The Management of Epidemic Disease

Satellite Conference and Live Webcast
Thursday, February 18, 2010
12:00 - 1:30 p.m. Central Time

Produced by the Alabama Department of Public Health
Video Communications and Distance Learning Division

Faculty

Joseph J. Contiguglia, MD, MPH, MBA
Clinical Professor
Tulane University School of Public Health
and Tropical Medicine

Premature Victory

• 1967

“The war against infectious diseases has been won and we should focus our efforts on other areas of research and public health…”

– Surgeon General William H. Stewart testifying before Congress

Overview

• History
• Background
• Vulnerabilities
• Management
• Ethics
• Tools

Plague of Antoninus, 165 AD

• Started in the Army of Verus campaigning in the east
• Returning soldiers spread it from Persia to the Rhine and to Rome
• Spread through Gallic & Germanic Tribes

Consequences

• Death of Marcus Aurelius
• Succession of Commodus
• Cities abandoned & ruined
• Depopulation in Italy & Provinces
• Economic decline throughout Empire
• Demoralization of military, political, and commercial life
• High water mark of the Roman Empire
Plague Of Justinian 540-590 AD

- “It appeared not in one part of the world only, not in one race of men only, and not in any particular season, but it spread over the entire earth (Procopius)
- Widespread depopulation, 100,000,000 dead

Plague Of Justinian 540-590 AD

- 10,000 deaths a day in Constantinople
- Over 70 years devastated most of the known world, war, pestilence, & famine

Consequences

- Undermined efforts to re-establish the Western Empire
- Roman world in confusion & economic decline
- Decline of Eastern Empire
- Beginning of the “Dark Ages”

The Black Death: 1346 AD

- Lasted more than 130 years
- Killed 20-30 million Europeans
  - 1/3 of the European population
- Probably began on the Mongolian steppes as an epidemic among marmots
  - Weather favored a rodent population explosion

The Black Death: 1346 AD

- Trappers collected furs of dead animals & sold them to Western buyers

America and the Columbian Exchange

- Smallpox & measles
- New diseases in non-immune populations
- 95% mortality
- “The gods are against us”
The Pilgrims

- Native population devastated by European vectored epidemics
  - Over 95% mortality
  - 1615 visit by Champlain
  - Widespread epidemic
  - Pilgrims encountered little resistance

- “God ended the controversy”
  - Increase Mather
  - By 1634 only 50 live Indians within 300 miles of Plymouth Colony

Louisiana Purchase

- French forces (15,000) sent to Santo Domingo & New Orleans in 1802
- General LeClerc & French army in Santo Domingo destroyed by Yellow Fever
  - Napoleon’s brother in law
  - Rebellion & risk of British invasion

- France sells everything for $15,000,000
  - Beyond Pres. Jefferson’s wildest expectation
  - Actually discounted to $11,250,000

Epidemic

- The occurrence of more cases of disease than expected in a given area or among a specific group of people over a particular period of time

- A sudden severe outbreak of a disease such as SARS
  - From the Greek “epi-”, "upon" + "demos", "people or population" = "epidemos" = "upon the population"
Global Population Growth

- Overall
  - Today – 6.8 B
  - 2040 – 9B
- Urban
  - 1800 - 3%
  - 2000 - 47%

Life Expectancy

- United States
  - Today
    - Male - 75.6
    - Female - 80.8
  - 1950
    - Male - 65.5
    - Female - 71.0
  - 1900
    - Male - 47.9
    - Female - 51.7

Special Needs

- Age
- Disability
- Medical
- Acute injury
- Psychological
- Culture & lifestyle

Water

- Hierarchy of needs
- WHO
  - 78 percent of the population in less developed countries is without clean water
  - 85 percent without adequate fecal waste disposal
World Hunger

- Poverty
- Economic Systems
- Conflict
- Climate
- But the world produces enough food – 2720 kcal/person/day

Zoonoses

Emerging Infectious Disease

- Risk levels of emerging diseases transmitted from wildlife
- Majority of hotspots are located in lower-latitude developing nations

Emerging Infectious Disease

- “Category A” List (CDC)
  - Anthrax
  - Smallpox
  - Plague
  - Tularemia
  - Botulinum toxin
  - Viral hemorrhagic fevers
**Virus Evolution: Epidemics-in-Waiting**
- Infectious parasites may pose a serious threat even if they are not initially able to cause epidemics
- Poised to evolve so that they can cause epidemics
- The longer the parasite persists, the greater will be its opportunity to evolve to a higher $R_0$

**Management of Epidemic Disease**
- Disease as an individual event
  - Illusion!
  - “Mommy I’m sick”
- Disease as a social event
  - Reality

