Lesson Three

Biologic Disasters

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Objectives

- Describe six key factors that compose the “chain of infection”
- Identify clinical and epidemiologic clues suggestive of a biologic disaster
- Discuss actions that can be taken to protect the health, safety, and security of responders and affected populations in a biologic disaster
- Describe essential infection control strategies to prevent the spread of biologic agents
- Discuss appropriate clinical management guidance for CDC category A biologic agents

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Background

- Infectious diseases are a threat to everyone
- Rising global concern about epidemics/pandemics, emerging infections, bioterrorism
- Public health and medical professionals are at the front lines of detection, diagnosis, treatment, and response

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Key Terms

- **Emerging infection** – Newly recognized, new population, new virulence or resistance
- **Epidemic** – An illness in higher than expected numbers
- **Pandemic** – Epidemic across large geographic region

A disease outbreak in one country = A CONCERN FOR ALL

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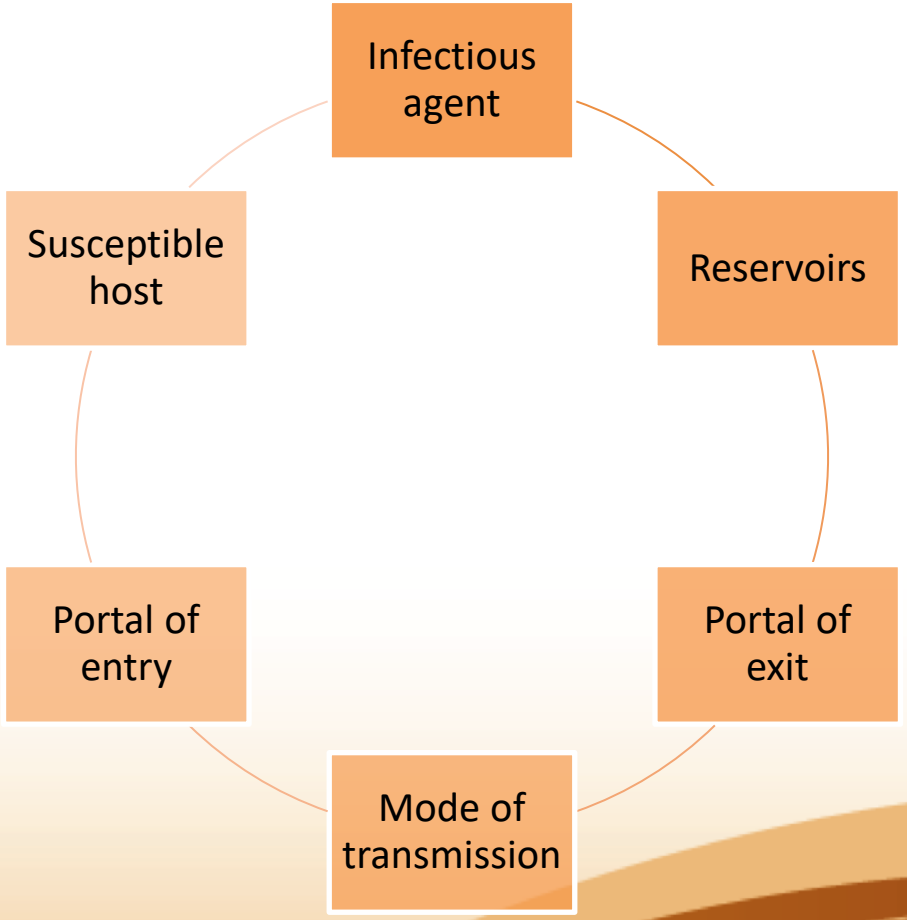
Chain of Infection



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Bioterrorism/Biowarfare

- Both involve use of a biologic agent or product to cause harm
  - A matter of scale
- Difficult to detect research, production, transportation of BT agents

A criminal act that requires ➔ Public Health + Law Enforcement/military

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CDC Categories

A

B

C

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Detection
Situational Awareness

The first to detect a biologic event incident will be a healthcare provider (primary care, school nurse, prehospital personnel, etc.) who:

- Has a high index of suspicion
- Notes something unusual happening
- Seeks the answer

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Detection
Situational Awareness

EMS	Multiple calls in same area, same complaints
Primary Care Provider	Unusual patterns of disease, increased numbers of patients with unusual disease, disease affecting different ages or healthy patients
Public Health	Patterns at multiple facilities, atypical season for event
Medical Examiner	Rapid rise in mortality rate

