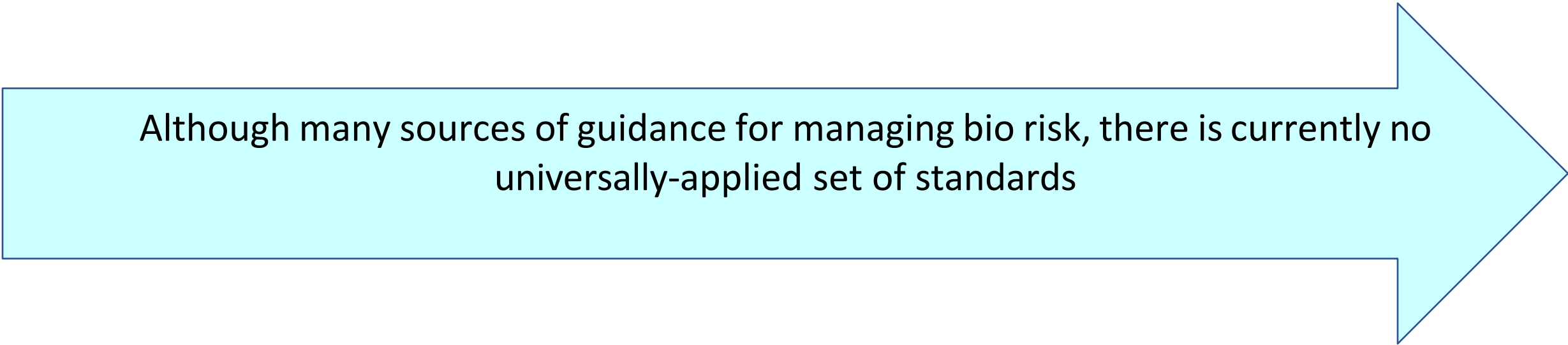
This figure will focus on the capabilities and motivations of potential bioterrorists and assess their impact on actual usage of bioweapons., indicating the relationship between the intention and capability of an attacker , This equation points to the role of intent, vulnerability, and capabilities in regards to the threat of an attack

Understanding of emerging infectious disease helps individuals understand the nature of the threat and realities of the risk .

Understanding of biorisk management helps mitigate effects of bioterrorism



Ethical responsibility for labs should be in mind to manage bio risk

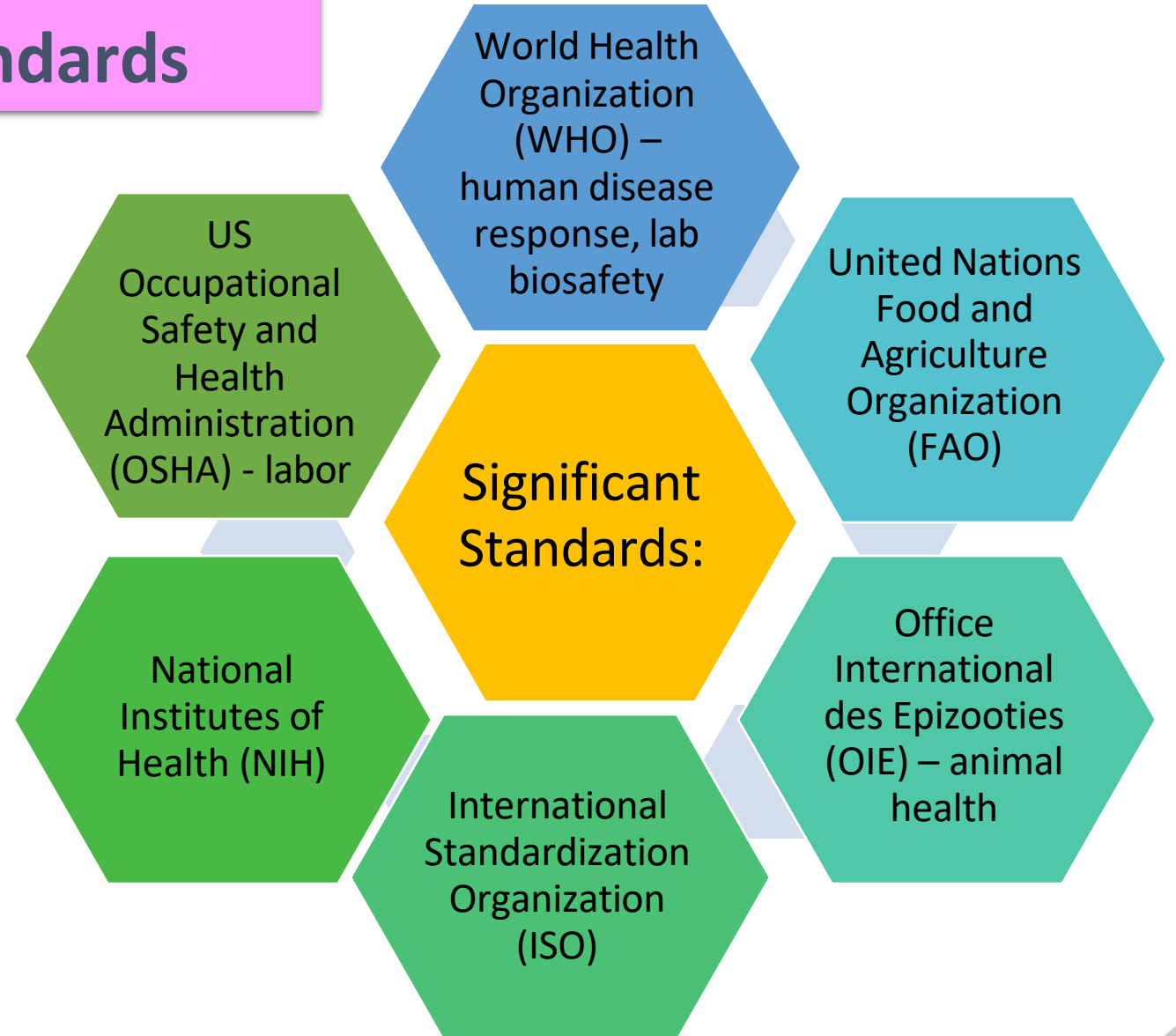


Although many sources of guidance for managing bio risk, there is currently no
universally-applied set of standards



International Standards

Always manage biorisk in individual labs through risk assessment and then custom application of general standards





dreamstime.
THANK YOU

