

Confronting Twenty First Century Plagues

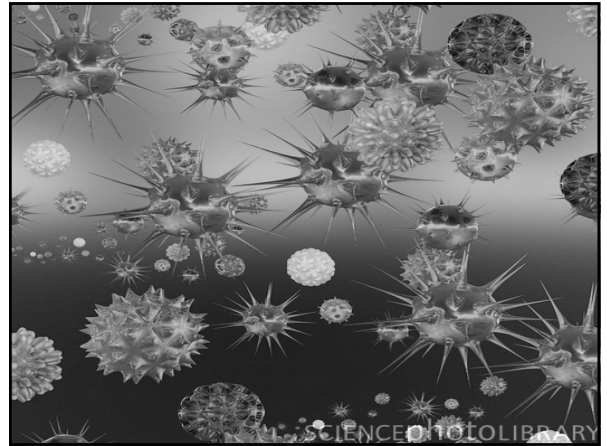
Prof. Robert Pratt, Thames Valley University
A Webber Training Teleclass

Confronting 21st Century Plagues

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Director, Richard Wells Research Centre
Thames Valley University

Hosted by Paul Webber
paul@webbertraining.com

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Concordance

Commensalism

Mutualism

Parasitism

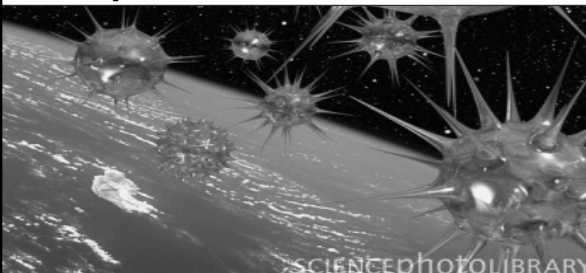


Infectious Diseases

- **Endemic** – infection/disease that is present (prevalent) in a population or geographical area at all times
- **Epidemic** – outbreak of an infectious disease that spreads rapidly and widely
- **Pandemic** – epidemic that occurs over a wide geographical area

Pandemics

Past, Current & Future



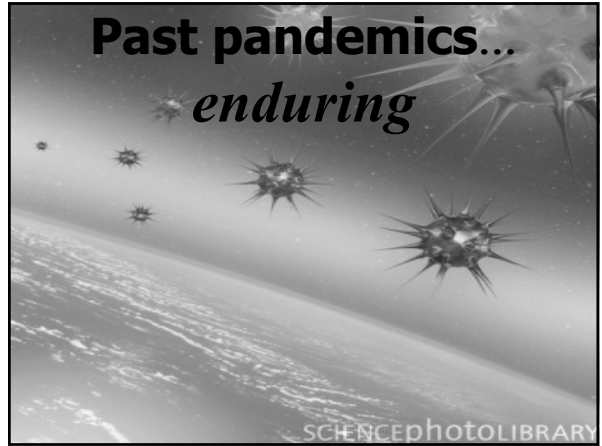
Forces driving pandemics

- **Globalization**
 - International air travel & nautical traffic
- **Modern Medical Practices**
- **Accelerating Urbanization**
- **Environmental factors**
 - global warming
- **Changes in social and behavioural pattern**

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Infectious Diseases

- 20th Century optimism that infectious diseases were 'conquered' now fading
- Cause great morbidity and disability throughout the world, incl. 14 millions deaths each year
- Some cause epidemics on a regional or global scale ⇒ **pandemics**



- Blood
- Frogs
- Gnats
- Flies
- Cattle disease
- Boils
- Hail
- Locust
- Darkness
- Death to the first born



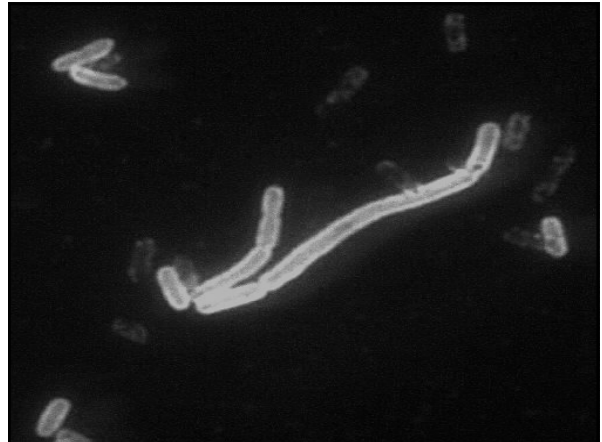
Four Horsemen of the Apocalypse

Pestilence

The 4th Horseman

And I looked and behold a pale horse; and his name that sat on him was Death, and Hell followed with him.

