The Management of Epidemic Disease

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Faculty

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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**

BACK TO THE FUTURE, 1918

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

The Pilgrims

- "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

Louisiana Purchase

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

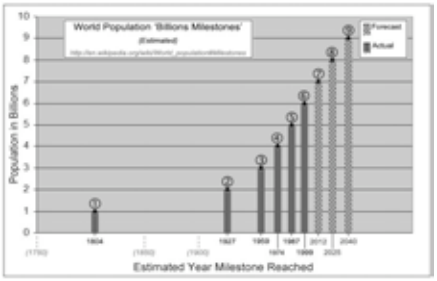
Epidemic

- 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

Epidemic

- 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



Global Population Growth

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

Life Expectancy

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

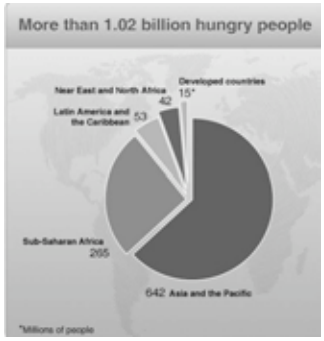
Special Needs

- 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

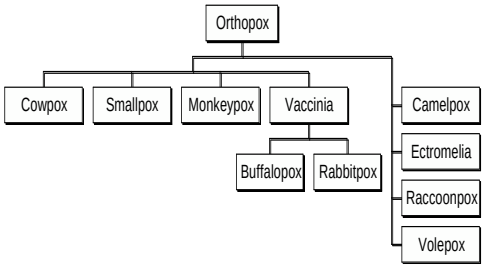
World Hunger



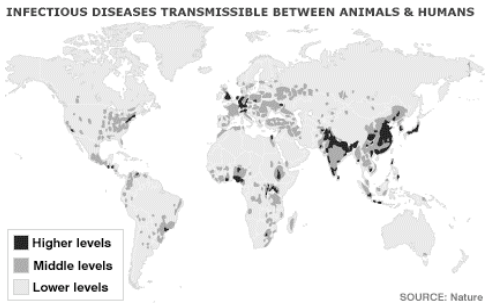
World Hunger

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

Zoonoses



Emerging Infectious Disease



Emerging Infectious Disease

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

Biological Terrorism "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

Virus Evolution: Epidemics-in-Waiting

- Immunocompromised patients may act as stepping stones to foster evolution of new pathogens
  - Ebola
  - Monkeypox
  - Rabies
  - Hantavirus

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

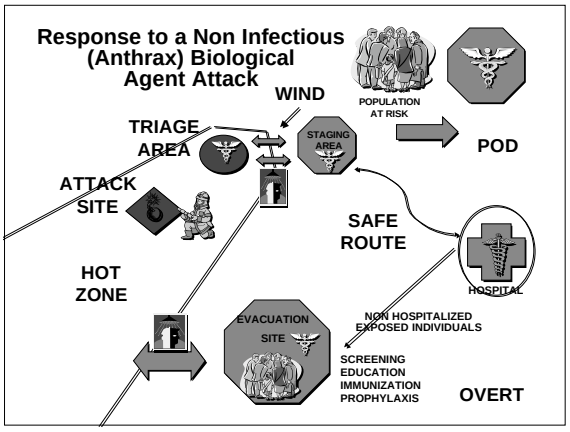
- Non-contagious (Anthrax)
- Waterborne (Cholera)
- Vectorborne (Malaria)
- Bacterial Infectious (Plague)
- Viral Infectious (Measles)
- Mixed
- Exotic (Ebola)

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



What Is a Pod?

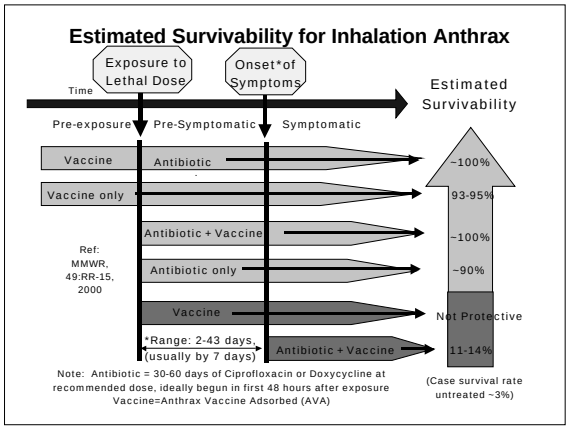
- A site where medications or vaccines intended to prevent disease may be given quickly to a large number of people in the event of a public health emergency

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



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

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

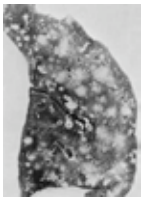
New Form of Malaria Threatens Thai-Cambodia Border

- 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

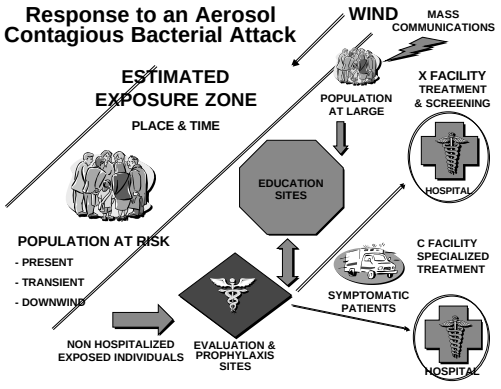
New Form of Malaria Threatens Thai-Cambodia Border

- Misuse has built up drug resistance worldwide

Contagious Bacterial



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



Bacterial Infectious Timeline

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

Q FLAG

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.

