

**BOSTON
PUBLIC
HEALTH
COMMISSION**



Boston MRC Introduction to Biological Hazards Response

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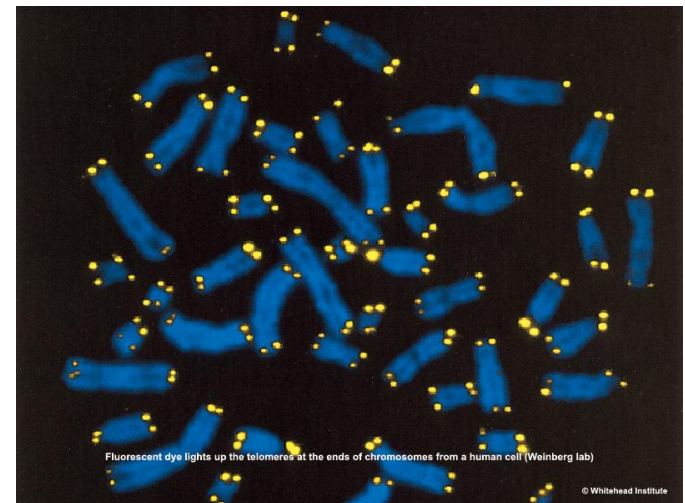


Objectives

- Describe the types and classes of biological agents
- Discuss how biological agents can affect the human body

Microorganisms

- Microorganisms – They're everywhere
- 10,000 – 10,000,000 bacteria on each hand
- 500-1000 species of bacteria in the gut
- 100 million – 3 billion organisms in a gram of soil
- But there are only about 300 known microorganisms that cause disease





Types of Microorganisms

- Bacteria
- Chlamydia and
- Rickettsia
- Mycoplasma
- Fungi – molds and yeast
- Parasites
- Viruses
- Prions

Microorganisms vary in size:

- <http://learn.genetics.utah.edu/content/begin/cells/scale/>

Visible with Electron Microscope		Visible with Microscope				Visible with Naked Eye	
.001 u	.01 u	.1 u	.5 u	1.0 u	5.0 u	10.0 u	100+ u



Viruses
(.015 - .45)



Bacteria
(.3 - 5)



Spores
(2 - 60)



Parasites
(2 - 100+)



Algae
(1 - 100+)



Pollen
(10 - 100)

1 u = .03 inches
1u = 1 millionth of a meter

Biological hazards



- An agent of biological origin that has the capacity to produce harmful effects on humans
 - Micro-organisms, toxins and allergens derived from those organisms
 - An organism capable of causing disease is known as a *pathogen*
 - The ability of an organism to produce disease is called *pathogenicity*
 - Allergens and toxins derived from higher plants and animals

Where do pathogens come from?

Humans: infected individuals

Animals/animal products: meat, fish, milk

Inanimate objects

Food, water





Routes of Entry

- To cause an infection, microbes must enter our bodies.
 - Inhalation
 - Ingestion
 - Injection
 - Absorption via a splash to mucosal tissue

How are Pathogens Transmitted?

- Direct Transmission

- Transmission of airborne particles
- Needle stick
- Splash

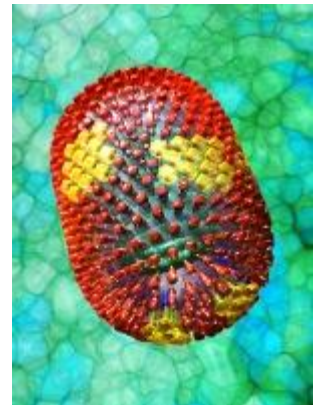
- Indirect Transmission

- Object
- Food
- Insect bite (Vector)



Pathogenicity

- A pathogen is successful when it can invade and avoid detection
- Infection is the invasion by and multiplication of pathogenic microorganisms in a bodily part or tissue, which may produce tissue injury and progress to a disease through a variety of mechanisms



