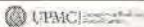


**The Challenge of Infectious Diseases in the 21<sup>st</sup> Century**

D.A. Henderson, MD, MPH  
Center for Biosecurity, U. of Pittsburgh Medical Center

**World Congress of Nephrology**  
Singapore  
25 June 2005

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- *Man's only competitors for the dominion of the planet are the viruses – and the ultimate outcome is not foreordained.*

*Joshua Lederberg*  
Nobel Laureate, USA

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**The competitors are increasing**

- New and emerging infections have been increasing in number
- The sources of the threat:
  - Natural mutation of microbes
  - Emergence of organisms from remote areas
  - Biological terrorism
- The threats are international

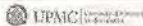
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**"Conquest" of the infectious diseases**  
1950s-70s

- Dramatic changes post WW II
  - Vaccines
  - Antibiotics
  - Nutrition
  - Housing
  - Sanitation
- Decline or elimination of many diseases in the industrialized world
  - Smallpox, diphtheria, whooping cough, tetanus, polio, measles, *et alia*

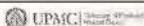
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- *"One can think of the middle of the 20<sup>th</sup> century as the end of one of the most important social revolutions in history, the virtual elimination of the infectious diseases as a significant factor in social life"*

*Sir Macfarland Burnet*  
Nobel Laureate, Australia


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**A cloud on the horizon**

- June, 1981 – first cases of AIDS diagnosed
- April, 1984 – HIV is identified  
"the triumph of science over a dread disease"  
"a vaccine will be available in 2 years"
- 2005 -a world-wide pandemic in progress
  - 4<sup>th</sup> leading cause of death world-wide
  - No vaccine
  - No curative drug

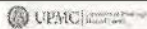
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## HIV is not the only surprise

- 1989 Conference on Emerging Infections
- An illustrative additional inventory
  - SARS – from Asia
  - Monkeypox – from Africa
  - TSE – “mad cow” disease – from UK
  - *H5N1 influenza* – from Asia
- More than 30 new agents in 25 years

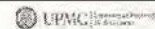
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## Newly emerging hemorrhagic agents

- Filoviruses
  - Marburg
  - Ebola
- Arena viruses
  - Lassa
  - New world hemorrhagic viruses
    - Machupo, Junin, et al
- E. Coli O:157

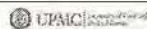
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## Why now?

- Growth in urban populations
  - Population of cities
    - 1975 – 5 with more than 10,000,000
    - 2004 – 20 with more than 10,000,000
    - 6 with more than 15,000,000
  - By 2015
    - 5 cities with more than 20,000,000 persons
    - 55% of world's population in urban areas

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## Why now?

- Growth in urban populations
- International travel
  - Volume
    - 18 million commercial air flights yearly
    - 1.6 billion air passengers per year
  - Remote area destinations
  - All cities less than 36 hours from others

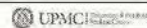
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## Why now?

- Growth in urban populations
- Travel
- Growth of hospitals in endemic areas
  - Major sites for disease distribution
  - Problem of blood borne diseases
  - Development of antibiotic resistance

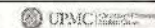
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## Why now?

- Growth in urban populations
- Travel
- Growth of hospitals in endemic areas
- Food supply
  - Internationalized
  - Industrialized
    - Animal husbandry
    - Food processors

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## Intentional release of biological agents

- A threat, largely ignored until 1995
  - Too difficult to grow organisms
  - Technologically difficult to disseminate
  - Not used because of a moral barrier

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## What has changed?

- Advances in biotechnology
  - Numbers and sophistication of laboratories
  - Information access – internet
  - Trained microbiologists
  - Aerosolization devices
- Growth of independent terrorist groups

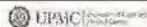
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## Watershed events Aum Shinrikyo -- Japan

- Religious cult released Sarin gas in Tokyo subway (1995)
  - Cult - previously unknown to intelligence
  - Thousands of members, well-funded
  - Tried to aerosolize anthrax and botulinum toxin throughout Tokyo at least 8 times
- *Concern – unknown, non-state sponsored organization, acting without concern for moral deterrents*

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## Watershed events USSR Bioweapons Program

- A secret program – unknown until 1989
- 1992 – Ken Alibek, Deputy Director of bioweapons program, deserts
- 1995 – Full scope of program apparent
  - 60,000+ persons in 50 different labs
- *Concern – Expertise and possibly specimens now dispersed world-wide. Still a secret program*

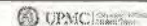
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## Bioweapons of greatest concern

- Smallpox
  - Anthrax
  - Plague
  - Tularemia
  - Botulinum Toxin
  - Hemorrhagic fevers  
Ebola, Marburg, etc.
- Agents that, if used, could threaten the integrity of civil government

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*Two agents  
of great concern*

"On May 8, 1980, WHO announced that smallpox had been eradicated..Soon after, smallpox was included in a list of biological weapons targeted for improvement in the 1981-85 Five -Year Plan.."

Where other governments saw a medical victory, the Kremlin perceived a military opportunity...the military command issued an order to maintain an annual stockpile of 20 tons (of smallpox virus)."

Alibek, 1998

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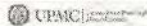


*Sigmond Bond*

## A recurrent menace -- influenza

- Influenza – 1918 – H1N1
  - Case-fatality rate - about 2 %
  - Deaths -- U.S. 550,000  
World >40,000,000
- Influenza – 2004/2005 – H5N1
  - ~97 cases/ 53 deaths

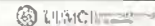
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## Early detection is critical but difficult

- A prevalent myth –  
There is a great deal of information available but officials are not collecting the data
- Possible sources for information?
  - Routine reports from health centers
  - Death certificates
  - Hospital reports
  - Laboratory reports

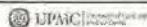
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## What does history tell us?

- Unusual outbreaks come to attention because of an alert physician and an effective investigation team
  - West Nile encephalitis
  - HIV/AIDS
  - Ebola hemorrhagic disease
  - SARS
  - Anthrax

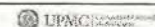
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## International reporting systems-- nascent beginnings

- World Health Organization
  - Global Public Health Information Network
  - Influenza surveillance program
  - Global Operations and Response Network
- Pro-med information exchange

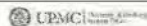
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## An agenda for the future

- Greatly strengthened network of international cooperation and communication
  - Cooperative international centers for epidemiology and laboratory diagnosis in all countries
  - A far more generously supported WHO effort to orchestrate the many national initiatives
- A focused research and development program

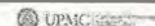
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- "Today's world is truly a global village, characterized by growing concentrations of people in huge cities, increasing global commerce and travel...One can safely predict that infectious diseases will continue to emerge...Depending on present policies and actions, this situation could lead to a catastrophic storm of microbial threats."

*Institute of Medicine/ National Academy of Sciences  
Microbial Threats to Health, 2003*

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- *International collaboration and cooperation is not an option for dealing with infectious diseases. It is a necessity if mankind is to survive.*

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*will require the best  
of us all, whatever the  
area of interest or specialization.*