Emerging Infections and Healthcare Preparedness
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What Are Emerging Infectious Disease?
• These are human illnesses caused by microorganisms or their poisonous byproducts and having the potential for occurring in epidemic numbers.
• These Infections have newly appeared in a population or have existed but are rapidly increasing in incidence or geographic range.

Receding – then Resurging?

1950s-60s: Infectious diseases apparently receding in developed countries
• Antibiotics and vaccines
• Pesticides to control mosquitoes
• Improved surveillance and control measures
• Early 1970s: Authorities proclaimed end of infectious disease era. Premature!
• >30 new or newly-discovered human IDs over past 40 yrs
• Penicillin began to lose its power to cure infections caused by Staphylococcus aureus
• In the 1970’s, there was a resurgence of sexually transmitted diseases and new diseases identified in the U.S. and elsewhere (Legionnaire’s Disease, toxic shock syndrome, Lyme’s disease).
• During the 1980’s, HIV emerged as a new infection and tuberculosis re-emerged in an antibiotic resistant form.
• Between 1980 and 1992, the death rate from infectious diseases increased 58%.
• The increase in drug resistance in strains of bacteria forced the U.S. to return to the pre-antibiotic era in the battle against many common organisms, at the same time that new bacterial and viral pathogens were appearing.
Why are we concerned about Emerging Infectious Diseases?

- These diseases
  - Pose a threat to all persons regardless of age, sex, lifestyle, ethnic background, or socioeconomic status
  - Cause suffering and death
  - Impose a financial burden on society.

Factors Related to the Emergence of Infectious Diseases

1. Biological — Genes, microbes, medicines, vaccines, blood and organ transplants, rapid microbial adaptation and resistance to antibiotics
2. Behavior — Sports, nutrition, sexuality, tobacco, alcohol, international travel
3. Environment: Physical — Air, water, toxins, radiation, pollution, noise, agricultural development, climate change, technology
4. Environment: Social — Housing, education, employment, and working conditions
5. Environment: Human Rights — Discrimination, war, torture, physical and mental abuse, lack of access to health care, prevention and health education
6. Breakdown of traditional basic public health infrastructure

Economic and Societal Impact of Some Infectious Diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Annual cost</th>
<th>Type of cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquired Immunodeficiency syndrome (AIDS)</td>
<td>$5.8 billion</td>
<td>Direct medical charges, (1993 dollars)</td>
</tr>
<tr>
<td>Tuberculosis (TB)</td>
<td>$703 million</td>
<td>Direct medical charges, (1993 dollars)</td>
</tr>
<tr>
<td>Nosocomial infections (acquired in hospitals)</td>
<td>$4.5 billion</td>
<td>Hospital charges (1993 dollars)</td>
</tr>
<tr>
<td>Foodborne bacteria (FS)</td>
<td>$2.9–$6.7 billion</td>
<td>Direct and indirect costs (1993 dollars)</td>
</tr>
<tr>
<td>Human parvovirus (6–10)</td>
<td>$1.23 billion</td>
<td>Direct medical charges (1993 dollars)</td>
</tr>
<tr>
<td>Neonatal group B streptococcal infections (GN)</td>
<td>$294 million</td>
<td>Direct medical charges (1993 dollars)</td>
</tr>
<tr>
<td>Bacterial vaginosis (TV)</td>
<td>$1.0 billion</td>
<td>Direct medical charges (1993 dollars)</td>
</tr>
</tbody>
</table>

How Are Infectious Diseases Acquired?

- Inhalation
- Ingestion
  - Food, water, soil
- Percutaneous inoculation
- Absorption from mucous membranes
- Exposure to blood and body fluids
CDC’s targets nine categories of problems that cause human suffering and place a burden on society

- Antimicrobial resistance
- Foodborne and waterborne diseases
- Vectorborne and zoonotic diseases
- Diseases transmitted through blood transfusions or blood products
- Chronic diseases caused by infectious agents

CDC’s Target Areas (cont.)

- Vaccine development and use
- Diseases of persons with impaired host defenses
- Diseases of pregnant women and newborns
- Diseases of travelers, immigrants, and refugees

CONTROL MEASURES

- Water treatment
- Vector control
- Rodent reduction
- Vaccination
- Antibiotics

ROLE OF PUBLIC HEALTH

- Surveillance and early response (detect, investigate, initiate action and monitor)
- Assessment of health status, risks, and services available to a community
- Development of health policy
- Assurance of quality services (discourage inappropriate use of antibiotics)
- Laboratory identification is required for rapid and accurate diagnosis of an outbreak or unusual disease.
ROLE OF PUBLIC HEALTH
(CONT.)
• Rapid communication with medical providers
  hospitals and media to alert them to outbreaks
  and disease changes as well.
• Public and health care provider education about
  prevention or early identification and detection
• Environmental assessment and remediation,
  e.g. food inspection, water supply inspection,
  vector control.

