

# Environment and Emerging Infections

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## **Abstract**

Emerging infection has become a major threat globally affecting the economy and public health of different nations. The steady increase in the incidence of these new infections across geographical border calls for immediate attention of different stakeholders. The major cause of these infections is linked with environment, advancement in technology and socio-economic factors such as Climate change and changing ecosystems, economic development, Land use such as urbanization and deforestation, advancement in technology and industry (food processing and handling), International travel and commerce, breakdown of public health system, war, unrest, overcrowding and deterioration in surveillance systems and lack of political will. The solution to these problems lies in Public health surveillance and response systems. This will rapidly detect unusual, unexpected and unexplained disease patterns. And in addition, facilitate tracking and exchanging information in real time for immediate response to prevent widespread of the new infections. Containment of emerging infections can also be done by eliminating the reservoirs of infection, breaking the chains of transmissions and protecting susceptible individuals.

## **Introduction**

Emerging infectious disease is an infectious disease whose incidence in humans has increased within the past two to four decades or threatens to increase in the near future and is caused by newly recognized infectious agent e.g. HIV/AIDS, SARS, Ebola, Hantavirus pulmonary syndrome, . It can also be defined as a newly identified or previously unknown infectious agents that cause public health problems either locally or internationally Re-emerging infectious diseases are infections that were previously controlled but have newly appeared in a

given population or have existed but are rapidly increasing in incidence or geographic range or infectious agents that have been known for some time, which had fallen to such low levels that they were no longer considered public health problems and are now showing upward trends in incidence or prevalence worldwide.

## **Examples of Emerging Infectious Diseases**

- Zika virus is a Flavi virus, spread by *Aedes* mosquitoes. Its name comes from the Zika Forest of Uganda, where the virus was first isolated in 1947.

- **Ebola virus** (first outbreaks in 1976 and the discovery of the virus in 1977).
- ***Legionella pneumophila*** (first outbreak in 1976 as Legionnaire disease and since associated with similar outbreaks linked to poorly maintained air conditioning systems).
- ***E. coli* O157:H7** (first detected in 1982, often transmitted through contaminated food, has caused outbreaks of hemolytic uremic syndrome).
- ***Borrelia burgdorferi*** (first detected in 1982 and identified as the cause of Lyme disease).
- **HIV/AIDS** (virus first isolated in 1983).
- **Hepatitis C** (first identified in 1989, now known to be the most common cause of post-transfusion hepatitis worldwide).
- **Influenza A (H5N1) virus** (well known pathogen in birds but first isolated from humans in 1997).
- **Severe Acute Respiratory Syndrome (SARS)** (first detected in 2003 in Asia); the first emerging infectious disease of the 21<sup>st</sup> century.
- **Swine Flu Influenza A (H1N1)** (first observed in 2009 in Mexico).

#### *Epidemiological Triad*

In epidemiology, disease causation is as result of interplay of 3 main forces: The agent, the host and the environment Any change in any of this factors can lead to emergence of an epidemic disease .Agents that can cause emerging infections are bacteria, virus, and protozoa, e.t.c. Factors in the host that can predispose a person to diseases includes: Physiological, anatomical, genetic and behavioral factors. Factors in the environmental that predispose a person to diseases are: Physical, chemical, biological, social, political, economic, population density and cultural factors.

#### **Transmission of Infectious Agent from Animals to Humans**

It is known that more than 2/3<sup>rd</sup> of emerging infections originates from animals- wild and domestic e.g. emerging Influenza infections in humans is associated with Geese, Chickens and Pigs. In addition, animal displacement in search

of food after deforestation/ climate change can cause diseases such as Lassa fever .

Furthermore, human encroachment or modification of forest regions makes man come closer to animal reservoirs/ vectors resulting into diseases like Yellow fever, Malaria).

#### *Steps in Emergence of Diseases includes*

- Emerging infection starts with introduction of infection into new host population causing disease of zoonotic origin like Ebola and Lassa infection. Bovine spongiform encephalitis (Mad cow disease).
- Following this is the establishment and further dissemination within new host population resulting into person to person transmission of infection.

