

Plagues for the 21st Century a communications challenge

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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

The competition is increasing

- The increasing threats and challenges of infectious agents in the 21st century are only beginning to be appreciated
- The sources of the threat:
 - Natural mutation of microbes
 - Emergence of organisms from remote areas
 - Biological terrorism
- The threats are international
- Solutions will be neither simple nor inexpensive

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

- Dramatic changes post WW II
 - Vaccines
 - Antibiotics
 - Nutrition
 - Housing
 - Sanitation
- Marked decline or elimination of many diseases
 - Smallpox, diphtheria, whooping cough, tetanus, polio, measles, *et alia*

- *"One can think of the middle of the 20th 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

A cloud on the horizon

- June, 1981 – first cases of AIDS identified
- April, 1984 – HIV is identified
 - "the triumph of science over a dread disease"
 - "a vaccine will be available in 2 years"
- A world-wide pandemic in progress
 - 4th leading cause of death world-wide
 - No vaccine as of 2004
 - No curative drug as of 2004

HIV is not the only surprise

- 1989 Conference on Emerging Infections
- An illustrative partial new inventory
 - SARS – from Asia
 - Monkeypox – from Africa
 - Anthrax – from ?
 - TSE – “mad cow” disease -- ? a mutant
 - H5N1 influenza – from Asia

Increasing numbers of emerging diseases Major causes

- Growth in urban populations
 - Population of cities
 - 1975 – 5 with more than 10,000,000
 - 2000 – 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

Increasing numbers of emerging diseases Major causes

- Growth in urban populations
- International travel
 - Volume
 - 18 million commercial air flights (2000)
 - 1.1 billion air passengers
 - Increased proportion of children
 - Remote area destinations

Increasing numbers of emerging diseases Major causes

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

Increasing numbers of emerging diseases Major causes

- Growth in urban populations
- Travel
- Growth of hospitals in endemic areas
- Food supply
 - Internationalized -- 70% of some fruits and vegetables in U.S come from developing countries (e.g. green onions, cantaloupe)
 - Industrialized – Feed lots

Intentional release of Biological Agents

- A threat, largely ignored until 1995
 - Too difficult to grow organisms
 - Technologically difficult to disseminate
 - Seldom used because of an inherent moral barrier

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

Watershed events USSR Bioweapons Program

- A secret program – unknown until 1989
- 1992 – Ken Alibek, Deputy Director of USSR bioweapons program, defects
- Bioweapons program consisted of 60,000+ persons in 50 different labs.

"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, 1996

Russia today

- More than half of the scientists are no longer working in the old biological weapons labs. Many have gone abroad
- The major production lab for smallpox virus, at Sergiyev Posad, remains a secret facility
- Former Vice-Minister of Health Burgasov admits (2002) aerosolized smallpox was released on Voz Island in 1971 for studies

Possible Bioweapons of Greatest Concern

- | | |
|------------|--|
| ■ Smallpox | ■ Tularemia |
| ■ Anthrax | ■ Botulinum Toxin |
| ■ Plague | ■ Hemorrhagic fevers
Ebola, Marburg, etc. |

Agents that, if used, could threaten the integrity of civil government

A recurrent menace -- influenza

- Influenza – 1918 – H1N1
 - Case-fatality rate - about 1 %
 - Deaths -- U.S. 550,000
World >20,000,000
- Influenza – 2004 – H5N2
 - 35 cases/ 23 deaths

Problems of disease detection – international

- Possible sources for information?
 - Routine reports from health centers
 - Death certificates
 - Hospital reports
 - Laboratory reports
 - Special surveys
 - Special syndromic surveillance methods
- A prevalent myth –
There are many data sets available that could be utilized if only epidemiologists were more imaginative

Smallpox surveillance in India I

- Surveillance status after 5 years – 1967
 - >8,000 hospitals and health centers
 - Smallpox identified as priority disease and program by government
 - Reports of cases compulsory by international agreement
 - Cases reported – 83,975: estimated -- 840,000

Smallpox surveillance in India II

- National search (October, 1973)
 - 11,000 cases found; prior reporting – 500 cases/week
- New approach to methodology – 1973
 - Each Hospital/health center to report weekly – 8167
 - District epidemiologist to enforce reporting – 397 Districts
 - Surveillance teams to investigate all cases, to seek for others and to contain cases

Necessary for Effective Surveillance

- Program is necessarily disease specific
- National authorities must be persuaded
- Reporting sites must have continuing feed back to know that reports are really used
 - Regular contact with supervisors
 - Assistance in investigation and control
 - Published surveillance reports

What Does History tell us?

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

Elements for early disease detection

- Alert clinicians at major sites where very sick patients are likely to be seen
 - Access to current information
 - Plan for emergency contact with investigation team either in country or local region
- Investigation teams that respond promptly
 - Access to current information
 - Plan for emergency contact with consultants and laboratory
 - Plan for contact with international resources

Nascent beginnings

- World Health Organization
 - Global Operations and Response Network
 - Global Public Health Information Network
 - Influenza surveillance program
 - Caribbean Epidemiology Center (PAHO)
- DOD-Global Emerging Infections System (GEIS)
 - Includes medical research units in Peru, Egypt, Kenya, Thailand and Indonesia
- International Center for Diarrheal Diseases Research (Bangladesh)

An Agenda for the Future

- **Greatly strengthened network of international cooperation and communication**
 - **Cooperative international centers for epidemiology and laboratory diagnosis in most countries with access to current literature and international reports**
 - **Broader, more rapid communication between investigators**
 - **A far more generously supported WHO effort to orchestrate the many national initiatives**
- **A focused research and development program, especially for diagnostics**

- "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."

JOM Microbial Threats to Health, 2003

- "No responsible assessment of microbial threats to health in the 21st century could end without a call to action. The magnitude and urgency of the problem demand renewed concern and commitment. We have not done enough – in our own defense or in the defense of others."

JOM Microbial Threats to Health, 2003