Influenza virus

Bloodborne Pathogens

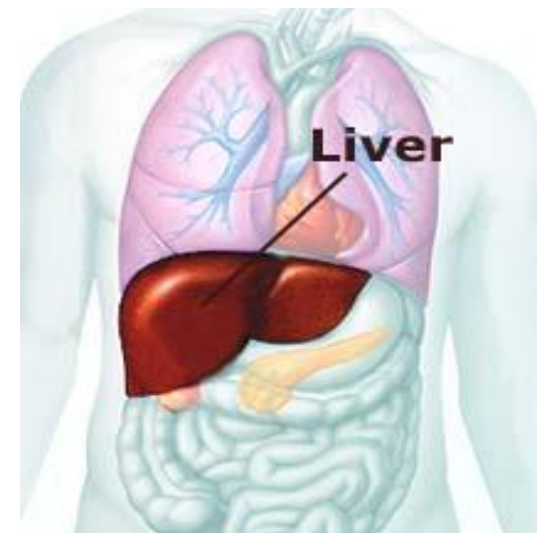
- **Bloodborne Pathogens** are biohazardous microorganisms found in human blood, body fluids, organs, tissues, and cell lines. The most common are; HIV, Hepatitis B, Hepatitis C
- **Universal Precautions** – Assume ***ALL*** human-source material is infected

Possible infectious agents in blood and body fluids

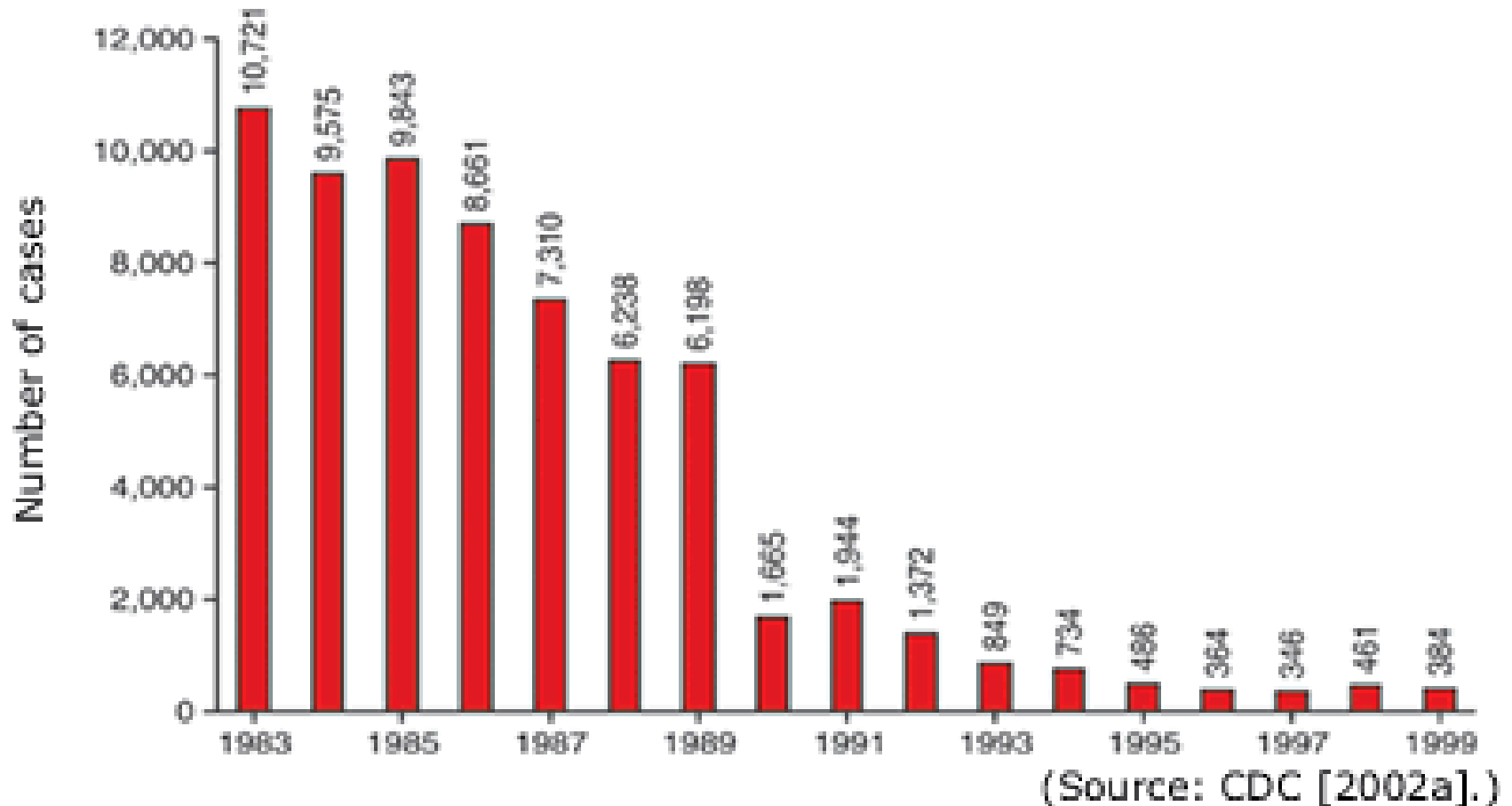
- HIV
- Hepatitis B and/or C Virus
- Malaria
- Chagas
- Toxoplasma gondii
- Cytomegalovirus
- Syphilis
- And more!