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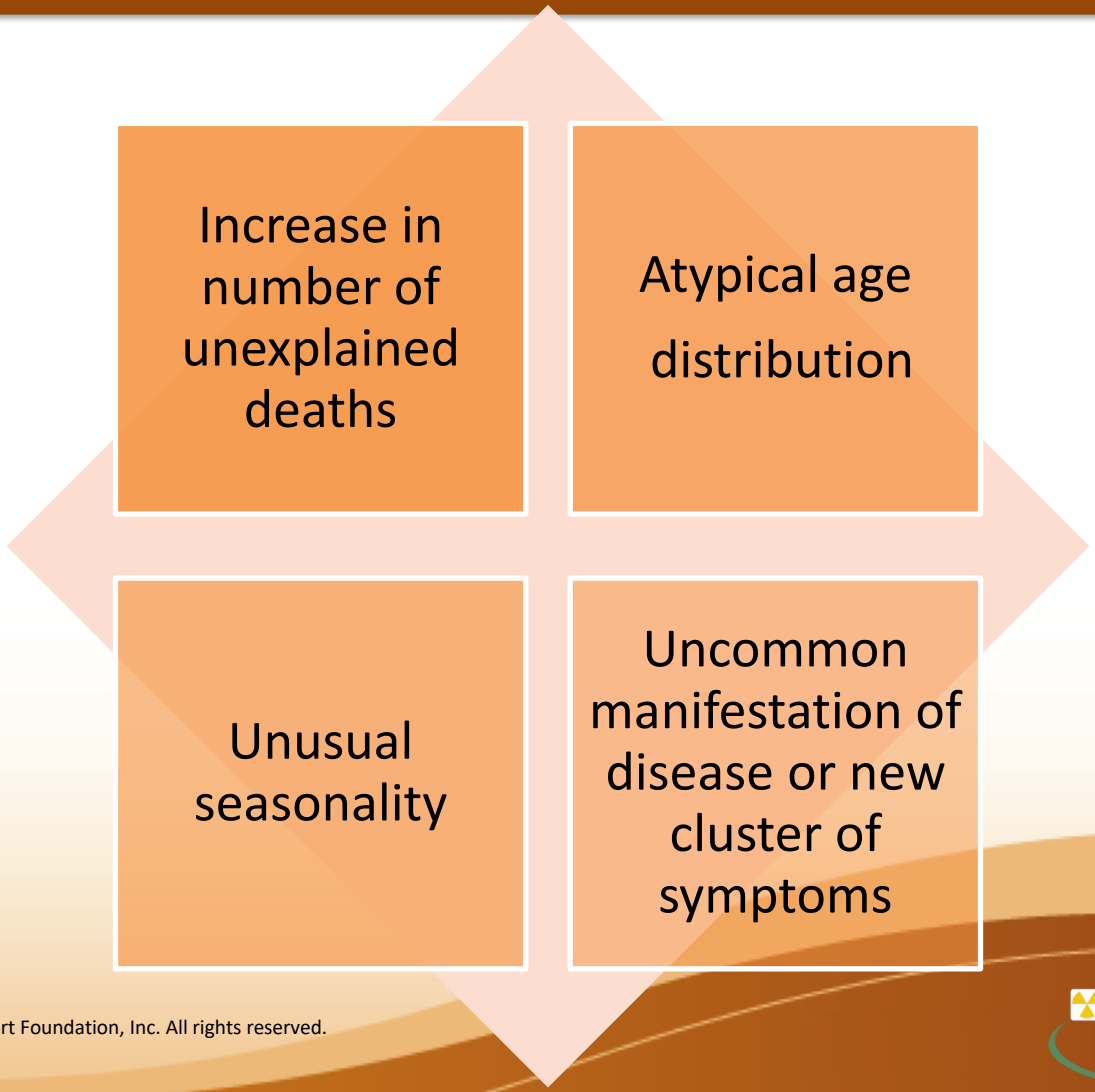
Epidemiologic Clues



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Detection Bioterrorism Agents

- Victims initially may present with subtle symptoms or those resembling normal disease, such as flu-like symptoms
- Few tests available for quick diagnosis

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Symptom / Finding	Potential BT Disease	Differential Diagnoses
Chest x-ray with wide mediastinum	Anthrax	Trauma, cancer, postoperative
Symmetric/flaccid paralysis	Botulism	Guillain-Barre syndrome
Hemoptysis	Pneumonic plague, inhalational anthrax	TB, pneumonia, carcinoma, PE, cancer, trauma
Pox-like rash	Smallpox	Chickenpox, monkeypox, cowpox
Diarrhea (maybe bloody)	Cholera, shigellosis	Multiple diseases