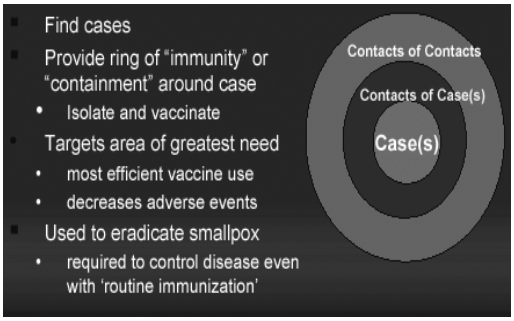
When Drugs Stop Working

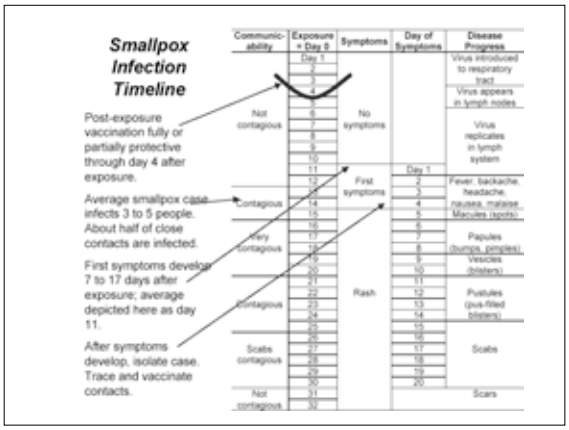
- America's farmers give their pigs, cows and chickens about 8 percent more antibiotics each year
- We thought antibiotics had conquered most infectious diseases, but some are back in new forms
- In the U.S., drug-resistant diseases killed more than 65,000 people last year

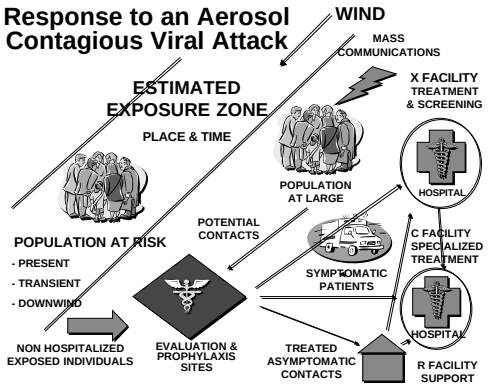
Contagious Viral

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

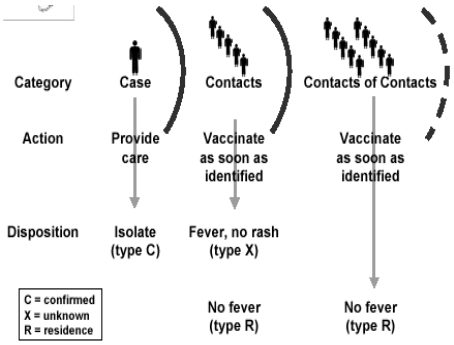
Ring Vaccination: Search & Containment







Regaining Control

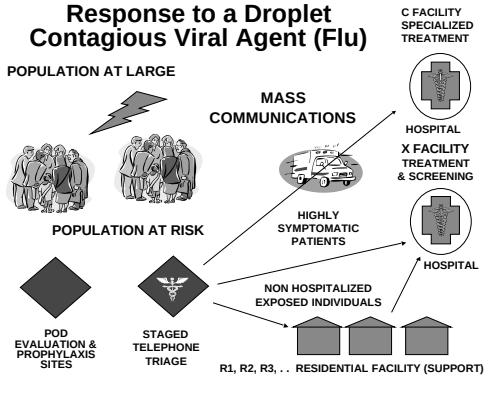


Measles

- 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

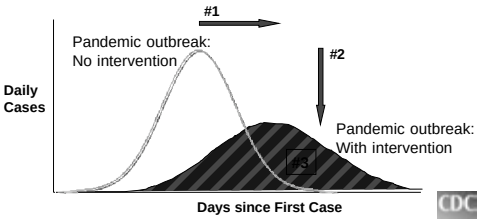
Influenza

- 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

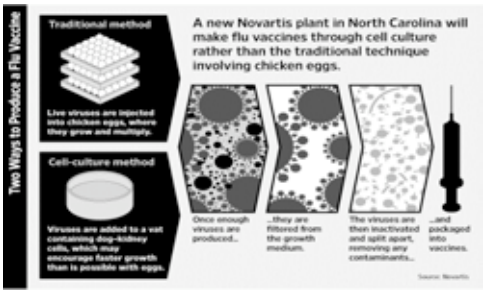


Surge Capacity & Triage Management

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



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

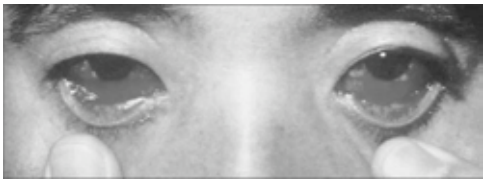
SARS Lessons Learned

- Existing statutes inadequate
  - Clear authority & regional coordination
  - Travel restrictions
- Public health training in medical schools

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

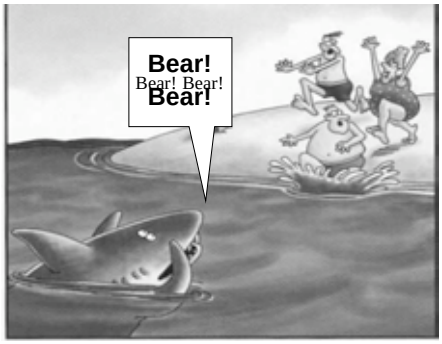
1. Who - Competencies & training
2. What - Intervention
3. When - Triage and prioritization
4. Where - Transport & facilities
5. Why - Survival & outcome
6. How - Evaluation & oversight

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

"If we don't deal with these issues now, our children will face them in the future."

Questions?