INFECTIOUS DISEASES
IMPACT OF INFECTIOUS DISEASES

• 14th century - Europe - plague kills 20-45% of the world’s population

• 1831 - Cairo - 13% of population succumbs to cholera

• 1854-56 - Crimean war – deaths due to dysentery were 10 times higher than deaths due to casualties

• 1899-1902 - Boer War – deaths due to dysentery were 5 times higher than deaths due to casualties
Rare but deadly amoeba infection hard to prevent

By Patrick Oppmann and John Zarrella
CNN

(CNN) -- Ray Herrera does not mince words about what his 12-year-old son, Jack, went through.

"It's beyond description to watch your most precious, beautiful, wonderful, loved one become a vegetable essentially and then die," Herrera said.

In August, Jack returned from summer camp that included swims in Texas' Lake LBJ. Five days after coming home he was dead, killed by a microscopic amoeba.

"He was the happiest boy anyone ever knew," Herrera said.

Jack is one of six people to die this year in the United States from the naegleria fowleri amoeba.

All were believed by health officials to have contracted the amoeba from swimming in warm, freshwater lakes, rivers or natural springs. There is no risk from properly chlorinated swimming pools, according to the Centers for Disease Control and Prevention.
Brain-eating amoeba kills Lake Elsinore boy

Riverside County health officials urge swimmers to use caution after the death Saturday. It is not known where the boy contracted the Naegleria fowleri amoeba.

By David Kelly, Los Angeles Times Staff Writer
August 6, 2008

Riverside County health officials are urging swimmers to use caution after the death Saturday of a Lake Elsinore child infected with a waterborne parasite.

Authorities said it was unknown exactly where the 9-year-old boy contracted the deadly Naegleria fowleri amoeba. He had gone swimming in Lake Elsinore several times this summer.

The parasite lives in warm freshwater lakes, rivers and poorly maintained swimming pools, experts say. It enters the brain through the nose, where it can cause a severe and nearly always fatal infection. This is the county's first confirmed case of the illness.
Ft. Bragg investigates infant deaths

Ten babies have died suddenly since January 2007 while living in base housing. All were younger than 8 months, and no sign of foul play was found in any of the deaths.

Reporting from Ft. — On April 15, 2009, Melissa Pollard’s two-month-old son, Jay’Vair, stopped breathing and died inside military housing on this sprawling Army base.

Three months later, on July 23, seven-month-old Ka’Mya Frey died suddenly while taking a nap in the same house. The baby was the daughter of Pollard’s brother and his fiancée, Bianca Outlaw, who were living temporarily with Pollard and her soldier husband.

Only later did Pollard and Outlaw learn from neighbors that another infant who had lived in the same house in 2007 died that year of an undetermined cause while with a babysitter in nearby Fayetteville, N.C.

"Unfortunately, our kids died before we had any idea what was going on with them," Outlaw, 20, said Tuesday. "I mean, there has to be something in that house that’s causing healthy babies to get sick and die."

According to Ft. Bragg officials, 10 infants have died suddenly while living in base housing since January 2007, including Jay’Vair and Ka’Mya. Autopsies were performed by the military for all 10, with the manner of death ruled "undetermined" in seven cases.
Govt wakes up to superbug
Durgesh Nandan Jha
TNN | Oct 6, 2011, 04.36AM IST

New Delhi: A day after TOI reported the findings of a private hospital that confirmed the prevalence of the NDM1 superbug in hospital settings, the state health department has been jolted into action. It has called an emergency meeting of all stakeholders to analyse the report and find a solution to the danger.

Delhi Health Minister A K Walia said the meeting will be held on Friday and representatives from Ganga Ram hospital, which has conducted the study, Indian Council of Medical Research (ICMR), National Centre for Disease Control (NCDC) and pathologists from Lok Nayak hospital among others are expected to attend.
Infectious disease is one of the few genuine adventures left in the world. The dragons are all dead and the lance grows rusty in the chimney corner . . . About the only sporting proposition that remains unimpaired by the relentless domestication of a once free-living human species is the war against those ferocious little fellow creatures, which lurk in the dark corners and stalk us in the bodies of rats, mice and all kinds of domestic animals; which fly and crawl with the insects, and waylay us in our food and drink and even in our love.

