Past Outbreaks: Public Health Lessons Learned

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Unpredictability

Variation in mortality, severity of disease & pattern of spread

1918
- Second wave- 10 fold increase in death rate
- Young and healthy individuals 15 - 35 yrs
- Deaths were from Pneumonia- Ill-ndry infection

1957
- Outbreak explosive but fatalities much lower
- Infants and elderly, illness concentrated among school children
- Close contacts and over crowding
- Second wave concentrated in elderly

1968
- Milder and mortality still lower than 1957 Epidemic
- Death concentrated among elderly
Sudden Surge

Rapid surge in number of cases with exponential increase over weeks- Sudden burden on Health Care System

1918
- Huge burden on the health care system

1957
- Biggest challenge was the provision of adequate Medical and Hospital services

1968
- As the disease was much milder the hospital still has burden but less than 1957 pandemic

Sudden sharp increase in the need for medical care will always appear
Burden: Health Care System

• An influenza pandemic will place a huge burden on the U.S. Health Care System

• Based on extrapolation of the 1957 and 1968 pandemics suggests
  – 839,000 to 9,625,000 hospitalizations,
  – 18–42 million outpatient visits, and
  – 20–47 million additional illnesses, depending on the attack rate of infection during the pandemic
Epidemiology

• Severe disease in nontraditional age group
• Epidemiological Variations
  1918: Deaths- 40-50 million
    Young adults and virus mutated within months and become more lethal
  1957: Deaths- 2 million
    School Children, wave 2- elderly
  1968: Deaths- One million
    Very young and the elderly
Started Abruptly…Ended Abruptly

• Started abruptly without any warning
• Swept population with ferocious velocity
• Peaked rapidly
• Subsided almost abruptly
• Second wave more deadly virus
• Subsequent waves began simultaneously in different parts of the world
• Great variations has been observed:
  – Mortality, severity and pattern of spread
Origin: South East Asia

- World’s primary breading ground for new strains
- People, pigs, domestic fowls all harbor influenza virus
- Lives Cheek-by-jowl increases the likelihood that two strains recombine genetically and produce the deadly virus which has the capability to jump from animal-to-human and human-to-human

Nature, July 2003
Public Health Interventions

- Public Health Interventions delayed the spread but did not stop the disease
- Quarantine and travel restrictions: shown little effect
- Spread within countries was associated with close contact and overcrowding
- Banning of public gathering, closure of schools, social distancing etc
Delayed Spread: Desirable

- Flattens the epidemiological peak distributing cases over longer period of time
- Fewer people ill at a given time hence, reduce the burden on health care system and improve capacity to cope with a sharp increase in demand for care
- Medical and other essential services can be maintained
① Delay outbreak peak
② Decompress peak burden on hospitals / infrastructure
③ Diminish overall cases and health impacts

Pandemic outbreak: No intervention

Pandemic outbreak: With intervention
Quarantine & Isolation

• 1918: did little to stop the disease
• 1957: not effective
• Maritime Quarantine worked in Australia and Madagascar- disease reached there in late 1919
• Dampens the spread
Vaccine

• During 1957 and 1968 the manufacturer responded quickly

• Limited production capacity resulted in inadequate quantities and too late to have impact

• Countries with domestic manufacturing capacity will be the first to receive the vaccine
9/11 Families for a Secure America is a multi-ethnic coalition of Americans both native born and naturalized.
Terrorism
Anthrax Outbreak 2001
Anthrax

• Zoonotic disease
• Wool sorter’s disease - John Bell in late 15th Century
• Robert Koch - established the microbial origin in 1876
• Louis Pasteur – developed vaccine
• Inhalation anthrax was described in the later half of 19th Century
Anthrax- 2001

22 cases of Anthrax
  – 11 Cutaneous (7 confirmed, 4 suspected)
  – 11 Inhalation (5 deaths)
Not limited to…

• The anthrax outbreak was not limited to large metropolitan facilities.