Bloodborne Pathogen - HCV

- Most common chronic bloodborne infection in the US
- Sexual transmission less important
- Seroconversion - infected sharps ~1.8%
- Survive and transmit for 6 hours but not longer than 4 days
- No vaccine



Estimated occupational HBV infections US health care workers '83-'99

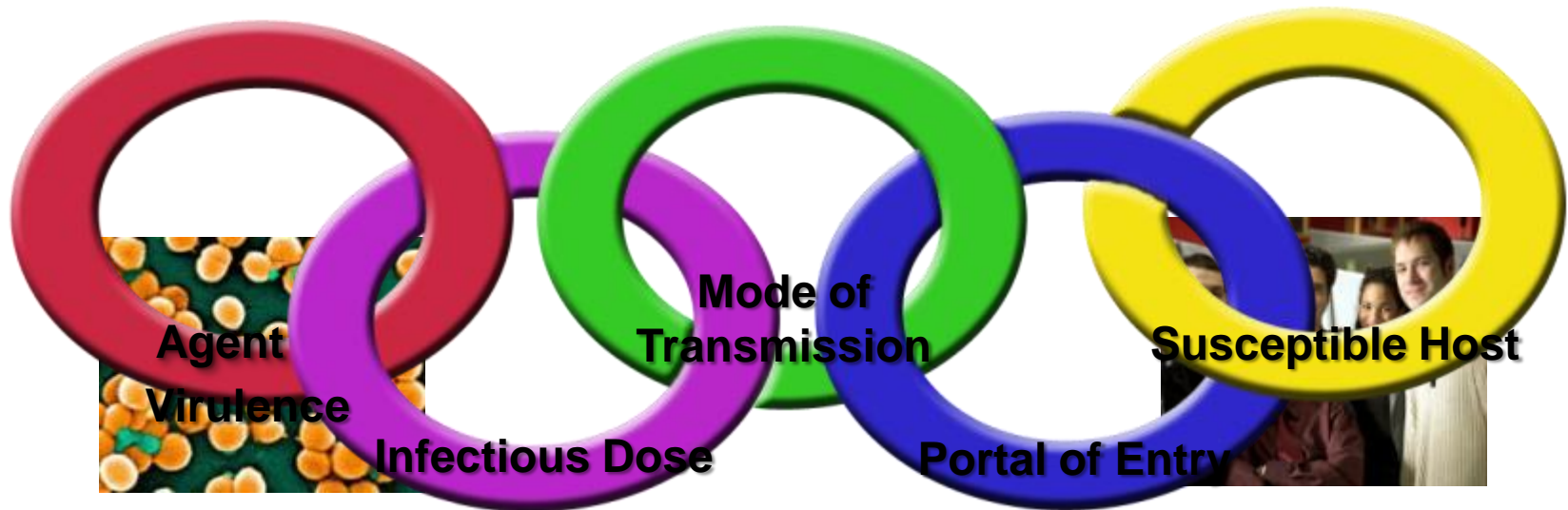




Human Immunodeficiency Virus

- 1.1 million people with HIV in the U.S. in 2006
- 56,000 new infections in 2006 in the U.S
- Body fluids with high concentrations of HIV
 - Blood, semen, vaginal fluid and breast milk
 - Low concentrations in saliva and tears
- Fragile, will not survive outside of host
 - “Drying” results in 90 – 90% reduction of virus in 3 hours
- Transmission
 - Needle stick/sharp from HIV contaminated needle
 - Mucous membrane exposure
 - Open cut/skin exposure