King James Version of the Bible, Revelation 6 (8)



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Plague

- Caused by the bacterium *Yersinia pestis*
- Habitat: gut of certain rodents
- Three clinical forms: bubonic, septicaemic, pneumonic***
- Transmitted by rat fleas - *Xenopsylla cheopis* or *Pulex irritans*



Plague Pandemics

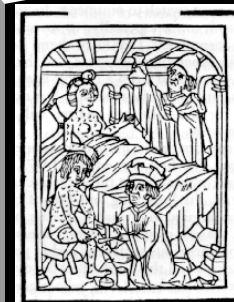
- Justinian Plague A.D. 541-42 ↷
- France A.D. 588
- China 1330s ↷
- Western Asia and Europe 1347 ↷
- England 1348 (Black Death)
- Great Plague of London 1665
- China 1860s ↷
- Asia and Africa



Plague Pandemics

- Responsible for >200 million deaths
- Transformed societies
- Remains endemic throughout the world today

Medieval & contemporary Pox

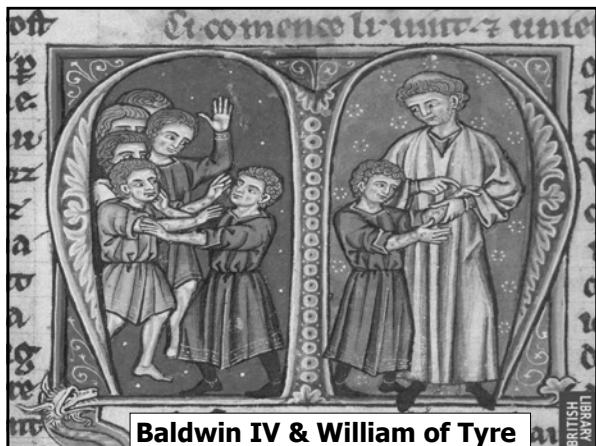


Syphilis

- *Treponema pallidum*
- Ancient human disease
- European pandemic in 15th C. (**Great Pox**)
- By 17th C., 25% of Europeans were infected
- Not brought under control until the availability of penicillin in 1945

Smallpox

- **Variola virus**
- **Africa/Asia 12,000 years ago**
- **European pandemic in 18th C.**
- **20th C. – 300 million people died of small pox**
- **Vaccine - 1776**
- **Global eradication - 1977**



Baldwin IV & William of Tyre

Leprosy

- **Known since recorded history & reported B.C. 600 in Egypt**
- *Mycobacterium leprae*
- **Airborne transmission: not highly infectious**
- **Today, decreasing in incidence worldwide (410K new cases in 2004)**
- **Multidrug Therapy dapsone, clofazimine, rifampicin**

Polio Poliovirus

- Evidence of polio in Egypt 3000 years ago
- Epidemics in cities in the developed world in 20th C.
- Vaccines available in the 1960s
- Now rare



Influenza

O4rthomyxoviridae

Influenza viruses

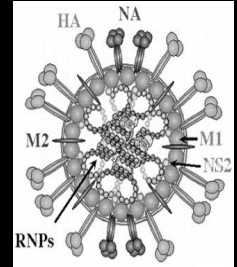
3 types

- **A** – cause epidemics and occasionally **pandemics** – there is an animal reservoir, e.g. birds
- **B** – only cause epidemics and does not involve animal hosts
- **C** – does not cause epidemics and give rise to only minor respiratory illness

Influenza virus A

subtypes

- Divided into subtypes based on two surface proteins
- hemagglutinin (H) & neuraminidase (N)



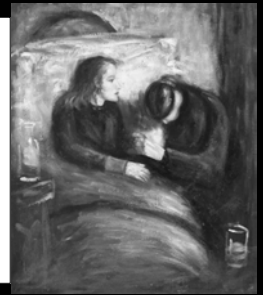
Influenza

- Mentioned by Hippocrates B.C. 412
- First European pandemic A.D. 1173-4
- Between A.D. 1580 – 1900: 28 pandemics
- Greatest pandemic 1918-19