• Every laboratory in every small town or large city has the potential of finding the index case of an anthrax - or plague, or small pox - outbreak.

• The lesson here is that every city or locale is at risk for involvement in a BT event.

• Leach DL, Ryman DG. Biological weapons: preparing for the worst. MLO 2002;32(9):26-43.
Economics: Clean-up

• The Environmental Protection Agency spent US$41.7 million to clean up government buildings in Washington, D.C.

• One FBI document said the total damage exceeded US$1 billion.

Little Progress In FBI Probe of Anthrax Attacks, The Washington Post, September 16, 2005

Mailroom in Washington D.C.
Prior Training

- In Palm Beach County Florida, both the on-site rapid response laboratory and the off-site main laboratory noted the unusual nature of their findings on CSF Gram stain.

- Their prior training in BT preparedness guided them through the appropriate steps necessary for prompt referral of the organism to their Level B laboratory where it was identified.

- CDC responds: coping with bioterrorism - the role of the laboratorian. Nov 9, 2001
Education: Public

• Education of the public regarding the signs and symptoms of diseases associated with infectious agents is also essential
Communication

The lack of communication between different agencies involved in preparation for and handling of a BT event has been a common complaint throughout the anthrax situation and during follow-up and critique of preparedness drills.
Communication

In both the first case in Florida and the last case in Connecticut, the laboratory that initially isolated B. anthracis in cultures and forwarded them to the Level B public health laboratory, found out the identity of the organism through television news reports. The top-to-bottom communication system failed.
Communication

Other communication deficiencies that have been noted include the difficulty that Level A laboratories have had in contacting a person-in-charge at their Level B facility on a 24/7 basis.

• CDC responds: coping with bioterrorism - the role of the laboratorian. Nov 9, 2001
Public Health

Local public health officials have not been active in communicating with hospital microbiology laboratories and Health Care Facilities were not communicating well with Public Health
Surveillance

- Anthrax attacks has emphasized the need for a strong surveillance infrastructure

Rural Facilities

Small rural hospital were receiving questions from physicians as well as mail carriers and the worried well and were not prepared to answer
Guidelines

• Advance guidelines on how to handle questions from the worried well and from postal employees
• Protocols detailing optimal specimens and specimen collection
Expertise From All Areas

• Expertise from all areas of involvement must be included in the planning and practice stages to have a complete picture of what a BT event may encompass.

• Practice drills and brainstorming sessions locally have involved law enforcement, FBI, emergency medical, fire department, and others but have not included hospital microbiology department representatives as an integral part of the team.
Track Vulnerable

What we learned from the mail-service anthrax attack of 2001 is that you really have to look at the vulnerable people along the chain of exposure, don't assume a case is isolated.

Dr. Anthony Fauci,
Director of the National Institute of Allergy and Infectious Diseases,
National Institutes of Health.
SARS Pandemic
SARS has been referred as the First Pandemic of the 21st Century
Severe Acute Respiratory Syndrome (SARS)

- Entirely new pathogen that has found its way from animal to human
- March 2003 – July 2003
  - Rapid onset and rapid decline
- 8437 cases 916 deaths, 26 countries
- Had social, economic, and humanitarian repercussions
  - Asia 30 billion
  - Canada 13 billion

*N Eng J Med 350;23, June 2004*
Alert Clinicians

• Recent high profile outbreaks-SARS, West Nile Virus, Monkey pox, Anthrax etc all were first identified by alert office-based primary care physician or an internist

• Though global and national surveillance programs are essential, but the primary healthcare givers have critical role in early detection and warning system

N Eng J Med 350;23, June 2004
Clinicians: Care & Prevention

- If they don't call public health, public health would not know

- All primary care physicians are the front lines of public health expected to play a significant role in detecting disease and providing patient care and prevention
Transport & Communication