Chain of Infection

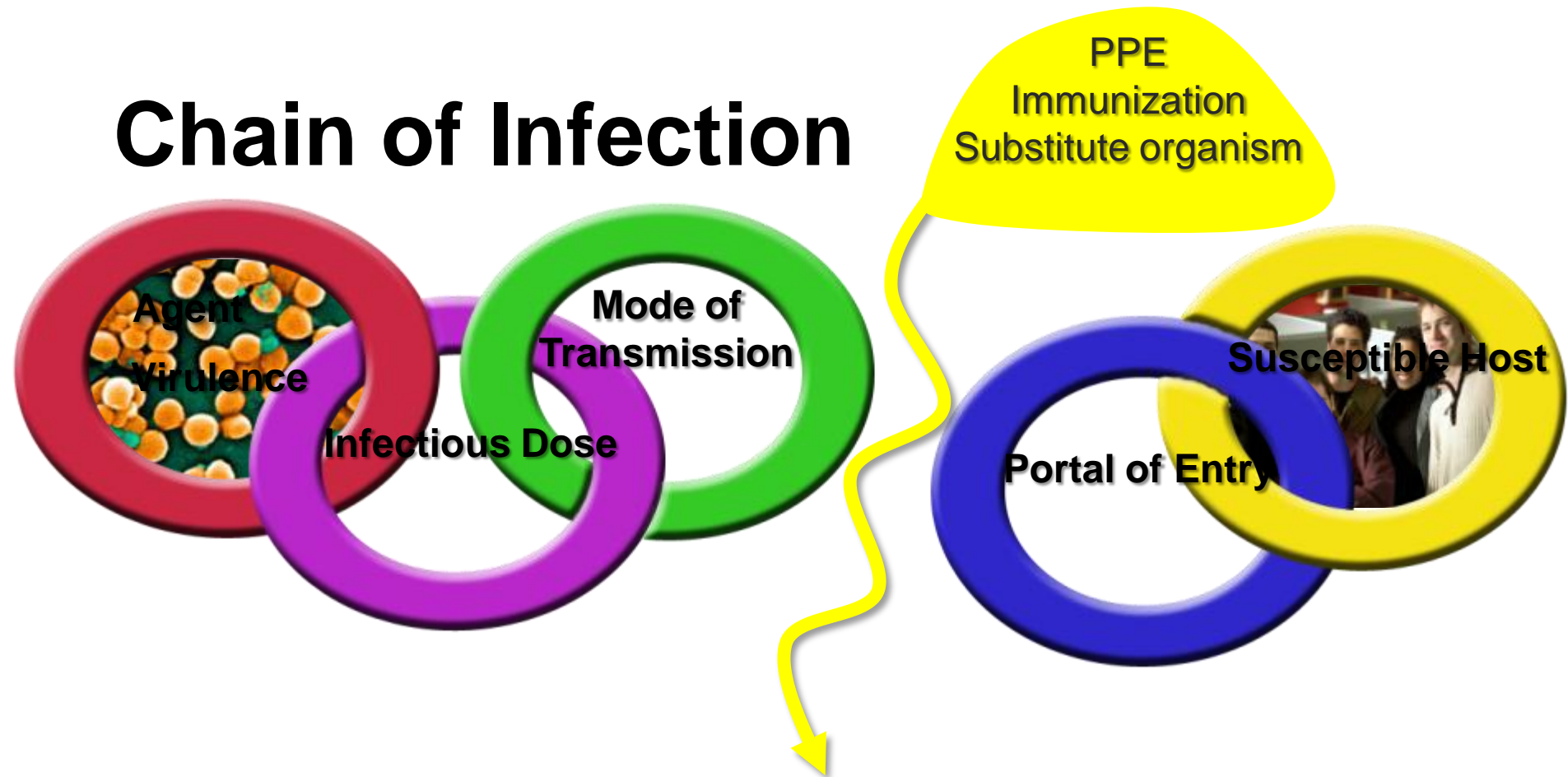


Defense Against Infection

- In addition to the agent, virulence, infectious dose, exposure, and susceptibility, the body has natural defenses to protect against invasion by a pathogen
 - Physical barriers
 - Non specific defenses
 - Immune system