- (Hans Zinsser, 1934 quoted in Murphy 1994)
EMERGING INFECTIOUS DISEASES

Microbes and vectors swim in the evolutionary stream, and they swim faster than we do. Bacteria reproduce every 30 minutes. For them, a millennium is compressed into a fortnight. They are fleet afoot, and the pace of our research must keep up with them, or they will overtake us. Microbes were here on earth 2 billion years before humans arrived, learning every trick for survival, and it is likely that they will be here 2 billion years after we depart (Krause 1998).
FIGURE ES-1 The Convergence Model. At the center of the model is a box representing the convergence of factors leading to the emergence of an infectious disease. The interior of the box is a gradient flowing from white to black; the white outer edges represent what is known about the factors in emergence, and the black center represents the unknown (similar to the theoretical construct of the "black box with its unknown constituents and means of operation"). Interlocking with the center box are the two focal players in a microbial threat to health—the human and the microbe. The microbe-host interaction is influenced by the interlocking domains of the determinants of the emergence of infection: genetic and biologic factors; physical environmental factors; ecological factors; and social, political, and economic factors.
Direct economic impact of selected infectious disease outbreaks, 1990-2003

MICROBIAL THREATS (1)

• Newly recognized agents (SARS, acinetobacter)
• Mutation of zoonotic agents that cause human disease (e.g., H5N1, H1N1)
• Resurgence of endemic diseases (malaria, tuberculosis)
MICROBIAL THREATS (2)

• Development of drug-resistant agents (tuberculosis, gonorrhea)
• Recognition of etiologic role in chronic diseases (chlamydia causing respiratory and heart disease)
• Use of infectious agents for terrorism and warfare (anthrax)
Selected emerging and re-emerging infectious diseases, 1996-2004

FIGURE 1 Leading infectious killers; millions of deaths worldwide, all ages, 1998. *HIV-positive people who died with TB have been included among AIDS deaths. SOURCE: WHO, 1999.
### TABLE 3 Antibiotic-Resistant Disease-Causing Bacteria

<table>
<thead>
<tr>
<th>Disease</th>
<th>Bacterium</th>
<th>Antibiotic Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dysentery</td>
<td><em>Shigella dysenteriae</em></td>
<td>Multidrug resistant</td>
</tr>
<tr>
<td>Gonorrhea</td>
<td><em>Neisseria gonorrhoeae</em></td>
<td><strong>Multidrug resistant</strong></td>
</tr>
<tr>
<td>Nosocomial infections:</td>
<td><em>Enterococcus species</em></td>
<td>Vancomycin resistant</td>
</tr>
<tr>
<td></td>
<td><em>Klebsiella species</em></td>
<td>Multidrug resistant</td>
</tr>
<tr>
<td></td>
<td><em>Pseudomonas species</em></td>
<td>Multidrug resistant</td>
</tr>
<tr>
<td></td>
<td><em>Staphylococcus aureus</em></td>
<td>Methicillin resistant</td>
</tr>
<tr>
<td>Pneumonia</td>
<td><em>Streptococcus pneumoniae</em></td>
<td>Multidrug resistant</td>
</tr>
<tr>
<td>Typhoid</td>
<td><em>Salmonella enterica</em></td>
<td>Multidrug resistant</td>
</tr>
</tbody>
</table>

**SOURCE:** Workshop presentation by David Heymann, World Health Organization, 1999.
**Box 23 Drug-Resistant Malaria**

Malaria is a leading killer of young children. As shown in this map, resistance to antimalarial drugs is widespread, involving most parts of the world where malaria is found. For many years, chloroquine was the mainstay of malaria treatment and control. However, resistance to chloroquine by *Plasmodium falciparum*, the parasite that causes the most severe form of malaria, has spread and intensified in almost all malaria-endemic areas. Moreover, *P. falciparum* has developed resistance to many other antimalarial drugs. In some areas of Southeast Asia, resistance has been reported to chloroquine, sulfadoxine/pyrimethamine, mefloquine, halofantrine, and quinine, leaving combination therapies that include artemisinins as the only effective treatment. In 1989, a chloroquine-resistant strain of *Plasmodium vivax* was reported in Papua, New Guinea, which was the first time a non-*P. falciparum* malaria species had exhibited resistance to any major antimalarial drug. Data such as these are critical for helping nations to establish appropriate malaria treatment policies and ensure the availability of drugs that will be effective against this disease.
Rising resistance. H3N2 strains around the world are rapidly losing their sensitivity to amantadine and rimantadine, a trend that started in Asia.