**Management Style**
- Recovery based
  - Primary focus on disaster events
  - Responsibility in single authority
  - Short time frames
- Prevention based
  - Focus on vulnerability and risk
  - Multiple authorities, interests, actors
  - Moderate to long time frames

**Levels of Complexity in Epidemic Management**
- Non-contagious (Anthrax)
- Waterborne (Cholera)
- Vectorborne (Malaria)
- Bacterial Infectious (Plague)
- Viral Infectious (Measles)
- Mixed
- Exotic (Ebola)

**Not Contagious**
- Anthrax
  - Spore-forming/persistent
- Dustborne
- Zoonosis
  - Highly lethal but prophylaxis effective
Timeline
- Aerosol Attack (100-10,000 Spores)
- 1-13 days Incubation Pulmonary
- 3-5 days Incubation GI
- 1-3 days Nonspecific flu-like course
- Survival horizon 2-18 days
  - Dose related, multifactorial
- 1-2 day Catastrophic progression
  - Mortality approaches 100% once mediastinitis or meningitis appear

Response to a Non Infectious (Anthrax) Biological Agent Attack

What Is a Pod?
- A site where medications or vaccines intended to prevent disease may be given quickly to a large number of people in the event of a public health emergency

Public Health Emergency that May Require a Pod
- Many people have been exposed to an infection that may make them sick
- Disease from that infection may be prevented by antibiotics or a vaccine
- Any other public health emergency where timely provision of material is key

Non-Contagious Timeline
- Identify Agent T+15
- Identify Population at Risk T+30
- Approved Plan Activation T+30
- Public Announcement T+40
- Evacuation Site (Overt) 1h
- Complete Prophylaxis 48h
- Reverse Flow Evacuation 96h
- 100% Exposure ID

Estimated Survivability for Inhalation Anthrax

Note: Antibiotic = 30-60 days of Ciprofloxacin or Doxycycline at recommended dose, ideally begun in first 48 hours after exposure. Vaccine=Anthrax Vaccine Adsorbed (AVA)
**Waterborne: Cholera Attack Rates**
- Open situations 1-2%
- Refugee camps 5%
- Goma, Zaire 8%
  - Implies 100% infection rate
- Rates depend on
  - Population immunity
  - Sanitary conditions
  - Level of overcrowding

**Waterborne: Cholera Mortality Rate**
- Mortality can approach 50%
- CFR depends on
  - Preparedness
  - Rapid action
  - Public awareness
  - Collaboration

**Waterborne: Cholera Mortality Rate**
- Effective security
- Effective staff
- Target CFR < 2%

**Malaria Worsening Situation**
- Parasites
  - Resistant to drugs
- Mosquitoes
  - Resistant to insecticides
- Humans
  - Movement of non-immune populations (highlands) to areas with malaria (lowlands)

**Malaria Worsening Situation**
- Government
  - Deterioration of infrastructure of malaria control

**Malaria Resistance**

![Map of Malaria Resistance]
Malaria Resistance

- Widespread uncontrolled and unregulated drug distribution & use
  - Renders available drugs ineffective and new closely related drugs show reduced efficacy
  - Insufficient research in new drugs
- Emergence of resistance to insecticides

Malaria High Risk Factors

- Substandard housing in swampy areas
- Crowding
- Malnutrition and immunosuppression
- Lack of medical care
- Control programs disturbed by civic unrest

New Form of Malaria Threatens Thai-Cambodia Border

- After decades of antibiotic overuse and misuse, resistance to malaria spreads faster and wider than previously documented
- Once-curable diseases such as tuberculosis and malaria are coming back as germs rapidly mutate to form aggressive strains that resist drugs

New Form of Malaria Threatens Thai-Cambodia Border

- Misuse has built up drug resistance worldwide

Contagious Bacterial

- Highly Infectious Bacterial
  - Plague (zoonotic & aerosol)
  - Self multiplying with short cycle time

Response to an Aerosol Contagious Bacterial Attack

- Estimation of Exposure Zone
- Place & Time
- Population at Risk
  - Present
  - Transient
  - Downwind
- Education Sites
- Specialized Treatment Sites
- Symptomatic Patients
- Hospital
- Mass Communication
- Non Hospitalized Exposed Individuals
- Evaluation & Prophylaxis Sites
Bacterial Infectious Timeline

- Public announcement: 1h
- Evaluation site: 1h
- X facility: 2h
- C facility: 6h
- Detailed instructions: 2h
- Implement quarantine: 2h

Increased Risk from STDs

- HIV
- Gonorrhea
- Syphilis
- Hepatitis
- Other usual suspects

Extremely Drug-Resistant TB

- "Diseases conquer drugs’ efficacy"
- First case of aggressive, highly drug-resistant TB (XXDR) found in U.S.
- Juarez’s strain
  - Has never before been seen in the U.S.