• Modern fast transportation and communication spread the disease globally

• Problem affecting a remote province in China one day can become everyone’s problem next day

N Eng J Med 350;23, June 2004
Single Case

• One case has enormous impact
• Ill physician traveled from Guangdong province to Hong Kong and triggered the pandemic

N Eng J Med 350;23, June 2004
SARS

- November 2002 Guangdong province of China which borders on Hong Kong. The first case of infection was speculated to be a farmer.
- On February 21, 2003 a Chinese doctor who had treated cases in Guangdong checked into the Hong Kong hotel Metropole and infected up to twelve other guests. He was admitted to the Hong Kong Kwong Wah Hospital and died on March 4, 2003.
- A 27-year-old infected man who stayed in Metropole and on the same floor with the Chinese doctor was admitted to Prince of Wales Hospital.
- A large number of hospital workers were infected while treating him.
- About 80% of the Hong Kong cases have been traced back to this doctor.
Epidemiological Work-up

• Epidemiological history was quite successful for case ascertainment, clinical management and infection control

• Epidemiological histories alone were sufficient to identify the chain of SARS transmission to be traced

N Eng J Med 350;23, June 2004
Vigilant Surveillance

• The tremendous capabilities of molecular virology lead to recognition of the virus within a matter of weeks

• Vigilant Surveillance plays pivotal role in early recognition

N Eng J Med 350;23, June 2004
The close collaboration of WHO, CDC and local public health agencies developed the necessary surge capacity

Hence, the close watch on the part of local public health and health care giver is warranted

*N Eng J Med* 350;23, June 2004
Infection Control

• Hospital Exposure: 30% cases - Healthcare workers
• Heightened risk to health care workers SARS appears to spread mostly through large respiratory droplets, requires close contact
  – ICU Medical Staff, Physiotherapists
  – During aerosol-generating procedures such as intubations
• 50% death in patients on ventilator
• Basic infection control measures worked well

* N Eng J Med 350;23, June 2004
Toronto Experience

• 13,000 people voluntarily quarantined
• Only 27 needed to be served with formal quarantine order
• One person appealed, but withdrew when told how he had been exposed and how he could transmit it to others
• Possible reason for very high compliance – intense media coverage and rapid demystification of quarantine
• People showed responsibility and cooperation not divisiveness or panic
Quarantine: Ethics

• When public health trumps civil liberties:
  There are times when the interests of protecting public health override some individual rights, such as freedom of movement. At such times, society has a duty to inform people of the nature of the threat, be open in explaining the reasons for over-riding individual freedoms and do as much as possible to assist those whose rights are being infringed.

Journal Watch Infectious Diseases June 28, 2004
Personal Information

While the individual has a right to privacy, the state may temporarily suspend this privacy right in case of serious public health risks, when revealing private medical information would help protect public health. As a general rule, the privacy and confidentiality of individuals should be protected unless a well-defined public health goal can be achieved by the release of this information.

Journal Watch Infectious Diseases June 28, 2004
Health Care Workers

Health care professionals have a duty to care for the sick. During infectious epidemics this must be done in a way that minimizes the possibility of their transmitting diseases to the uninfected. Institutions have a reciprocal duty to support and protect health care workers to help them cope with very stressful situations, and recognize their contributions.

Journal Watch Infectious Diseases June 28, 2004
Collateral Damage

Severe restrictions on entry to SARS-affected hospitals meant that many people were denied medical care, sometimes for severe illnesses. As a result, patients in hospital, with or without SARS, and their families suffered from lack of contact due to the elimination of visits for a period of time. It is essential to maintain an equitable balance among the interests of those patients with or at risk of SARS, and those who are sick with other diseases, and need urgent treatment.

*Journal Watch Infectious Diseases June 28, 2004*
Disease Globalization

SARS is a wakeup call about global interdependence, and the increasing risk of the emergence and rapid spread of infectious diseases. There is a need to strengthen the global health system to cope with infectious diseases in the interests of all, including those in the richer and poorer nations. This will require global solidarity and cooperation in the interest of everyone's health.