#### **Factors Contributing To Emergence of New Infections**

##### *Climate change*

Activities of man like deforestation forces animals into closer human contact, which increases possibility for agents to breach species barrier between animals & humans.. Warm ocean current in the pacific can triggers natural disasters and related outbreaks of infectious diseases (Malaria, Cholera), while global warming spread diseases like Malaria, Dengue, Leishmaniasis and Filariasis.

##### *Poverty, Neglect and Weakening of Health Infrastructure*

Poverty and weakened health system can fuel the spread of new infections. For example inability to pay for treatment and inadequate health infrastructure, lack of facility to make diagnosis of new infections and poverty can encourage continuous transmission new disease.

In addition, lack of funds, poor prioritization of health funds, emphasis on curative rather than preventive medicine can also make emerging infections spread.

##### *Uncontrolled Urbanization and Population Displacement*

Uncontrolled urbanization leads to growth of densely populated cities which can produce

negative consequences such as overcrowding, poor sanitation, unavailability of safe water, indoor air pollution and construction of substandard housing. These problems can further be worsened by problem of population displacement with its attendant problems resulting in spread of diseases like diarrheal diseases, Intestinal parasitic diseases and acute respiratory Infection.

#### *Antimicrobial Drug Resistance*

Antimicrobial resistance can result due to wrong prescription practices and non-adherence by patients to drug prescription; others include use of counterfeit drugs and use of antibiotics drugs in animals and plants. These have caused mutations in known aetiological agents resulting in antibiotic resistance or antigenic shifts resulting in resistance in diseases like *N. gonorrhoea*, *M. tuberculosis* and influenza virus and development of multiple strains which can cause emergence of new disease.

#### *Ecological Changes*

Ecological changes due to climate changes can encourage breeding ground of Mosquito- borne diseases like malaria, dengue and Japanese encephalitis. Cholera growth in sea water and Leptospirosis in Nicaragua has emerged due to flooding.

#### *Agricultural or Economic Development*

Agricultural or economic development such as development of dams can cause emergence of Schistosomiasis, reforestation can increase lyme disease, cultivation can increase Junin virus causing Argentine haemorrhagic fever while deforestation can increase development of malaria.

#### *Human Demographics and Behaviour Change*

Human demographics and behaviour change such as population growth and migration, age distribution, rural to urban shift, war or civil disturbances, behavioural changes can cause spread of diseases like STDs. Use of Intravenous drug use can cause spread of HIV and hepatitis B virus. Other factors include changing work patterns e.g. men working in cities, families in rural areas can cause spread of HIV and other STDs.

#### *International Travel and Commerce*

International travel and commerce has been known to spread *Y. pestis* (plague) from Asia to Europe. New example is HIV which is spread along truck routes. Transport of vectors such as airport mosquitoes and rats are transport of agents from one continent to another. Zika virus which is spread by mosquito is another important emerging infection.

#### *Technology and Industry*

Technology and industry: blood transfusions and organ transplant has been known to spread hepatitis viruses and HIV. Others such as mass food processing has led to death of a large number of people from *E.coli* 0157:H7.

#### *Breakdown of Public Health Measures*

Breakdown of public health measures or deficiencies in health infrastructure such as reduced chlorination of water supply has resulted in cholera in Peru. Malfunctioning in water filtration system causing cryptosporidiosis in Milwaukee, decreased vaccination levels causing pertussis in places like UK.

#### *Bioterrorism*

Bioterrorism is a deliberate release of infectious agents by dissident individuals or terrorist groups. Introduction of biological agents are attractive instruments of terror and easy to produce leading to mass casualties, difficult to detect, but causing widespread panic and civil disruption. Examples of such agents are - *B. anthracis*, *C. botulinum toxin*, *F. tularensis*, *Y. pestis*, *Variola* virus and Viral haemorrhagic fever viruses. Likeliest route of dissemination is aerosol.

### **Strategic Ways of Controlling Emerging Diseases**

One of the strategic ways of controlling emerging infections is surveillance. Surveillance can take place at the national, regional and global level. This is done by collecting epidemiological, laboratory and ecological data which helps to determine the magnitude of the problem and associated contributory factors thereby enabling appropriate measures of control. Then early

control measures or implementation of preventive measures (such as behavioural, political, environmental controls) can be done. Monitoring and evaluation of all control measures put in place is an important part of intervention that must be factored into surveillance and strategic plans for effective control of emerging infections.