20th Century Influenza Pandemics

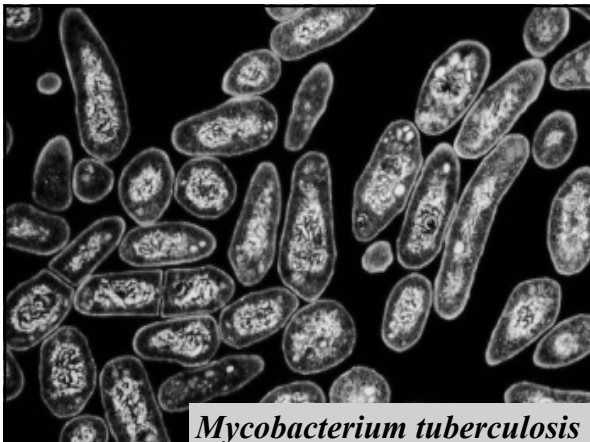
- † † • Spanish Flu 1918 (H1N1)
- Asian Flu 1957 (H2N2)
- Hong Kong Flu 1968 (H3N2)



Tuberculosis

- “The captain of all these men of death that came against him to take him away, was the **Consumption**, for it was that that brought him down to the grave.”

John Bunyan. (1680)
The life and death of Mr. Badman



Mycobacterium tuberculosis

TB in Europe

- Tuberculosis became the leading cause of death in most European countries by the beginning of the 19th Century
- Poor, urban people most affected but no one was immune



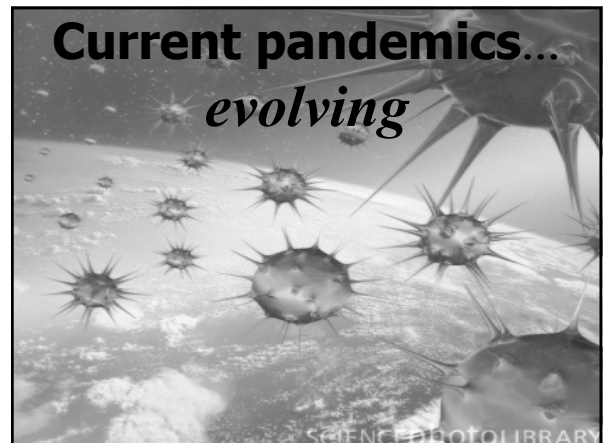
TB England & Wales

1851-1910

- 4 million people died of TB (13% of all recorded deaths)
- Most TB (90%) urban location and pulmonary manifestation

Tuberculosis in the world

- Spreading from Europe, TB responsible for global pandemics throughout the 19th and early 20th Centuries
- Known as the 'White Death'

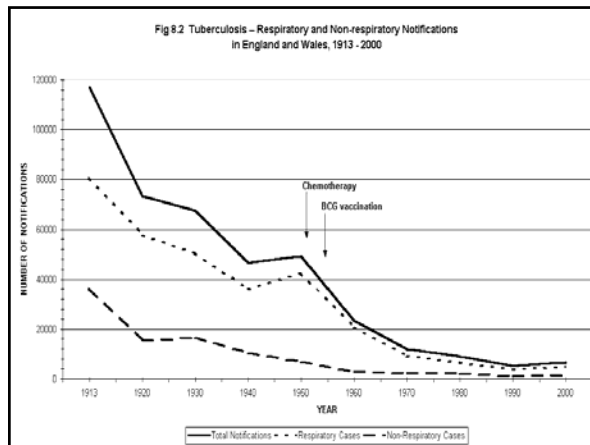


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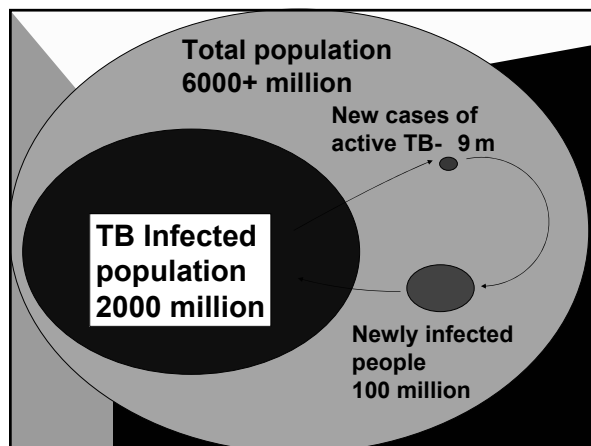
Tuberculosis