### NEWLY IDENTIFIED INFECTIOUS DISEASES AND PATHOGENS (1)

<table>
<thead>
<tr>
<th>Year</th>
<th>Disease or Pathogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>Hantavirus pulmonary syndrome (Sin Nombre virus)</td>
</tr>
<tr>
<td>1992</td>
<td><em>Vibrio cholerae</em> O139</td>
</tr>
<tr>
<td>1991</td>
<td>Guanarito virus</td>
</tr>
<tr>
<td>1989</td>
<td>Hepatitis C</td>
</tr>
<tr>
<td>1988</td>
<td>Hepatitis E; human herpesvirus 6</td>
</tr>
<tr>
<td>1983</td>
<td>HIV</td>
</tr>
<tr>
<td>1982</td>
<td><em>Escherichia coli</em> O157:H7; Lyme borreliosis; human T-lymphotrophic virus type 2</td>
</tr>
<tr>
<td>1980</td>
<td>Human T-lymphotrophic virus</td>
</tr>
</tbody>
</table>

Source: Workshop presentation by David Heymann, World Health Organization, 1999
<table>
<thead>
<tr>
<th>Year</th>
<th>Disease or Pathogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>H1N1</td>
</tr>
<tr>
<td>2004</td>
<td>Avian influenza (human cases)</td>
</tr>
<tr>
<td>2003</td>
<td>SARS</td>
</tr>
<tr>
<td>1999</td>
<td>Nipah virus</td>
</tr>
<tr>
<td>1997</td>
<td>H5N1 (avian influenza A virus)</td>
</tr>
<tr>
<td>1996</td>
<td>New variant Creutzfelt-Jacob disease; Australian bat lyssavirus</td>
</tr>
<tr>
<td>1995</td>
<td>Human herpesvirus 8 (Kaposi’s sarcoma virus)</td>
</tr>
<tr>
<td>1994</td>
<td>Savia virus; Hendra virus</td>
</tr>
</tbody>
</table>

Source: Workshop presentation by David Heymann, World Health Organization, 1999
NIAID List of Emerging and Re-emerging Infectious Diseases (1)

**Group II—Re-emerging Pathogens**

- Enterovirus 71
- *Clostridium difficile*
- Mumps virus
- *Streptococcus, Group A*
- *Staphylococcus aureus*  

Malaria  
Tuberculosis
NIAID List of Emerging and Re-emerging Infectious Diseases (2)

Group III—Agents with Bioterrorism Potential
NIAID—Category A

- Bacillus anthracis (anthrax)
- Clostridium botulinum toxin (botulism)
- Yersinia pestis (plague)
- Variola major (smallpox) and other related pox viruses
- Francisella tularensis (tularemia)
- Viral hemorrhagic fevers
  - Arenaviruses
    - LCM, Junin virus, Machupo virus, Guanarito virus
    - Lassa Fever
  - Bunyaviruses
    - Hantaviruses
    - Rift Valley Fever
  - Flaviruses
    - Dengue
  - Filoviruses
    - Ebola
    - Marburg
NIAID List of Emerging and Re-emerging Infectious Diseases (3)

Group III – Agents with Bioterrorism Potential (continued)

