Emerging and Re-emerging Infectious Diseases

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Infectious Disease– Trends

Infectious diseases keep emerging and re-emerging. It is therefore imperative that while efforts for control of well established communicable disease must continue relentlessly, a regular vigil must be maintained on the behavior of emerging and re-emerging diseases.
Definition of Emerging Infectious Disease

Newly identified & previously unknown infectious agents that cause public health problems either locally or internationally
Definition of Re-Emerging Infectious Disease

Infectious agents that have been known for time, had fallen to such low levels that they were no longer considered public health problems & are now showing upward trends in incidence or prevalence worldwide.
Infectious Diseases: A World in Transition

- AIDS
- Avian Influenza
- Ebola
- Marburg
- Cholera
- Rift Valley Fever
- Typhoid
- Tuberculosis
- Leptospirosis
- Malaria
- Chikungunya
- Dengue
- JE
- Antimicrobial resistance

Increasing

- Guinea worm
- Smallpox
- Yaws
- Poliomyelitis
- Measles
- Leprosy
- Neonatal tetanus

Decreasing
Factors Contributing To Emergence

AGENT

- Evolution of pathogenic infectious agents (microbial adaptation & change due to increasing virulence)
- Development of resistance to drugs
- Resistance of vectors to pesticides
Factors Contributing To Emergence

HOST
1. **Human demographic change**
   - Due to mass migration of people provoked by natural and man made disaster with resulting in temporary human settlements under unhygienic conditions.
   - Uninhibited and reckless industrialization leading to migration of labor population from rural to urban areas in unhygienic squatter settlements
   - International travel as a result of trade and tourism contributing to global dispersion of disease agents, disease reservoirs and vectors
2. **Human Behaviour**
   - Changes in lifestyle that promote unhealthy and risk prone behavior patterns affecting food habits, sexual practices, drug abuse etc.
3. **Human susceptibility to infection**
   - Declining immunity of as a result of HIV infection and Cancer
4. **Poverty and Social inequality**
Factors Contributing To Emergence

ENVIRONMENT

- **Climate & changing ecosystems**
  Climatic changes resulting from global warming inducing increased surface water evaporation, greater rainfall changes in the direction of bird migration and changes in the habitat of disease vectors are also contributory factors.

- **Economic development & Land use (urbanization, deforestation)**

- **Technology & industry (food processing & handling)**

- **Environmental sanitation**
  characterized by unsafe water supply, improper disposal of solid and liquid waste, poor hygienic practices and congested living conditions all contribute to emergence of infection.
Other factors

- International travel & commerce
- Breakdown of public health measure (war, unrest, overcrowding)
- Deterioration in surveillance systems (lack of political will)
Transmission of Infectious Agent from Animals to Humans

- >2/3rd emerging infections originate from animals— wild & domestic
- Emerging Influenza infections in Humans associated with Geese, Chickens & Pigs
- Animal displacement in search of food after deforestation/ climate change (Lassa fever)
- Humans themselves penetrate/ modify unpopulated regions— come closer to animal reservoirs/ vectors (Yellow fever, Malaria)
Climate & Environmental Changes

- Deforestation forces animals into closer human contact—increased possibility for agents to breach species barrier between animals & humans
- Natural disasters triggers outbreaks of infectious diseases (Malaria, Cholera)
- Global warming—spread of Malaria, Dengue, Leishmaniasis, Filariasis
Poor populations – major reservoir & source of continued transmission

Poverty – Malnutrition – Severe infectious disease cycle

Lack of funding, Poor prioritization of health funds, Misplaced in curative rather than preventive infrastructure, Failure to develop adequate health delivery systems
Uncontrolled Urbanization & Population Displacement

- Growth of densely populated cities—substandard housing, unsafe water, poor sanitation, overcrowding, indoor air pollution (>10% preventable ill health)
- Problem of refugees & displaced persons
- Diarrhoeal & Intestinal parasitic diseases, ARI
- Lyme disease (B. burgdorferi)—Changes in ecology, increasing deer populations, suburban migration of population
Human Behaviour