Problems of National surveillance includes independent vertical control programmes, surveillance gaps for important diseases, limited capacity in field epidemiology, laboratory diagnostic testing, rapid field investigations. Others include inappropriate case definitions, delays in reporting, poor analysis of data and information at all levels, no feedback to periphery, insufficient preparedness to control epidemics and no evaluation.

Public health surveillance and response systems should rapidly detect unusual, unexpected, unexplained disease patterns; track and exchange information in real time, response effort should be quick and widespread. Containment of transmission should be swift and decisive.

There is also Global Outbreak Alert & Response Network coordinated by WHO with mechanism for combating international disease outbreaks. This will ensure rapid deployment of technical assistance and contribute to long-term epidemic preparedness and capacity building. Internet-based information technologies should be deployed which will improve disease reporting, facilitate emergency communications and dissemination of information. Well-Coordinated, prepared and equipped Public Health systems should be instituted while partnerships- among clinicians, laboratory scientist and Public health agencies should be strengthened.

Improved methods for detection and surveillance should be put in place with effective preventive and therapeutic technologies. In addition, there is need to strengthened response capacity and political commitment by providing adequate resources to address underlying socio-economic factors and facilitate International collaboration and communication.

Control Measures for Domesticated Birds include putting up surveillance, biosecurity, restricting movement of birds, destroying birds humanely and disposing of carcasses properly.

Use of Vaccines for infection control measures in health care settings, Use of droplet protection masks, gowns and gloves. Limiting exposures (e.g. no new admissions), having ill workers stay in home and case management with antiviral agents.

### **Veterinary and Public Health Integration**

Bio-security measures should include keeping disease out of a farm in order to keep disease from spreading from one infected farm to another.

- Separate new poultry for 2 weeks
- Prevent unknown birds from entering flock.
- Control of human traffic into the farm
- Infected poultry and poultry products must be prevented from entering the food supply chain for human consumption.
- Compensation such as reimbursement for loss of birds by giving monetary compensation, restocking of stock encourages voluntary reporting of sick/dead birds and community participation in 'Stamping Out' emerging infection.

### **Prevention and Control of an Epidemic Disease**

The basic concept of control of an epidemic is to break the weakest link in the chain of transmission of the disease this can be done using 3 methods: these are elimination of reservoir, breaking of chain of transmission and protection of susceptible.

**Elimination of Reservoir:** can include elimination of environmental reservoir- such as air, water, soil etc or elimination of animal reservoir such keeping animals away from human habitation. Elimination of human reservoir can be done by early diagnosis and treatment, notification to appropriate authority for appropriate response, epidemiologic investigations, Isolation, disinfection and quarantine of exposed persons.

**Breaking the chain of transmission:** can be done breaking the mode of transmission through direct method and indirect method mode transmission

**Direct Mode of Transmission and Prevention**

- Contact-avoid close physical, skin contact with infected person e.g. in ebola.
- Droplet infection- infected person should cover mouth, while coughing, laughing, sneezing and talking e.g. in TB.
- Soil borne- use of shoe while walking e.g. in Tetanus.
- Bite by animal-keep animal away from man e.g. in Rabies.
- Trans-placental transmission- give treatment to mothers during pregnancy e.g. in HIV and Syphilis or termination pregnancy in rubella.

**Indirect Mode of Transmission and Prevention**

- Vehicle route- chlorinate water, pasteurize milk, disinfect fruits and vegetables, adopt food hygiene measures before, during and after cooking e.g. in cholera epidemic and screen blood e.g. to prevent hepatitis, HIV transmission.
- Vector route-control of vectors e.g. spraying of environment with insecticide e.g. to prevent malaria.
- Air borne-control of air pollution, control of infected dust e.g. in hospital wards, adequate ventilation to prevent TB.
- Fomites –disinfect fomites by washing clothes with chlorine or other disinfectant e.g. to prevent transmission of scabies.
- Hands and fingers- wash hands regularly e.g. to prevent cholera.

**Protection of Susceptible:** Those that are not infected should be protected by specific measures-using immuno-prophylaxis and chemoprophylaxis. General measures to protect susceptible is by improving quality of life of the people e.g. providing good housing, better nutrition and environmental sanitation. Legislative measures such as ban of selling bush meat in public can also be used to control of some emerging diseases.

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