Journal Watch Infectious Diseases June 28, 2004
Smallpox is rated among the most dangerous of all potential biological weapons, with far-reaching ramifications.

D. A. Henderson

WHO Smallpox Eradication Program
1949
The last case of smallpox in the US

1972
Routine vaccination stopped in the US

1977
The last case of smallpox in Somalia
“Smallpox eradication has been achieved throughout the world.”

May 18, 1980
World Health Organization
• Smallpox is a serious & sometimes fatal contagious disease
• There is no specific treatment/cure

• Only prevention is vaccination
Unique Characteristics

- Biological agent is self replicating
- Can produce and spread on its own
- Spread by personal contact
- Person becomes a vector
Smallpox Vs Chicken Pox

Smallpox
• Lesions tend to appear on the face and extremities, especially the palms of the hands and soles of the feet.
• Lesions develop at the same time and leave disfiguring scars.
• Lesions go deeper into the skin.
• Potentially a lethal disease.

Chicken Pox
• Sores appear more on the torso.
• Sores usually develop in clusters.
• Sores are more superficial and usually leave no scar.
• Chicken Pox is rarely lethal.
Smallpox Vs Chicken pox
1901-03: Boston Outbreak

• Previous vaccination against the disease not only lessened the likelihood of serious infection, but vaccination after the epidemic began improved the chances of survival of those who got sick

• Children under 5 and adults over 45 were less likely to survive smallpox
Post Exposure Vaccination

Because the (type of smallpox virus used in the vaccine) inoculated into the arm has a shorter incubation period (six to eight days) than variola virus acquired through respiratory inhalation, vaccination can alleviate or even abort smallpox if given soon after exposure.

Joel G. Breman, National Institute of Health
1947: New York

- A single case of smallpox
- Response:
  - 6,350,000 people were immunized promptly
  - 500,000 in one day, including President Harry Truman
1962: Bradford

- Source of the outbreak: child from Pakistan
- Had never been vaccinated
- Second case, died within 48 hours of admission, had over 200 close contacts
- Tracing, vaccinating and placing under surveillance of all possible contacts
- >1000 thousand contacts were traced in the first five days after the discovery of the outbreak
- 285 000 persons were vaccinated

*Journal of Royal Society of Medicine: Vol 97, May 2004*
1963: Stockholm

- Seaman previously vaccinated against smallpox.
- 2 weeks after arrival in Stockholm, he developed fever followed by reddish rashes, stayed at home.
- 80 year old grandmother became ill with similar symptoms and was suspected to have chickenpox.
- A third family member later also became ill.
- Later on the grandmother was transferred to a hospital where she infected other people.
- A community nurse visited the grandmother on a daily basis became infected and later also infected her family.
- A total of 27 persons were infected, and four of these died.

1970: Germany

- Single infected person visited his ailing relative at the hospital
- In hospital
  - 4 on same floor
  - 8 on floor above
  - 9 on 3rd floor
- Hospital: Isolation and Quarantine
- >100, 000 promptly vaccinated

- Bull World Health Organ 1970;4:669-79
- Gelfand et al. The recent outbreak of smallpox in Meschede, West Germany. Am J Epi 1971;93:234
Presumed infectious period of index case while at Meschede Hospital

Case number

- Stairs
- Smoke pattern

CDC
Fenner et al 1988
1972: Yugoslavia

• 150 cases infected within 4 weeks
• 20 million promptly vaccinated
• >10,000 Isolation/quarantine
• Cases 175/35 died

Emerging Infections Vol 3 Number 3 1998
Lane J. Smallpox in Yugoslavia: September 22, 1972. CDC Epi Prog Report, Atlanta 1972
President Marshal Tito ordered to seal the border
And all the residents were vaccinated.
Lessons Learned