- Incidence fell in industrially developed world from early 20th Century
- Curative treatment become available in the late 1940s
- Nadir in incidence reached in England & Wales mid-1980s



Tuberculosis 2006

- One third of world population infected with *M. tuberculosis* complex
- 10% will develop active disease
- HIV infection will increase the incidence from 10% life-time risk to 10% per annum
- Each will infect 10-15 other people while they are infectious



Tuberculosis - 2004

- Annual global incidence
8,918,00
- Annual global prevalence
14,602,000
- Annual mortality
1,693,000

Drug Resistant TB

- Currently, most TB seen in the UK is drug-sensitive; however...
- Resistance to anti-tuberculosis drugs is common throughout the rest of the world
- There are 3 forms of drug resistance



Tuberculosis

Drug Resistance

- **Drug-resistant tuberculosis (DR-TB)** – resistant to one or more 1st line anti-tuberculosis drugs
- **Multidrug-resistant tuberculosis (MDR-TB)** – resistant to isoniazid and rifampicin



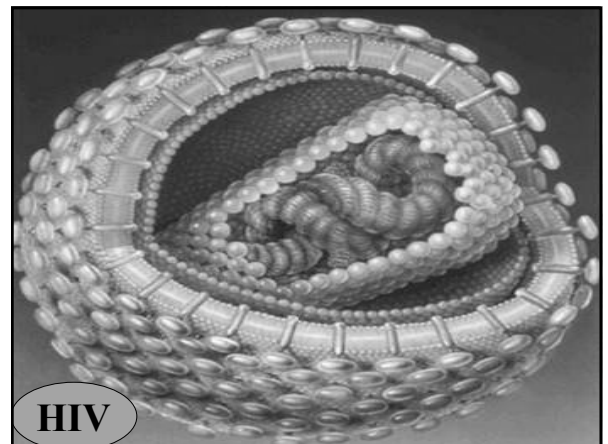
Tuberculosis

Drug Resistance

- **XDR-TB - extreme (extensively) drug-resistant tuberculosis**
- **MDR-TB that is also resistant to 3 or more of the 6 classes of second-line drugs**
- **Most cases are in HIV co-infected persons**

XDR-TB 2006

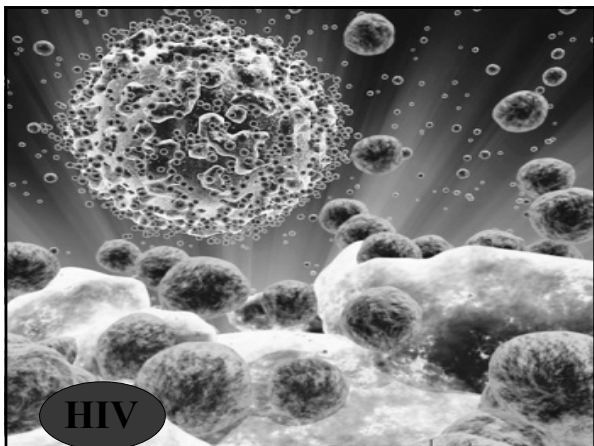
- **2% of all cases of TB are currently XDR, i.e., 180,000 cases**
- **Cases of XDR-TB reported in:**
 - USA
 - South Africa
 - Latvia
 - Russia



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HIV infection & AIDS

1981 - 2006

Pandemic Evolving

CENTERS FOR DISEASE CONTROL

June 5, 1981 / Vol. 30 / No. 21

MMWR

MORBIDITY AND MORTALITY WEEKLY REPORT

Epidemiologic Notes and Reports

- 249 Dengue Type 4 Infection in U.S. Travelers - Caribbean
- 250 Pneumocystis Pneumonia - Los Angeles
- 251 Measles - United States, First 20 Weeks
- 252 Risk Factor Prevalence Survey - Utah
- 253 Surveillance of Childhood Lead Poisoning - United States
- 259 International Notes
- 261 Quarantine Measures