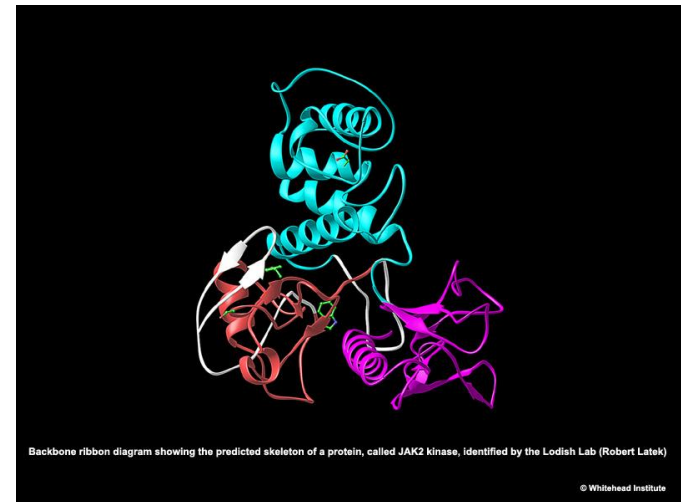
Chain of Infection



Any break in the chain can prevent infection from occurring

Biological Toxins

- Poisonous by-products of microorganisms, plants or animals that produce adverse clinical effects in humans, plants or animals
- Toxic effect of material is similar to chemical poisoning – not infection





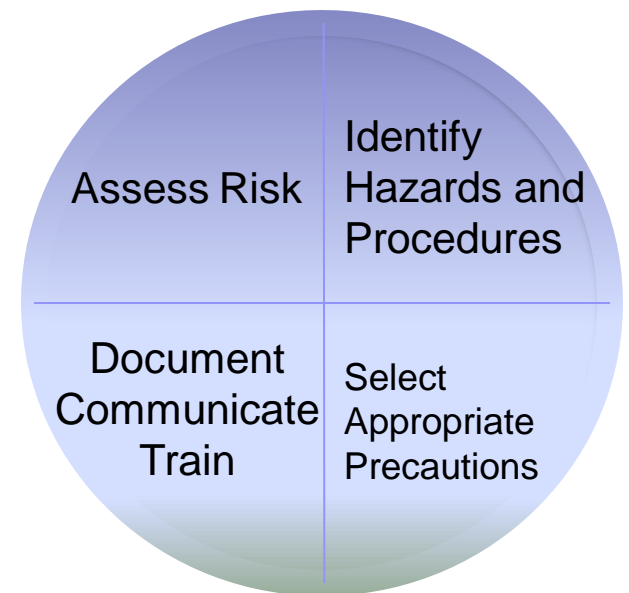
Ricin Toxin

- Ricin is produced in maturing seed from the castor bean
- Much less toxic than Botulinum toxin
- Ingestion is seldom fatal, but inhalation and intravenous exposure are more problematic
- No vaccine or antidote is currently available

Organism	Toxin
<i>Bacillus anthracis</i>	anthrax
<i>Clostridium tetani</i>	tetanus
<i>Corynebacterium diphtheriae</i>	diphtheria
<i>Escherichia coli</i>	enterotoxin (e.g., O157:H7)
<i>Shigella species</i>	shigatoxin
<i>Vibrio cholerae</i>	cholera
Rosary pea plant	abrin
Cone snail	conotoxin
Marine dinoflagellates	saxitoxin
Puffer fish	tetrodotoxin
<i>Aspergillus species</i>	aflatoxin

Risk Assessment

- Risk assessment is the process that enables the appropriate selection of the items below in order to prevent laboratory-associated infections
- It is the Risk Assessment that allows for the development of PPE selection



Minimizing Risk

HAZARD - something that has the potential to cause harm to you or the environment.

RISK - depends on both the level of exposure and the degree of the hazard.

PROBABILITY – how likely you are to be exposed to the hazard

Hazard X Probability = RISK

REDUCE RISK by reducing the **HAZARD** or the **PROBABILITY**