EMERGING INFECTIOUS DISEASES
PART 2

New Emerging Infectious Diseases
• H1NI INFLUENZA
• Severe Acute Respiratory Syndrome (SARS)
• West Nile encephalitis (WNV)
• Monkey Pox
• Ebola
• Chikungunya virus

H1N1 Influenza virus
"THE INFLUENZA CLOCK IS TICKING, WE JUST DON'T KNOW WHAT TIME IT IS"

– Ed Marcuse, MD and past chairman, The National Vaccine Advisory Committee

What is Influenza?

- RNA Virus
- Genus A, B, and C

H1 N1
H2 N2
H3 N3
H4 N4
H5 N5
H6 N6
H7 N7
H8 N8
H9 N9
H10
H11
H12
H13
H14
H15
H16

Timeline of Emergence
Influenza A Viruses in Humans

Nucleoprotein (RNA)
Lipid Envelope
Capsid
Neuraminidase (Sialidase)
Hemagglutinin
Circulating Influenza Strains and Pandemics in the 20th and 21st Century

20-40 million deaths 1-4 million deaths 1-4 million deaths 13700 deaths

History of Novel H1N1

- March 2009 Novel H1N1 virus emerged in Mexico
- April 15, 2009 First novel H1N1 patient in the United States
- By April 22, 2009, enough cases were identified to prompt the CDC to activate the Emergency Operations Center to coordinate a public health response
- April 26, 2009 US Government declared a public health emergency
- June 11, 2009 WHO raised alert level to Phase 6 (global pandemic)
- June 19, 2009 All 50 states, the District of Columbia, and the U.S. Virgin Islands all reported novel H1N1 infection

Swine Influenza A(H1N1) facts

- Virus described as a new subtype of A/H1N1 not previously detected in swine or humans
- CDC determines that this virus is contagious and is spreading from human to human
**What We Do Know**

- This is an entirely new virus
- Genetic bits come from flu viruses that infect pigs, birds and humans
- It is easily transmitted among humans, especially the young
- No one, except those who have been infected, is immune
- Illness from the virus could become widespread quickly
- No previous vaccine, including seasonal flu vaccine, protects against infection
- H1N1 vaccine is available now.

**Transmission to Humans**

- Through contact with infected pigs or environments contaminated with swine flu viruses
- Through contact with a person with swine flu
- Human-to-human spread of swine flu has been documented also and is thought to occur in the same way as seasonal flu, through coughing or sneezing of infected people

**What are the Symptoms of Influenza?**

- Body aches
- Headache
- Chills and fatigue

**Symptoms of Swine flu**

- Systemic
  - Fever
- Psychological
  - Lethargy
  - Lack of appetite
- Nasopharynx
  - Runny nose
  - Sore throat
- Respiratory
  - Coughing
- Intestinal
  - Diarrhea
- Gastric
  - Nausea
  - Vomiting
Seasonal Epidemics vs. Pandemics

Seasonal Influenza
- A public health problem each year
- Usually some immunity built up from previous exposures to the same subtype
- Infants and elderly most at risk

Influenza Pandemics
- Appear in the human population rarely and unpredictably
- Human population lacks any immunity
- All age groups, including healthy young adults

What We’ve Learned from History

Pandemic influenza typically comes in waves. The great 1918-1919 pandemic came in 3 distinct 'waves'
- The second wave was very different – much more lethal
- Over the summer the virus had changed

SARS (SEVERE ACUTE RESPIRATORY SYNDROME)

A Novel Virus: SARS

SARS-associated Coronavirus.
Updated from Holmes

NEJM May 15, 2003
Epidemiology

- SARS was first noted in Guangdong Province, China in November 2002.
- Between November 16, 2002 and February 28, 2003, 792 cases were reported in this province.
- Healthcare workers and their contacts appeared to be affected by the outbreak.
- The index case for the illness in Hong Kong was a physician from Guangdong province who traveled to Hong Kong five days after the onset of symptoms.
- The index cases in Singapore, Thailand, Vietnam, and Canada were in travelers returning from Guangdong province or Hong Kong.
- The United States had 27 probable cases with no secondary cases and no deaths

SARS-BASIC FACTS

- SARS is an illness which can vary in severity and is caused by a Corona virus most likely of animal origin.
- The disease is spread by large respiratory droplets from sneezing and coughing within a radius of 6 to 8 feet.
- Incubation period-3 to 10 days
- It can survive on surfaces up to 3 days but is easily killed by standard disinfectants

SARS: Summary Points

- In retrospect epidemic started ~ November 2002 in Southern China
- February 2003 very infectious patient infects many guests at Metropole Hotel in Hong Kong who in turn spread SARS to their own countries
- World attention remained focused on SARS until global surveillance shows all chains of transmission interrupted ~ July 2003
SARS “over its peak”?