• Rapid recognition of the disease by physicians
• Rapid lab diagnosis – ELISA, PCR
• Epidemiological investigation to determine the source of infection
• Quarantine and Isolation
• Vaccination
• Communication & coordination with all the responding agencies

*Mayo Clinic Proceedings, July 2002, Vol 77 Number 7*
“We interrupt the current programming to bring you this important news update...there has been a reported case of smallpox in Illinois...”
Monkey pox

- May 2003 - July 2003
- Started abruptly ended quickly
- 79 cases
- 6 States
Monkey pox

• Monkey pox is a rare viral disease that occurs mostly in central and western Africa
• Monkey pox was reported in humans for the first time in 1970
• People can get monkey pox from an animal with monkey pox if they are bitten or if they touch the animal’s blood, body fluids, or its rash.
• The disease also can spread from person-to-person through large respiratory droplets

*CDC MMWR, 2003a, 2003b*
Facile Movement of Species

- 72 cases of monkeypox were reported to the CDC from Illinois, Wisconsin, Indiana, Kansas, Missouri, and Ohio
- No deaths occurred in this outbreak
- Demonstrated how new diseases can emerge due to facile movement of species from one location to another (including the illegal transporting of species)

*MMWR, 2003;52:642–6*
Monkey pox Vs Smallpox

• In humans, the signs and symptoms of monkey pox are like those of smallpox, but usually they are milder.

• Another difference is that monkey pox causes the lymph nodes to swell.

• When a clinician observes patients with atypical rashes, with or without encephalitis, monkey pox may need to be considered in the differential diagnosis.

Journal of Infectious Diseases, 2004:190, 1833-1840
CDC MMWR 2003a
Disease Spectrum

- Studied revealed a spectrum of monkey pox-associated disease ranging from only serologic evidence of monkey pox infection to febrile vesicular rash illness with lymphadenopathy.
- In Africa, the mortality rate for monkey pox virus infection is between 1% and 10%, and can be higher in children or those who are immuno-compromised.

*MMWR, 2003;52:642–6*
*Journal of Infectious Diseases, 190, 1833-1840*
Epidemiologic Studies

Human monkey pox infections have shown that younger children and persons not vaccinated against smallpox can have severe disease and complications, which supports the importance of host susceptibility, including previous immunity.

- *J Infect Dis* 1987;156:293–8
- *MMWR* 2003;52:642–6
Surveillance

• A microbe can easily traverse great distances
  – From Ghana -East Africa to USA

• Outbreak of monkey pox virus infection in humans and nonhuman animals is an important reminder to monitor surveillance programs for febrile rash illnesses designed to detect potential bioterrorism attacks with smallpox virus, which may be beneficial for detecting emerging infections

*N Engl J Med 2002;346:1300–8*
Monkey pox illustrated
The multi-state response and cross border coordination
Lessons Learned

The coming pandemic
Animal Pathogens

Can pose major threat to human
- Corona Virus- SARS
- West Nile virus
- Monkey pox virus
- Avian Influenza
- Prion agent of bovine spongiform encephalopathy (mad cow disease)

*N Eng J Med 350;23, June 2004*
Vet, Ag and PH

- Veterinary surveillance and alerting of public health
- Closer collaboration between agriculture and veterinary and public health agencies
- Immediate reporting of any disease of animal origin
Single Case

One case has enormous impact
– SARS
– Smallpox
– Influenza Pandemic?