NIAID—Category B

- Burkholderia pseudomallei
- Coxiella burnetii (Q fever)
- Brucella species (brucellosis)
- Burkholderia mallei (glanders)
- Chlamydia psittaci (Psittacosis)
- Ricin toxin (from Ricinus communis)
- Epsilon toxin of Clostridium perfringens
- Staphylococcus enterotoxin B
- Typhus fever (Rickettsia prowazekii)
- Food- and waterborne pathogens
  - Bacteria
    - Diarrheagenic E.coli
    - Pathogenic Vibrios
    - Shigella species
    - Salmonella
    - Listeria monocytogenes
    - Campylobacter jejuni
    - Yersinia enterocolitica)
NIAID List of Emerging and Re-emerging Infectious Diseases (4)

Group III – Agents with Bioterrorism Potential (continued)

Category B (continued)

- Viruses (Caliciviruses, Hepatitis A)
- Protozoa
  - Cryptosporidium parvum
  - Cyclospora cayatanensis
  - Giardia lamblia
  - Entamoeba histolytica
  - Toxoplasma
- Fungi
  - Microsporidia
- Additional viral encephalitides
  - West Nile virus
  - LaCrosse
  - California encephalitis
  - VEE
  - EEE
  - WEE
  - Japanese Encephalitis virus
  - Kyasanur Forest virus
Group III – Agents with Bioterrorism Potential (continued)

Category C

Emerging infectious disease threats such as Nipah virus and additional hantaviruses.

NIAID priority areas:

- Tick-borne hemorrhagic fever viruses
  - Crimean-Congo Hemorrhagic Fever virus
- Tick-borne encephalitis viruses
- Yellow fever
- Multidrug-resistant TB
- Influenza
- Other Rickettsias
- Rabies
- Prions
- Chikungunya virus
- Severe acute respiratory syndrome-associated coronavirus (SARS-CoV)
DISEASE EMERGENCE AND RE-EMERGENCE: CAUSES

- **GENETIC/BIOLOGIC FACTORS**
  - Host and agent mutations
  - Increased survival of susceptibles

- **HUMAN BEHAVIOR**
  - POLITICAL
  - SOCIAL
  - ECONOMIC

- **PHYSICAL ENVIRONMENTAL FACTORS**

- **ECOLOGIC FACTORS**
  - Climatic changes
  - Deforestation
  - Etc.
FACTORS CONTRIBUTING TO EMERGENCE OR RE-EMERGENCE OF INFECTIOUS DISEASES (1)

• Human **demographic change** by which persons begin to live in previously uninhabited remote areas of the world and are exposed to new environmental sources of infectious agents, insects and animals

• Unsustainable **urbanization** causes breakdowns of sanitary and other public health measures in overcrowded cities (e.g., slums)
FACTORS CONTRIBUTING TO EMERGENCE OR RE-EMERGENCE OF INFECTIOUS DISEASES (2)

- Economic development and changes in the use of land, including deforestation, reforestation, and urbanization
- Global warming - climate changes cause changes in geographical distribution of agents and vectors
- Changing human behaviours, such as increased use of child-care facilities, sexual and drug use behaviours, and patterns of outdoor recreation
- Social inequality
FACTORS CONTRIBUTING TO EMERGENCE OR RE-EMERGENCE OF INFECTIOUS DISEASES (3)

- International travel and commerce that quickly transport people and goods vast distances

- Changes in food processing and handling, including foods prepared from many different individual animals and countries, and transported great distances
FACTORS CONTRIBUTING TO EMERGENCE OR RE-EMERGENCE OF INFECTIOUS DISEASES (4)

• Evolution of pathogenic infectious agents by which they may infect new hosts, produce toxins, or adapt by responding to changes in the host immunity. (e.g. influenza, HIV)

• Development of resistance by infectious agents such as *Mycobacterium tuberculosis* and *Neisseria gonorrhoeae* to chemoprophylactic or chemotherapeutic medicines.
FACTORS CONTRIBUTING TO EMERGENCE OR RE-EMERGENCE OF INFECTIOUS DISEASES (5)

- Resistance of the vectors of vector-borne infectious diseases to pesticides.
- Immunosuppression of persons due to medical treatments or new diseases that result in infectious diseases caused by agents not usually pathogenic in healthy hosts. (e.g. leukemia patients)
FACTORS CONTRIBUTING TO EMERGENCE OR RE-EMERGENCE OF INFECTIOUS DISEASES (6)