- Unsafe sexual practices (HIV, Gonorrhoea, Syphilis)
- Changes in agricultural & food production patterns – food-borne infectious agents (E. coli)
- Increased international travel (Influenza)
- Outdoor activity
Antimicrobial Drug Resistance

Causes:
- Wrong prescribing practices
- Non-adherence by patients
- Counterfeit drugs
- Use of anti-infective drugs in animals & plants
- Loss of effectiveness
- Community-acquired (TB, Pneumococcal) & Hospital-acquired (Enterococcal, Staphylococcal) infections
Antimicrobial resistance (AMR) threatens the effective prevention and treatment of an ever-increasing range of infections caused by bacteria, parasites, viruses and fungi, especially: TB, Malaria, hospital-acquired infections, Gonorrhoea & HIV.

Over the last 30 years, no major new types of antibiotics have been developed.
Antimicrobial Resistance

Consequences
- Prolonged hospital admissions
- Higher death rates from infections
- Requires more expensive, more toxic drugs
- Higher health care costs

Without effective anti–infective treatment, many standard medical treatments will fail or turn into very high risk procedures.
Examples of recent Emerging Diseases
# Examples of Emerging Diseases

<table>
<thead>
<tr>
<th>Year</th>
<th>Disease</th>
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<tbody>
<tr>
<td>1976</td>
<td>Legionnaire’s Ebola</td>
</tr>
<tr>
<td>1977</td>
<td>Campylobacter jejuni</td>
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<tr>
<td>1980</td>
<td>Human T-lymphotropic virus</td>
</tr>
<tr>
<td>1982</td>
<td>Escheriscia coli 0157:H7</td>
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<tr>
<td>1983</td>
<td>HIV</td>
</tr>
<tr>
<td>1988</td>
<td>Hepatitis E and Herpes virus</td>
</tr>
<tr>
<td>1989</td>
<td>Hepatitis C virus</td>
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<tr>
<td>1992</td>
<td>Vibrio cholerae 0139</td>
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<th>Disease</th>
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<tr>
<td>1993</td>
<td>Hanta virus</td>
</tr>
<tr>
<td>1995</td>
<td>HHV8 (Kaposi sarcoma virus)</td>
</tr>
<tr>
<td>1996</td>
<td>Creuzt Jakob Disease</td>
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<tr>
<td>1997</td>
<td>H5N1 avian flu</td>
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<tr>
<td>1999</td>
<td>West Nile fever</td>
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<tr>
<td>2003</td>
<td>SARS</td>
</tr>
<tr>
<td>2005</td>
<td>Human retroviruses HTLV3,4</td>
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<tr>
<td>2009</td>
<td>H1N1 swine flu</td>
</tr>
<tr>
<td>2012</td>
<td>Novel Influenza A H7N9 &amp; novel coronavirus</td>
</tr>
</tbody>
</table>
Emerging Zoonoses: Human–animal interface

Avian influenza virus

Bats: Nipah virus

Ebola virus

Marburg virus

Borrelia burgdorferi: Lyme

Deer tick (Ixodes scapularis)

Mostomys rodent: Lassa fever

Hantavirus Pulmonary Syndrome
SARS: The First Emerging Infectious Disease Of The 21st Century

No infectious disease has spread so fast and far as SARS did in 2003

SARS Cases
19 February to 5 July 2003

Total: 8,439 cases, 812 deaths, 30 countries in 7-8 months

Source: www.who.int/csr/sars
Lessons learnt from SARS

- An infectious disease in one country is a threat to all
- Important role of air travel in international spread
- Tremendous negative economic impact on trade, travel and tourism, estimated loss of $30 to $150 billion
Continued

- High level commitment is crucial for rapid containment
- WHO can play a critical role in catalyzing international cooperation and support
- Global partnerships & rapid sharing of data/information enhances preparedness and response
Highly Pathogenic Avian Influenza (H5N1)

- Since Nov 2003, avian influenza H5N1 in birds affected 60 countries across Asia, Europe, Middle-East & Africa
- >220 million birds killed by AI virus or culled to prevent further spread
- Majority of human H5N1 infection due to direct contact with birds infected with virus
Swine Flu
Influenza A (H1N1)