... Notes and Reports

... Caribbean

CENTERS FOR DISEASE CONTROL

July 3, 1981 / Vol. 30 / No. 25

MMWR

MORBIDITY AND MORTALITY WEEKLY REPORT

Epidemiologic Notes and Reports

- 306 Kaposi's Sarcoma and Pneumocystis Pneumonia Among Homosexual Men - New York City and California
- 308 Cutaneous Larva Migrans in American Tourists - Martinique and Mexico
- 314 Measles - U.S. Military

Epidemiologic Notes and Reports

Kaposi's Sarcoma and Pneumocystis Pneumonia

AIDS Cases end 1981

< 1,000 worldwide

25 years later →

UNAIDS

Global estimates for adults and children, 2005

- People living with HIV 38.6 million [33.4 - 46.0 million]
- New HIV infections in 2005 4.1 million [3.4 - 6.2 million]
- Deaths due to AIDS in 2005 2.8 million [2.4 - 3.3 million]

+ 25 million AIDS-related deaths

0606 e 2

381 persons will become infected during this lecture

Over 11 000 new HIV infections a day in 2005

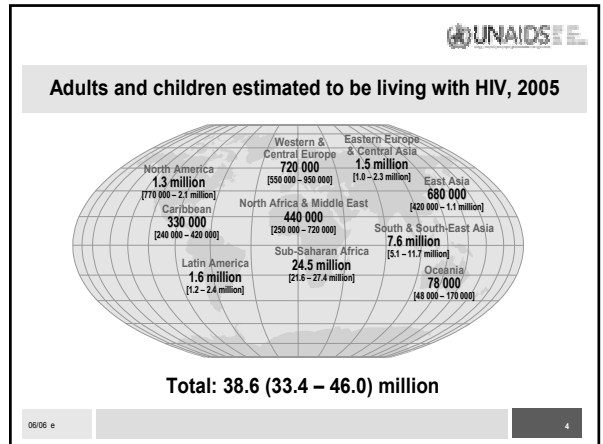
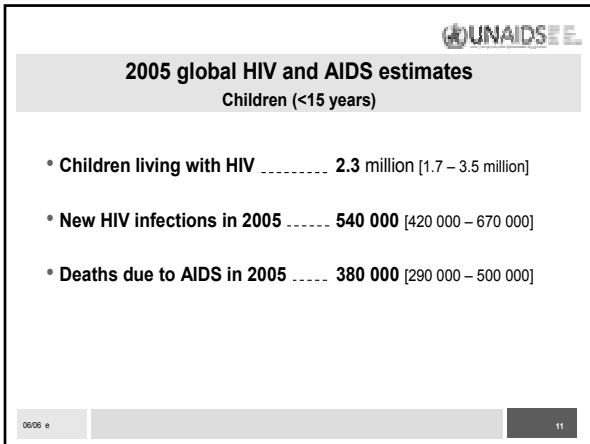
- More than 95% are in low and middle income countries
- About 1500 are in children under 15 years of age
- About 10 000 are in adults aged 15 years and older of whom:
 - almost 50% are among women
 - over 40% are among young people (15-24)

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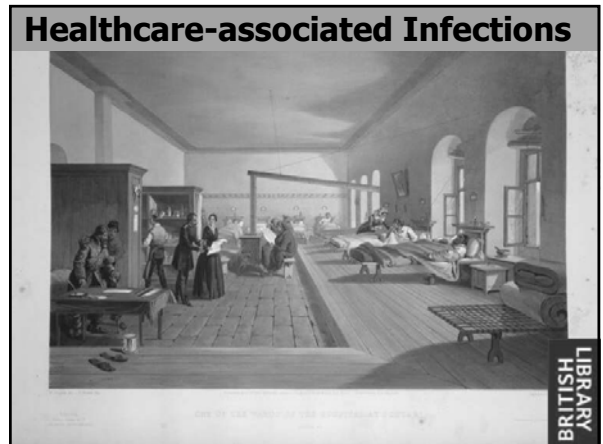
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Multidrug-resistant HIV-1 infection

- Primary multidrug-resistant HIV-1 infection identified in a newly diagnosed person in NYC 2005
- Rapid progression to end-stage disease (AIDS) ≤20 months