• Deterioration in surveillance systems for infectious diseases, including laboratory support, to detect new or emerging disease problems at an early stage (e.g. Indonesian resistance to “scientific colonialism”)

• Illiteracy limits knowledge and implementation of prevention strategies

• Lack of political will – corruption, other priorities
FACTORS CONTRIBUTING TO EMERGENCE OR RE-EMERGENCE OF INFECTIOUS DISEASES (7)

- Biowarfare/bioterrorism: An unfortunate potential source of new or emerging disease threats (e.g., anthrax and letters)
- War, civil unrest – creates refugees, food and housing shortages, increased density of living, etc.
- Famine causing reduced immune capacity, etc.
- Manufacturing strategies; e.g., pooling of plasma, etc.
STRATEGIES TO REDUCE THREATS (1)

• DEVELOP POLITICAL WILL AND FUNDING
• IMPROVE GLOBAL EARLY RESPONSE CAPACITY
  – WHO
  – National Disease Control Units (e.g. USCDC, CCDC)
  – Training programs
STRATEGIES TO REDUCE THREATS (2)

• IMPROVE GLOBAL SURVEILLANCE
  – Improve diagnostic capacity (training, regulations)
  – Improve communication systems (web, e-mail etc.) and sharing of surveillance data
  – Rapid data analysis
  – Develop innovative surveillance and analysis strategies
STRATEGIES TO REDUCE THREATS (3)

• IMPROVE GLOBAL SURVEILLANCE (continued)
  – Utilize geographical information systems
  – Utilize global positioning systems
  – Utilize the Global Atlas of Infectious Diseases (WHO)
  – Increase and improve laboratory capacity
  – Coordinate human and animal surveillance
CDC has six GDD Regional Centers, one per WHO region. Centers are selected in consultation with invited countries, internal experts, and national and international partners, and based on:

- Public health significance
- Established regional scope
- Established CDC presence
- International partner presence
STRATEGIES TO REDUCE THREATS (4)

• USE OF VACCINES
  – Increase coverage and acceptability (e.g., oral)
  – New strategies for delivery (e.g., nasal spray administration)
  – Develop new vaccines
  – Decrease cost
  – Decrease dependency on “cold chain”

• NEW DRUG DEVELOPMENT
STRATEGIES TO REDUCE THREATS (5)

• DECREASE INAPPROPRIATE DRUG USE
  – Improve education of clinicians and public
  – Decrease antimicrobial use in agriculture and food production

• IMPROVE VECTOR AND ZOONOTIC CONTROL
  – Develop new safe insecticides
  – Develop more non-chemical strategies e.g. organic strategies

• BETTER AND MORE WIDESPREAD HEALTH EDUCATION (e.g., west Nile virus; bed nets, mosquito repellent)
STRATEGIES TO REDUCE THREATS (6)

• DEVELOPMENT OF PREDICTIVE MODELS BASED ON:
  – Epidemiologic data
  – Climate change surveillance
  – Human behavior

• ESTABLISH PRIORITIES
  – The risk of disease
  – The magnitude of disease burden
    • Morbidity/disability
    • Mortality
    • Economic cost
  – REDUCE POTENTIAL FOR RAPID SPREAD
  – DEVELOP MORE FEASIBLE CONTROL STRATEGIES
Figure 2. Components of a predictive model of infectious disease based on satellite imaging to assess environmental change. SST, sea surface temperature; SSH, sea surface height.
STRATEGIES TO REDUCE THREATS (5)

• Develop new strategies requiring low-cost technology
• Social and political mobilization of communities
• Greater support for research
• Reduce poverty and inequality
ESSENTIAL FACTORS FOR DISEASE ERADICATION

- Knowledge of its epidemiology and transmission patterns/mode
- Availability of effective tools for diagnosis, treatment and prevention
- Knowledge of local cultural and political characteristics
- Community acceptance and mobilization
- Political will and leadership
- Adequate and sustained funding
ROLE OF THE PUBLIC HEALTH PROFESSIONAL (1)