June 5 & 19, 2003

The Return of SARS--2004

• SARS reoccurred in China in 2004
• There were nine cases
• WHO issued a Global Health Advisory
• The outbreak was contained 5/18/04, but WHO advised continued vigilance
History

• First isolated from a febrile adult woman in the West Nile District of Uganda in 1937.
• West Nile virus (WNV) has emerged in the temperate regions of Europe and North America in 1999, with encephalitis reported in humans and horses.
• The subsequent spread in the United States is an important milestone in the evolving history of this virus.

FACTS ABOUT WNV

• West Nile Fever is a “flu-like” illness of sudden onset, caused by a subgroup of viruses called Flavoviruses
• Symptoms: fever, sore throat, headache, malaise, arthralgia or myalgia and rash.
• Complications: meningitis or encephalitis

Life cycle

• Incubation period: usually 3 to 12 days
• Communicability: no direct person to person transmission
• Mode of transmission: the bite of an infected mosquito
• Prevention: Mosquito eradication, mosquito repellents
• Treatment: none specific
• Mortality rate: 3 to 15%
A New Infectious Disease Outbreak

MONKEY POX
- Monkey pox, an Orthopox virus caused infection, closely resembles small pox clinically
- Recently transmitted to humans by prairie dogs infected by a Gambian giant rat imported from Africa
- Symptoms: fever, rash, muscle aches, cough
- Mortality: 1 to 10% in Africa, none in the US

MONKEY POX
- Transmission: person to person has occurred
- Treatment: small pox vaccination if early in the course of the disease
- Prevention: small pox vaccination is partially successful, public education about the dangers of illegally imported pets
EBOLA

- Ebola is among the most virulent pathogens of humans, causing severe hemorrhagic fever that resembles fulminant septic shock
- RNA virus
- Mode of transmission: handling infected wild animals and may be spread person to person by contact with body secretions
- Incubation period: 2 to 21 days
- Symptoms: sudden onset of fever, myalgia, headache, followed by vomiting, diarrhea, and rash.
- Mortality: from 50 to 90% in Africa
- Complications: primarily hemorrhagic and pulmonary complications
- Treatment: supportive
- Prevention: caution in contact with infected monkeys

CHIKUNGYUNYA VIRUS

- The cause of an ongoing epidemic in India and the islands of the southwest Indian Ocean (e.g., Reunion).
- In India, 1.4 million cases were reported in 2006.

INTRODUCTION

- It is a single-stranded RNA arthropod borne virus of the genus Alphavirus.
- First isolated from mosquitoes and humans during an outbreak in Tanganyika (Tanzania) in 1952-53
- It means "that which bends up"
- Multiple outbreaks beyond west Africa have been described.
- Since 2004 chikungunya has spread broadly, causing massive outbreaks with explosive onset in the Indian Ocean region, India and other parts of Asia
**EPIDEMIOLOGY**

- It is an endemic in parts of West Africa
- Seroprevalence in 35 to 50 percent of the population in the absence of recognized outbreaks.
- Rapid spread in the last few years may also be related to a viral mutation that enhances replication efficiency in the mosquito.

**CLINICAL MANIFESTATIONS**

- **Acute infection**
  - High fever, bilateral polyarthralgia with intense pain, macular or maculopapular rash.
  - Additional manifestations may include headache, myalgia, and gastrointestinal symptoms.

- **Persistent rheumatologic symptoms** following acute illness. These may include polyarthralgia, morning stiffness, tenosynovitis and Raynaud phenomena.

- **Severe complications** such as meningoencephalitis, cardiopulmonary decompensation, acute renal failure and death have been described with greater frequency among patients older than 65 years and those with underlying chronic medical problems.
Diagnosis

• Serum IgM anti-chikungunya virus antibodies are present starting about five days (range 1 to 12 days) following onset of symptoms and persist for several weeks to three months.
• IgG antibodies start to appear about two weeks following onset of symptoms and persist for years.

Treatment

• supportive care including anti-inflammatory and analgesic agents.
• No antiviral agents have been shown to be effective in human infection.
• Prevention consists of minimizing mosquito exposure.