CDC. (28/7/06) *MMWR* 55(29):793



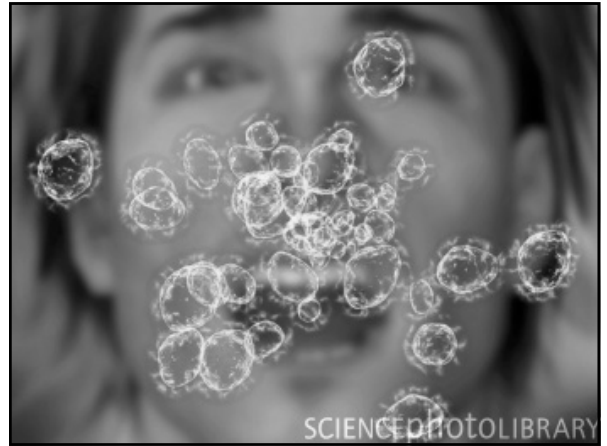
Healthcare-associated Infections

- Affect 5-10% of hospital inpatients
- Many are serious and potentially fatal
- Some are drug-resistant
- All are expensive and distressing
- Many are preventable



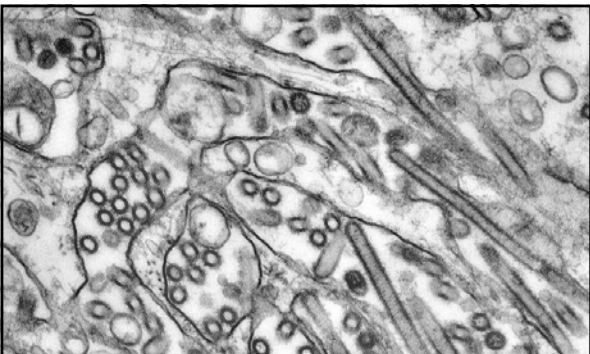
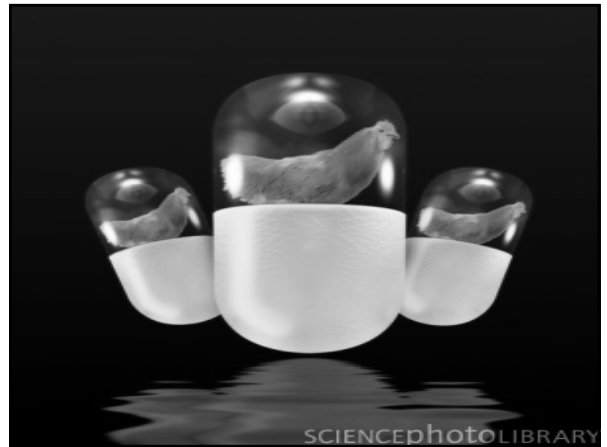
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SARS-CoV



Severe Acute Respiratory Syndrome SARS

- Caused by the SARS-associated coronavirus (SARS-CoV)
- **Transmitted by respiratory droplets and close personal contact**
- Asian Outbreak in 2003 spread globally
- **8000 affected (10% mortality)**
- No further cases since 2004



Avian influenza A H5N1 viruses (seen in gold)