• Establish surveillance for:
  – Unusual diseases
  – Drug resistant agents

• Assure laboratory capacity to investigate new agents (e.g., high-throughput labs)

• Develop plans for handling outbreaks of unknown agents

• Inform physicians about responsible antimicrobial use
ROLE OF THE PUBLIC HEALTH PROFESSIONAL (2)

- Educate public about
  - Responsible drug compliance
  - Emergence of new agents
  - Infection sources
    - Vector control
    - Malaria prophylaxis
- Be aware of potential adverse effects of intervention strategies
- Anticipate future health problems
- Promote health and maximize human functional ability
The figure shows peak influenza activity for the United States by month for the 1976-77 through 2008-09 influenza seasons. The month with the highest percentage of cases (nearly 50%) was February, followed by January with 20% and March and December, with approximately 15% of all cases.

Source: Influenza Division, CDC.
Clinical Outcomes of Influenza Infection

- **Asymptomatic**
- **Symptomatic**
  - Respiratory syndrome - mild to severe
  - Gastrointestinal symptoms
  - Involvement of major organs - brain, heart, etc.
  - Death
Virology of Influenza

Subtypes:
A - Causes outbreak
B - Causes outbreaks
C - Does not cause outbreaks
Immunogenic Components of the Influenza Virus

- Surface glycoproteins, 15 hemagglutinin (H1-H15), nine neurominidases (N1-N9)
- H1-H3 and N1N2 established in humans
- Influenza characterized by combination of H and N glycoproteins
  - 1917 pandemic - H1N1
  - 2004 avian influenza - H5N1
  - 2009 H1N1
- Antigenic mix determines severity of disease
- Human response specific to hemagglutinin and neurominidase glycoproteins
Figure 1. Natural hosts of influenza viruses

Genetic Changes in Influenza

- **Antigenic drift** - results of errors in replication and lack of repair mechanism to correct errors

- **Antigenic shift** - reassortment of genetic materials when concurrent infection of different strains occurs in the same host
Figure 2. Origin of antigenic shift and pandemic influenza. The segmented nature of the influenza A genome, which has eight genes, facilitates reassortment; up to 256 gene combinations are possible during coinfection with human and non-human viruses. Antigenic shift can arise when genes encoding at least the haemagglutinin surface glycoprotein are introduced into people, by direct transmission of an avian virus from birds, as occurred with H5N1 virus, or after genetic reassortment in pigs, which support the growth of both avian and human viruses.
Surveillance for Flu
2009 H1N1 Flu Situation Update
September 18, 2009, 5:30 PM ET

http://www.cdc.gov/h1n1flu/updates/us/

Map: Weekly Influenza Activity Estimates Reported by State and Territorial Epidemiologists
(Activity levels indicate geographic spread of both seasonal and 2009 influenza A [H1N1] viruses)
(Posted September 18, 2009, 5:30 PM ET, for Week Ending September 12, 2009)

*This map indicates geographic spread and does not measure the severity of influenza activity.
Percentage of Visits for Influenza-like Illness (ILI) Reported by the U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet), National Summary 2008-2009 and Previous Two Seasons (Posted September 18, 2009, 5:30 PM ET, for Week Ending September 12, 2009)

http://www.cdc.gov/h1n1flu/updates/us/
The H1N1 Epidemic
Preparing for the flu

Healy M. Vaccinate or risk it? Parents weigh choice. LA Times, 14 Sept, 2009; latimes.com/health
Rate per 100,000 population by age group of laboratory-confirmed novel influenza A(H1N1), 24 JUL 2009 (n=37,030*)

*Excludes 6,741 cases with missing ages.
Deaths by age group of laboratory-confirmed novel influenza A(H1N1), 24 JUL 2009 (n=302)

Number of deaths

- 0-4 Yrs: 7 (2%)
- 5-24 Yrs: 48 (16%)
- 25-49 Yrs: 124 (41%)
- 50-64 Yrs: 71 (24%)
- ≥65 Yrs: 26 (9%)
- Unknown: 26 (9%)
Factors Influencing the Response to Influenza

- Age
- Pre-existing immunity (some crossover)
- Smoking
- Concurrent other health conditions
- Immunosuppression
- Pregnancy
**Origin of the H1N1 virus**

The pandemic strain of H1N1 influenza is descended from a never-before-seen combination of human and animal flu viruses. The two most important genes — the ones that make the proteins hemagglutinin, or H, and neuraminidase, or N — both originated in pigs.