- March 18 2009 – ILI outbreak reported in Mexico
- April 15\textsuperscript{th} CDC identifies H1N1 (swine flu)
- April 25\textsuperscript{th} WHO declares public health emergency
- April 27\textsuperscript{th} Pandemic alert raised to phase 4
- April 29\textsuperscript{th} Pandemic alert raised to phase 5
- By May 5\textsuperscript{th} more than 1000 cases confirmed in 21 countries
- Stockpiling of antiviral drugs and preparations to make a new effective vaccine in May
- Global death toll estimated to be around 285,000.
Middle East respiratory syndrome coronavirus (MERS-CoV)

Middle East respiratory syndrome (MERS) is a viral respiratory disease caused by a novel coronavirus (MERS-CoV) that was first identified in Saudi Arabia in 2012. Coronaviruses are a large family of viruses that can cause diseases ranging from the common cold to Severe Acute Respiratory Syndrome (SARS). The virus appears to be circulating widely throughout the Arabian Peninsula. 906 laboratory-confirmed cases of MERS-CoV have been reported to the public health authorities worldwide, including 361 deaths as of 21 October 2014.
Ebola

Ebola is caused by viruses classified in the genus *Ebolavirus*, family *Filoviridae*. Five species of Ebola virus have been identified, namely Zaire, Sudan, Reston, Tai Forest and Bundibugyo. The fruit bat is the most likely natural reservoir of this virus. Up till now lab confirmed cases amount to 14,500 and 5000 deaths up to end October 2014.
Key Tasks in Dealing with Emerging Diseases

- Surveillance at national, regional, global level
  - epidemiological,
  - laboratory
  - ecological
  - anthropological
- Investigation and early control measures
- Implement prevention measures
  - behavioural, political, environmental
- Monitoring, evaluation
Bioterrorism

- Possible deliberate release of infectious agents by dissident individuals or terrorist groups
- Biological agents are attractive instruments of terror—easy to produce, mass casualties, difficult to detect, widespread panic & civil disruption
Continued

- Highest potential – Bacillus anthracis, C. botulinum toxin, F. tularensis, Y. pestis, Variola virus, Viral haemorrhagic fever viruses
- Likeliest route – aerosol dissemination
National surveillance: current situation

- Independent vertical control programmes
- Surveillance gaps for important diseases
- Limited capacity in field epidemiology, laboratory diagnostic testing, rapid field investigations
- Inappropriate case definitions
Continued

- Delays in reporting, poor analysis of data and information at all levels
- No feedback to periphery
- Insufficient preparedness to control epidemics
- No evaluation
Solutions

Public health surveillance & response systems

- Rapidly detect unusual, unexpected, unexplained disease patterns
- Track & exchange information in real time
- Response effort that can quickly become global
- Contain transmission swiftly & decisively
GOARN

Global Outbreak Alert & Response Network

- Coordinated by WHO
- Mechanism for combating international disease outbreaks
- Ensure rapid deployment of technical assistance, contribute to long-term epidemic preparedness & capacity building
Solutions

- Internet–based information technologies
  Improve disease reporting
  Facilitate emergency communications & Dissemination of information
- Human Genome Project
  Role of human genetics in disease susceptibility, progression & host response
Solutions

- Microbial genetics
  Methods for disease detection, control & prevention
- Improved diagnostic techniques & new vaccines
- Geographic Imaging Systems
  Monitor environmental changes that influence disease emergence & transmission
What skills are needed?

- Infectious diseases
- Public Health
- Telecommunication & Informatics
- Epidemiology
- International field experience
- Laboratory
- Information management

Multiple expertise needed!
Global Disease Intelligence:
A world on the alert
The Best Defense (Multi-factorial)

- Coordinated, well-prepared, well-equipped PH systems
- Partnerships—clinicians, lab scientists & PH doctors
- Improved methods for detection & surveillance
Continued

- Effective preventive & therapeutic technologies
- Strengthened response capacity
- Political commitment & adequate resources to address underlying socio-economic factors
- International collaboration & communication