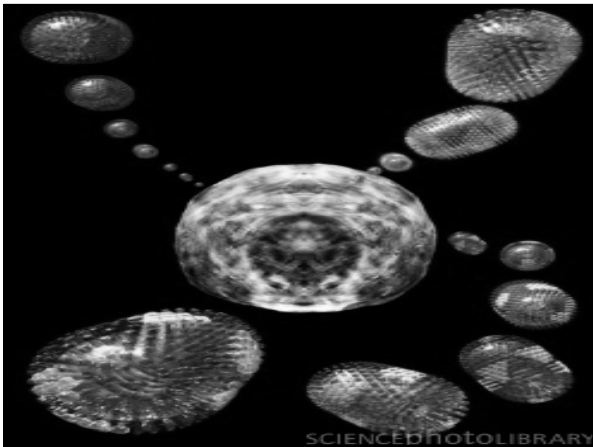
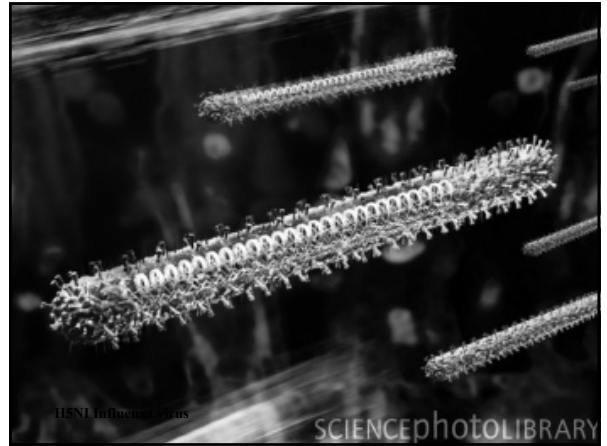
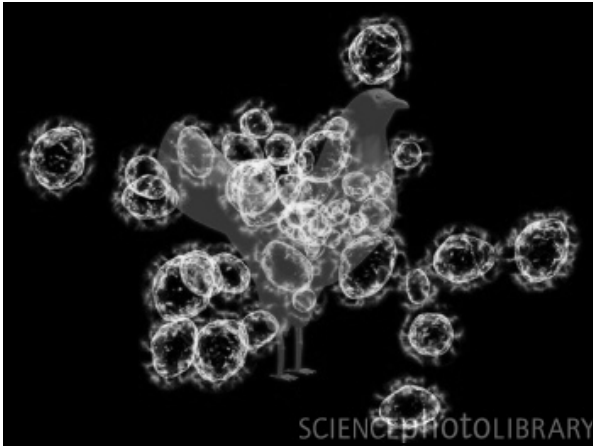
Centers for Disease Prevention & Control. C. Goldsmith, J. Katz, and S. Zaki 1997

Avian Influenza Virus


- **Current bird flu caused by Influenza A virus subtype H5N1 - began in 2003**
- **247 people have been infected with H5N1 – 144 have died**
- **No solid evidence of transmission among people, but...**
- **Could occur if H5N1 mixes with influenza A human subtypes**

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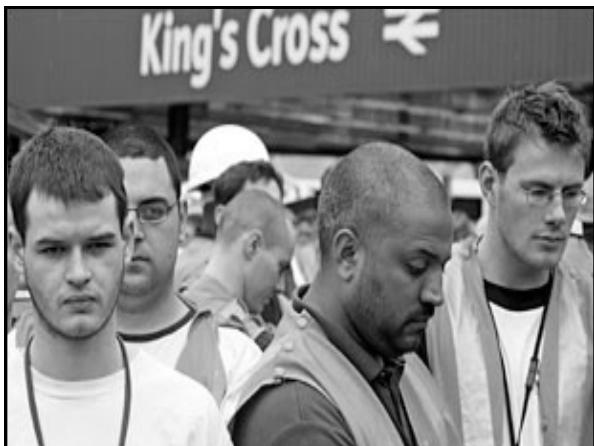
Emerging Infections



- This may be the twilight of the antibiotic era
- Antimicrobial resistance will increase
- Clinical effectiveness will decrease
- Finally →



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Bioterrorism

The threat from terrorism is real; it is here, it is deadly and it is enduring

Peter Clarke
Head, Anti-terrorism Branch
Scotland Yard [Aug 2006]

Joshua Lederberg

The microbe that felled one child in a distant continent yesterday can reach yours today and seed a global pandemic tomorrow.

JAMA 1998;260:684

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Thank you

Richard Wells Research Centre
Joanna Briggs Institute Collaborating Centre
University of Adelaide
Thames Valley University
London

The Next Few Teleclasses

- | | |
|-------------|--|
| February 8 | <i>Influenza – Of Poultry, Pets and People</i>
... with Dr. Corrie Brown, University of Georgia |
| February 15 | <i>Fresh Produce and Human Pathogenicity</i>
... with Prof. Keith Warriner, Guelph University |
| February 21 | <i>Infection Control in the Endoscopy Clinic</i>
... with Dr. Richard Everts, Nelson Marlborough Health Service |
| February 22 | <i>Best Practice for Hospital Construction Management</i>
... with Andrew Streifel, University of Minnesota |
| March 6 | <i>Tuberculosis in the Modern Age</i>
... with Evonne Curran, Health Protection Scotland |

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