1. **In the 1990s**, the classical swine flu mixed with other flu viruses from birds and people and formed a new version of swine flu that swept through U.S. hog farms.

2. **By 2000**, that virus had mixed again with the classical swine flu virus.

3. **By 2008**, the virus mixed yet again with another swine flu strain from Eurasian pigs.

4. **H1N1 strain**: Scientists think the resulting H1N1 virus jumped to people by November 2008. Human infections were first noticed in March 2009 and identified in April.

*The genome of the influenza virus consists of eight genes. If two viruses infect the same cell, they can trade some of these genes.*


Kaplan K. How the new virus came to be. LA Times, 14 Sept, 2009; latimes.com/health
EPIDEMIOLOGY AND BIOLOGY OF H5N1 INFLUENZA
Characteristics of H5N1 Avian Influenza

1. Highly infectious and pathogenic for domestic poultry
2. Wild fowl, ducks asymptomatic reservoir
3. Now endemic in poultry in Southeast Asia
4. Proportion of humans with subclinical infection unknown
5. Case fatality in humans is >50%
Spread of H$_5$N$_1$ Avian Influenza

- South Korea
- Vietnam
- Japan
- Thailand
- Cambodia
- China & Laos
- Indonesia
- Resurgence in Thailand, Vietnam, Cambodia and Indonesia
- Europe, Africa

December, 2003
- January
- 2004
- Feb
- 2005-6 2006-7
<table>
<thead>
<tr>
<th>Sex</th>
<th>Age (yrs)</th>
<th>Signs and symptoms on admission*</th>
<th>Subsequent complications</th>
<th>Initial investigative findings</th>
<th>Treatment and outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>7</td>
<td>Fever, cough, sore throat for 6 days. Dyspnea on day 6; CXR† bilateral interstitial infiltrates.</td>
<td>Respiratory failure on day 10; cardiac failure, pneumothorax, ARDS§, gastrointestinal bleeding.</td>
<td>Leukocytes: 4,100/μL Lymphocytes: 1,440/μL Platelets: 304,000/μL AST†: 120, ALT**: 52</td>
<td>Oseattamivir on days 18–22. Died on day 29.</td>
</tr>
<tr>
<td>Male</td>
<td>6</td>
<td>Fever, cough, rhinorrhea for 5 days. Dyspnea on day 6; CXR patchy infiltrates in right lower lobe.</td>
<td>Respiratory failure on day 8; hepatitis, ARDS.</td>
<td>Leukocytes: 1,200/μL Lymphocytes: 624/μL Platelets: 89,000/μL AST: 790, ALT: 150 Proteinuria: ≥3</td>
<td>Oseattamivir on days 18–20. Died on day 20.</td>
</tr>
<tr>
<td>Male</td>
<td>6</td>
<td>Fever, cough, rhinorrhea, sore throat for 4 days. Dyspnea on day 5; CXR multifocal patchy infiltrates.</td>
<td>Respiratory failure on day 6; pneumothorax, ARDS.</td>
<td>Leukocytes: 2,200/μL Lymphocytes: 638/μL Platelets: 150,000/μL AST: 175, ALT: 43</td>
<td>Died on day 18.</td>
</tr>
<tr>
<td>Female</td>
<td>58</td>
<td>Fever, cough, sore throat, myalgia for 2 days. Dyspnea on day 2; CXR multifocal patchy infiltrates.</td>
<td>Respiratory failure on day 4; cardiac failure, renal failure, ARDS.</td>
<td>Leukocytes: 5,680/μL Lymphocytes: 454/μL Platelets: 185,000/μL BUN††: 39 mg/dL Creatinine: 2.3 mg/dL</td>
<td>Died on day 8.</td>
</tr>
<tr>
<td>Male</td>
<td>6</td>
<td>Fever, cough, sore throat, myalgia for 4 days. Dyspnea on day 5; CXR multifocal patchy infiltrates.</td>
<td>Respiratory failure on day 5; cardiac failure, renal failure, ARDS.</td>
<td>Leukocytes: 2,900/μL Lymphocytes: 696/μL Platelets: 87,000/μL AST: 280, ALT: 50 BUN: 54 mg/dL Creatinine: 4.6 mg/dL</td>
<td>Oseattamivir on days 5–8. Died on day 8.</td>
</tr>
</tbody>
</table>