SARS: China - 2003
Smallpox
Stockholm - 1963
Germany - 1970
Yugoslavia - 1972
Golden Triangle of Response

Public Health

Health Care Delivery

Clinicians and Clinical Microbiologists
Enhance Communication

- Coordination and Communication within Public Health and with its Community Partners
- Health Care Facilities
- Partner agencies
  - law enforcement,
  - FBI,
  - Emergency medical Services,
  - Fire department,
  - and others
Information

• Free flow of vital and important information between public health departments and different agencies

• Cross-Border Coordination
  – Monkey pox
  – Pan Flu
  – etc
Education And Training

- Health-care workers, particularly physicians and nurses, need training about the clinical aspects of diseases that may result from the use of biological agents.
- Clinicians and laboratorians are vital to disease surveillance efforts and recognition of new diseases and syndromes.
- Training must be on-going and widespread.
- From the smallest rural facility with minimal expertise in microbiology to the large metropolitan laboratory with abundant and experienced microbiologists.
Public Communication

- West Nile virus, SARS, Monkey pox, hepatitis etc breakout raised the awareness for the public health to communicate with the public
- Flu Pandemic
- Education of the public regarding the signs and symptoms of diseases associated with infectious agents is essential
Rural Facilities

• In general, hospitals in the State of Mississippi, like a number of hospitals throughout the United States, are still not adequately prepared to manage victims of terrorist attacks involving chemical or biological WMD which consequently may result in the loss of hundreds or even thousands of lives

• Rural Health Care Facilities need enhancement

Epidemiologic Work-up

- Epidemiological history for the chain of transmission
  - Smallpox outbreaks in the past
  - SARS: was quite successful for case ascertainment, clinical management and infection control, and to identify the chain of transmission
- Proper training of field and investigative epidemiology
Surveillance

• Enhance surveillance
• New partnership
• Cross-Border Coordination
  – Monkey pox
  – Pan Flu
• Integration of the non-urban hospitals into the regional surveillance system to ensure early identification of infectious disease outbreaks
Mass Casualty

- Mass Casualty Management
- Proper plan and arrangements for mass casualty: coordination of
  - Public Health
  - Health Care Facility
  - Other agencies
Isolation/Quarantine

- SARS and monkey pox raised the question of Isolation and quarantine issues
- Smallpox, Flu pan
- Coordination and support of the various agencies
- Proper laws and guidance from State and Fed
Start to End: Abruptly Reach Peak Quickly

- Influenza Pandemics
- SARS
- Monkey pox
Sudden Surge

• Rapid surge in number of cases with exponential increase over weeks

• Sudden burden on Health Care System
Basic Infection Control

- Proper disposal
- Cough etiquette
- Hand washing
- PPE
  - Gloves
  - Gown
  - Mask
Both sexes and all age group

- All the past outbreaks show that both the sexes and all age groups are vulnerable and shall be considered in planning
Improvements

• After the experience of Anthrax and SARS the monkey pox was well handled - Improvement in communication and surveillance

• Monkey pox illustrated the excellent multi-state response and cross border coordination
• CDC acknowledge that inherent to terrorism is the unknown
• As was evident in the anthrax investigation, we must learn as we go, adapting our responses as new information becomes available and continuing to strive for excellence in our science, service, systems, and strategies.
• Worldwide, infectious diseases place a considerable burden on individuals and health care system
• A microbe can easily traverse great distances
• Since the early 1990s, there has been an increasing number of new infectious agents and species identified, and outbreaks or resurgence of previously known illnesses have been detected, many had already great impact on health and economy
• Be prepared for new and emerging infectious diseases
• Roles and responsibilities of various agencies response
• Coordination between Hospital, public health & Emergency Services Providers
• Enhance communication
• Surge capacity and contingency plans
• Unified Command and Control Concept

When many individuals and organizations are involved in the management of any serious outbreaks of communicable diseases, it is important both to ensure effective coordination and to maintain public confidence that one individual is seen to lead the response

Journal Watch Infectious Diseases: June 28, 2004
Message

• Emerging infections and animal pathogens can produce outbreaks of significant public health and economic impact.

• The “lessons learned” during past outbreaks provide the framework for better planning and readiness in the public health sector to respond to future challenges.
“Those who ignore history are doomed to repeat it.”
“Disasters are unpredictable but your response shouldn’t be!”

Thank you very much
For your attention!