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Incident Management
Public Health Notification

- Likely no “scene” as in other events but more diffuse
- Lead agency will be public health
  - Conduct epidemiologic investigation
  - Identify those who need prophylaxis, treatment, and quarantine

Public health authorities MUST be alerted as soon as any biologic event is suspected (emerging infection, unusual disease incident or patterns, or bioterrorism)

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Population-based Triage Model

- SEIRV – Goal is to prevent secondary transmission of pathogen
  - Susceptible: Persons not yet exposed and are susceptible
  - Exposed: Persons susceptible and had contact with infected person, may be infected not yet contagious
  - Infectious: Persons who are symptomatic and contagious
  - Removed: Person who can no longer transmit disease due to survived/developed immunity or died
  - Vaccinated: Persons who received prophylactic medical intervention to protect them from infection

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Safety and Security
Infection Control

- With all biologic events, cornerstone of management and limitation of effects is infection control
- Even bioterrorism agents can be prevented and controlled by basic infection control
- Precautions based on mode of transmission
- If unsure, wear most protective gear
  - Consult infectious disease specialist

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Assess the Hazard
Preventing Disease Spread

Medical	Public Health
▪ Immunizations ▪ Chemoprophylaxis ▪ Infection control	▪ Infection control ▪ Sheltering in place ▪ Social distancing ▪ Risk communication ▪ Isolation/quarantine

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Triage and Treatment Bioterrorism Threats

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Smallpox

- Severe prodrome
  - Fever, body aches
  - Prostration, delirium
- 2-3 days later
  - Rash: Palms, soles, face
  - Crops of vesicles
  - All in same stage
- Very contagious

Differentiate: monkeypox, chickenpox

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Smallpox

- Diagnosis: clinical
  - Special tests at CDC and some state labs
- Treatment: vaccination (if <3 days)
  - Supportive care, +/- antivirals
- Airborne and contact precautions
  - Negative-pressure room

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Anthrax

- Inhalational: **Flu-like symptoms**, SOB, CP
  - Evolves to severe respiratory distress, shock
  - High fatality rate
- Cutaneous: small itchy bumps turn into deep *black* ulcers, swollen lymph nodes
- Can be natural or bioterrorism

James Steele/CDC

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Anthrax

- Diagnosis: clinical
  - CXR: wide mediastinum, effusions, infiltrates
  - Blood/sputum cultures
- Early antibiotics for treatment and prophylaxis
- Standard PPE
  - No person-to-person spread

Arthur Kaye/CDC

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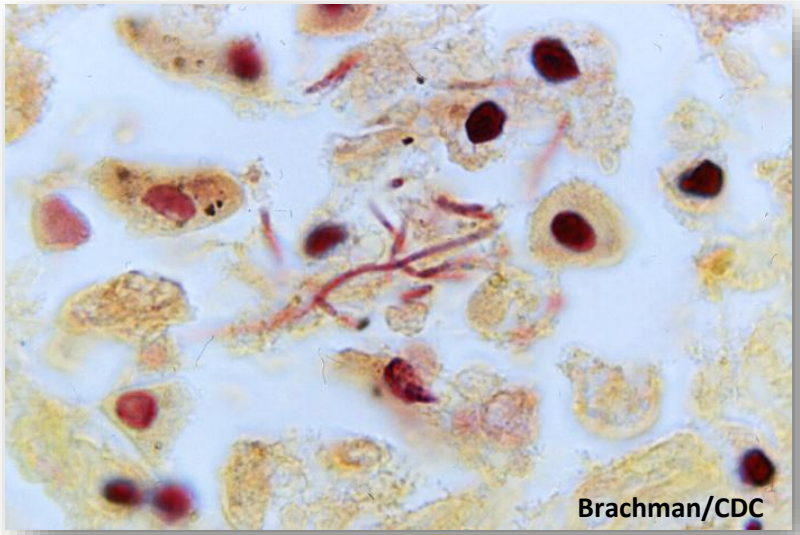
Pneumonic Plague

- High potential for use as bioweapon
  - Easy to grow and aerosolize
  - Person-to-person spread, high mortality rate
- Abrupt onset of flu-like symptoms
- Progresses to severe pneumonia, sepsis



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Pneumonic Plague

- Clinical diagnosis
  - CXR: patchy infiltrates
  - Blood/sputum cultures
- Early antibiotics for treatment/prophylaxis
- Highly contagious
  - Droplet precautions