* No patients had an underlying illness reported.
† Chest radiograph.
§ Acute respiratory distress syndrome.
†† Aspartate aminotransferase.
‖ Alanine aminotransferase.
††† Blood urea nitrogen.
Intervention Strategies (H5N1)

- Culling (killing of infected flocks)
- Innovative surveillance strategies
  - Identification and analysis of human to human clusters
  - Characterization of strains
    * Necessity for vaccine development (Science 304:968-9, 5/2004)
- Vaccination of bird handlers (vaccine being developed)
- Vaccination of commercial bird flocks
Barriers to H5N1 Control

- Reservoir in wild birds and ducks
- Economic impact of culling of poultry stocks
- Popularity of “wet markets” promotes transmission within poultry and to other species (e.g., pigs)
- Resistance to antivirals and vaccines
- Mistrust of rich nations
Don’t get the flu vaccine!
Prevention and Control of Influenza

Recommendations of the Advisory Committee on Immunization Practices (ACIP), 2008

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Summary

This report updates the 2007 recommendations by CDC's Advisory Committee on Immunization Practices (ACIP) regarding the use of influenza vaccine and antiviral agents (CDC. Prevention and control of influenza: recommendations of the Advisory Committee on Immunization Practices [ACIP]. MMWR 2007;56[No. RR-6]). The 2008 recommendations include new and updated information. Principal updates and changes include 1) a new recommendation that annual vaccination be administered to all children aged 6 months through 18 years, beginning in the 2008–09 influenza season, if feasible, but no later than the 2009–10 influenza season; 2) a recommendation that annual vaccination of all children aged 6 months through 4 years (59 months) continues to be a primary focus of vaccination efforts because these children are at higher risk for influenza complications compared with older children; 3) a new recommendation that either inactivated influenza vaccine or live, attenuated influenza vaccine (LAIV) be used when vaccinating healthy persons aged 2 through 49 years (the previous recommendation was to administer LAIV to persons aged 5–49 years); 4) a recommendation that vaccines containing the 2008–09 trivalent influenza virus strains A/Brisbane/59/2007 (H1N1)-like, A/Brisbane/10/2007 (H3N2)-like, and B/Florida/4/2006-like antigens be used; and 5) new information on antiviral resistance among influenza viruses in the United States. Persons for whom vaccination is recommended are listed in boxes 1 and 2. These recommendations also include a summary of safety data for U.S.-licensed influenza vaccines. This report and other information are available at CDC's influenza website (http://www.cdc.gov/flu), including any updates or supplements to these recommendations that might be required during the 2008–09 influenza season. Vaccination and health-care providers should be alert to announcements of recommendation updates and should check the CDC influenza website periodically for additional information.
RECOMMENDATIONS TO PREVENT FLU
STRATEGIES TO PREVENT FLU (1)

• COVER MOUTH AND NOSE WHEN SNEEZING
• WASH HANDS FREQUENTLY WITH SOAP AND WATER OR ALCOHOL
• AVOID TOUCHING EYES, NOSE AND MOUTH
• AVOID CONTACT WITH SICK PEOPLE
• AVOID CROWDED CONGESTED ENVIRONMENTS
STRATEGIES TO PREVENT FLU (2)

• IF SICK STAY HOME, DON’T EXPOSE OTHERS
• FOLLOW PUBLIC HEALTH ADVICE; e.g. school closures etc.
• GET FLU SHOT(S)
• TAKE ANTIVIRAL DRUGS IF PHYSICIAN RECOMMENDS