When Drugs Stop Working

- America’s farmers give their pigs, cows and chickens about 8 percent more antibiotics each year
- We thought antibiotics had conquered most infectious diseases, but some are back in new forms
- In the U.S., drug-resistant diseases killed more than 65,000 people last year

Contagious Viral

- Smallpox
- Measles
- Influenza
- Exotic hemorrhagic
- Identification, isolation, vaccination, prophylaxis
- Therapeutics & supportive care

Ring Vaccination: Search & Containment

- Find cases
- Provide ring of "immunity" or "containment" around case
- Isolate and vaccinate
- Targets area of greatest need
- Most efficient vaccine use
- Decreases adverse events
- Used to eradicate smallpox
- Required to control disease even with "routine immunization"
**Influenza**

- **Spanish Flu**
- **H1N1**
- **Mortality ~ 2%**
- **Age of death: 25-35**
- **Inflammatory reaction**
- **50,000,000 d**
- Control requires either immunity or interdiction of droplet/contact borne spread

---

**Measles**

- More severe in refugees
  - Progression even with 80% immunization coverage
  - Malnutrition
- Case fatality rate
  - Normal population - 5%
  - Refugees – up to 35%
- Breakdown of vaccination programs
  - Cohorts of unprotected children

---

**Regaining Control**

<table>
<thead>
<tr>
<th>Category</th>
<th>Case</th>
<th>Contacts</th>
<th>Contacts of Contacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action</td>
<td>Proximate care</td>
<td>Vaccinate as soon as identified</td>
<td>Vaccinate as soon as identified</td>
</tr>
<tr>
<td>Disposition</td>
<td>Isolate (type C)</td>
<td>No fever (type C)</td>
<td>No fever (type R)</td>
</tr>
</tbody>
</table>

- C = confirmed
- X = unknown
- R = residence

---

**Response to an Aerosol Contagious Viral Attack**

**Estimated Exposure Zone**

- Place & Time
- X Facility
- Treatment & Screening

**Population at Risk**

- Transient
- Downwind

**Population at Large**

**Non Hospitalized Exposed Individuals**

**Evaluation & Prophylaxis Sites**

- Treated Asymptomatic Contacts

**Facility Support**

**Response to a Droplet Contagious Viral Agent (Flu)**

**Population at Large**

**Mass Communications**

**Population at Risk**

- Highly Symptomatic Patients

**Non Hospitalized Exposed Individuals**

**Hospital**

**POC Evaluation & Prophylaxis Sites**

**Staged Telephone Triage**

**R1, R2, R3... Residential Facility (Support)**
Surge Capacity & Triage Management
1. Delay disease transmission & outbreak peak
2. Decompress peak burden on infrastructure
3. Diminish overall cases and health impacts

Vaccine Makers Struggle to Speed Output

- Cell-culture technology hastens the process, but slow-growing virus remains a problem, and U.S. production is years away

SARS Lessons Learned
- Surge capacity, quarantine & isolation
  - Equipment & supply
- Support services
- Hold citizens harmless for consequences

Exotic Hemorrhagic
- Identification
- Isolation
- Therapeutics (Ribavirin – Arenaviruses)
- Aggressive Supportive Treatment
Ethical Obligation in Disaster, A.M.A., June 2004
• Individual obligation to provide urgent medical care during disasters
• Even in the face of greater than usual risks to their own safety, health or life

Ethical Mandate
• Optimal balance between potential outcomes security/survival & liberty
  • Clinical paradigm
    – Focus on individual patient
  • Rescue paradigm
    – Save lives and minimize aggregate morbidity
    – Focus on community welfare

Ethical Mandate
• Infectious disease
  – Isolation
  – Quarantine
  – Prophylaxis
• Mass casualties
  – Decontamination, evacuation & treatment

Fall Back!
• Change process to maintain standards of outcome
• Deliberate decisions by authorized leadership
• Coordinated pullback to maintain new standards
  – Carefully planned

Fall Back!
– Capable of support
  – Personnel trained & equipped
• Optimize outcome under evolving conditions

Alternative Standards of Care
1. Who - Competencies & training
2. What - Intervention
3. When - Triage and prioritization
4. Where - Transport & facilities
5. Why - Survival & outcome
6. How - Evaluation & oversight
Medical Command & Control

The Role of Media

- THE MAIN source of health info for the public in a non-disaster setting
- THE ONLY source of ANY info in a disaster setting
- Studies indicate that panic is rare

Maintain Situational Awareness

Back to the Future

Camp Funston, Kansas

“If we don’t deal with these issues now, our children will face them in the future.”

Questions?