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Botulism

- Gradual onset of symptoms
  - Facial paralysis
  - Difficulty speaking and swallowing
  - Blurry vision
- Progresses to muscle weakness, *diaphragm paralysis*

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Botulism

- Diagnosis: clinical
  - Confirmed by toxin assay
- Must stay on ventilator until toxin wears off
  - Weeks to months
- Antitoxin available
  - Limited supply for episodic single cases
- Standard PPE
  - Not contagious

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Tularemia

- High potential to be weaponized
  - Likely attack via aerosol
- Symptoms: acute febrile illness
  - Prostration
  - Conjunctivitis
  - Lymph node swelling
- With/without pneumonia

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Tularemia

- Diagnosis: CLINICAL
  - Gram stain, cultures, antibody tests
  - 80% CXR with pneumonia
- Treatment/prophylaxis with antibiotics
- Standard PPE
  - Not contagious

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Viral Hemorrhagic Fevers

- Examples: Ebola, Marburg, Lassa, Omsk
- Potential to be weaponized
  - Fatality rate has been up to 90%
- Symptoms depend on virus
  - Flu-like symptoms, rash, joint pains, vomiting, diarrhea
  - Bleeding from everywhere, shock

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Viral Hemorrhagic Fevers

- Diagnosis: clinical
  - Multiple tests available depending on stage
- Presume VHF if:
  - Severely ill, fever + bleeding from 2 sites
  - High index of suspicion with travel to area with outbreak or close contact
- Treatment: supportive
- No prophylaxis
- *Extremely contagious*
  - *Blood and body fluids*
  - *PPE more than universal precautions*

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Triage and Treatment Summary

- Recognition is key – any pattern outside norm
- Different ages, severity, populations, symptoms, etc
- Early on, most have flulike symptoms
- Diagnosis clinical – requires high index of suspicion
- Largely supportive treatment, some respond to antibiotics or vaccines
- Responder safety and infection control paramount

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Issues to Consider

- Vaccination, Chemoprophylaxis, and Treatment Medications
  - How many doses are available?
  - How easy is it to mass vaccinate?
  - Can you accomplish vaccination in time?
- Provider safety/infection control
  - Do you have enough PPE for multiple patients?
  - Is PPE worn 100% of the time?
  - How will you ensure compliance with prophylaxis?

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Evacuation

- Evacuation
  - Issues with moving patients and protecting transporting staff
  - Issues with using public transportation to seek medical care
  - Issues with identifying receiving facilities capable and willing to accept patients

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Recovery

- Recovery
  - Stop the reemergence of disease
  - Address stigma for both survivors and treatment facilities
  - Healthcare can be hardest hit sector for casualties

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Lesson Summary

- Biologic disasters require observation for both clinical and epidemiologic clues
- There is increasing global concern about the possibility of bioterrorism
- Medical and public health professionals play a key role in preparedness, early identification, and intervention

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Questions?

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Scenario 2: Biological Hazards

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Biological Hazards

Detected following clusters of influenza like illnesses and/or rashes

Immediate notification of public health authorities is paramount

- Public health authorities will determine management approach

CDC category A agents are especially lethal and transmissible

- Anthrax, botulism, plague, smallpox, tularemia, viral hemorrhagic fevers

Personal protective equipment must be worn by all responders

- Airborne and droplet precautions require respiratory protection
- Bloodborne and contact precautions require body fluid protection

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Scenario 2: Biological Hazards

Group 1

You are working in the ED, and 15 patients report with similar signs and symptoms in the same shift:

- Double-vision
- Difficulty swallowing
- Weakness
- Loss of deep tendon reflexes
- Dilated pupils
- No fever

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Scenario 2: Biological Hazards

Group 2

You are working in the ED, and 15 patients report with similar signs and symptoms in the same shift:

- High fever
- Rapid heart rate
- Weakness
- Wide mediastinum on chest x-ray (without interpretation)

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Scenario 2: Biological Hazards

Group 3

You are working in the ED, and 15 patients report with similar signs and symptoms in the same shift:

- Vomiting
- Diarrhea with blood
- Fever
- Petechiae
- Coughing up blood
- Jaundice (a few patients)

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Scenario 2: Biological Hazards

Group 4

You are working in the ED, and 15 patients report with similar signs and symptoms in the same shift:

- Fever
- Headache
- Shortness of breath
- Generalized weakness
- Productive cough
- Chest x-ray shows infiltrate

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