

Emerging and Re-emerging Infections

¹Divya Rajaji, ²E Anuradha Sunil, ³Archana Mukunda, ⁴Meera K Pynadath, ⁵Arun Mohan, ⁶Steffy R Samuel

ABSTRACT

Context: From prehistoric times, humans have suffered from diseases—both infectious diseases caused by various microorganisms (e.g., bacteria, viruses, and parasites) and various diseases which arise as our human body age and degenerate. A wide variety of infections with varying epidemic and pandemic potentials have emerged and re-emerged in recent times, such as Ebola, Nipah virus (NIV), and Monkey pox.

Aim: This article intends to give a brief review on some of the infections re-emerging in the 21st century.

Materials and methods: In this review, PubMed was searched for relevant English articles from 1981 to 2015. The keywords included in the search were: infectious diseases, re-emerging infections, Ebola, severe acute respiratory syndrome (SARS), and Middle East respiratory syndrome (MERS).

Conclusion: Invention of antibiotics and vaccines were thought to bring an end to infectious diseases. But emergence of new microbial pathogens and re-emergence of new strains of existing pathogens have increased the need for more research aimed at countering these infections.

Keywords: Epidemic, Infection, Pandemic, Zoonoses.

How to cite this article: Rajaji D, Sunil EA, Mukunda A, Pynadath MK, Mohan A, Samuel SR. Emerging and Re-emerging Infections. *Oral Maxillofac Pathol J* 2018;9(2):76-78.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

An infectious disease is a disease that is caused by an agent which invades a host, harms the host's tissues, and is transmissible to other individuals. The term "infection" is not synonymous with the term "disease." When an infective agent invades and grows within a host, it is called infection. An infection turns into a disease only if the infective agent leads to impairment of tissue function. In the age of antimicrobial drugs and vaccinations, microorganisms are under constant struggle to survive, which leads to emergence and re-emergence of various infections.¹

¹Lecturer, ^{2,3}Professor, ⁴Reader, ⁵Senior Lecturer, ⁶Postgraduate Student

¹⁻⁶Department of Oral Pathology and Microbiology, Royal Dental College, Palakkad, Kerala, India

Corresponding Author: Divya Rajaji, Lecturer, Department of Oral Pathology and Microbiology, Royal Dental College Palakkad, Kerala, India, Phone: +919946027299, e-mail: divyavijesh01@gmail.com

Evolution of Infectious Diseases

For about 4 million years in the evolutionary history of mankind, humans dwelled as small nomadic populations in widely dispersed locations. The people were mostly hunter-gatherers. Binder² suggested that they had two types of diseases to contend with, for their adaptation to the environment. One type was the diseases which were present in pre-hominid ancestors, which were carried on when the pre-hominids evolved in to hominids. Most of these infections were parasitic infections like the head and body lice, pinworms, yaws, etc. The second type was zoonotic infections, which included nonhuman animals as their primary hosts and infected humans only occasionally. These infections could be through insect bites, from feeding on flesh of infected carcasses and from wounds caused by infected animals. The major diseases which have been found to affect the gatherer hunters were tetanus, scrub typhus, avian tuberculosis, leptospirosis, relapsing fever, sleeping sickness, trichinosis, schistosomiasis, and tularemia.²

The scenario shifted from gatherer hunters to farmers as a need for permanent residences arose due to increasing number of members in a family. Permanent settlements of large groups of populations in single locations led to early epidemiological transition, which in turn led to increased incidence of infections. Along with this, animals which were domesticated acted as a regular source of vectors and a larger incidence of zoonotic diseases.

Agricultural practices created pools of water, which acted as breeding sites for mosquitoes. Some disease vectors became co-dependent with human habitats, such as *Aedes aegypti*, vector for yellow fever and dengue, which breeds in stagnant pools of water in open containers. The storage of food resulted in the outbreaks of food poisoning.³

In 1981, the most dreadful pandemics of all times, acquired immunodeficiency syndrome (AIDS), was first recognized. An estimated 60 to 70 years ago, perhaps as an after effect of consumption of bushmeat this dreadful disease evolved. The incidence of AIDS led to a new interest in emerging infectious diseases.

Apart from the role of various microbial factors, social and environmental factors also play a detrimental role in re-emergence of infections. This is reflected in the fact that events leading to social instability, such as wars, riots, and natural disasters will catalyze re-emergence and spread of infections (Table 1).³

Table 1: Some of the major disease outbreaks of 21st century

Year	Disease	Location
2003	SARS	Asia
2004	Dengue	Indonesia
2004	Ebola	Sudan
2005	Yellow fever	Mali
2005	Dengue	Singapore
2006	Dengue	India, Pakistan
2006	Chikungunya	India
2007	Ebola	Congo
2008	Hand, foot, and mouth disease	China
2009	Hepatitis B	Gujarat, India
2009	Mumps	Worldwide
2009–10	Meningitis	West Africa
2012	Yellow fever	Sudan
2012	Middle East respiratory syndrome	Worldwide
2013–16	Ebola	West Africa
2013–15	Chikungunya	America
2015	H1N1 (swine flu)	India
2015	Zika virus outbreak	America
2016	Yellow fever outbreak	Africa
2017	Ebola	Africa
2018	NiV	Northern Kerala, India

EBOLA VIRUS DISEASE

Ebola virus disease (EVD), which was earlier called Ebola hemorrhagic fever, is a severe, fatal infection affecting humans. The infection can spread to humans from wild animals and then spreads through human-to-human transmission. Ebola virus belongs to the Filoviridae family (filovirus). Bats belonging to Pteropodidae family (fruit bats) are regarded as the natural host of the virus. Contact with infected fruit bats or other hosts, such as monkeys/apes and the consumption of their raw meat may cause transmission of virus to the humans.

Ebola virus is transmitted to the human population through contact with organs, blood, or other bodily fluids of the primary hosts. The EVD is an acute fatal infection, whose first signs often include muscle pain, headache, sore throat, intense weakness, and fever of rapid onset. This may progress to diarrhea, vomiting, skin rashes, and, in advanced cases, even liver and kidney dysfunction. Finally, increased hemorrhage will be seen, both internal and external.

Even when the symptoms of the disease may have subsided, infected humans can act as carriers if their blood and secretions contain the virus.²

H1N1 INFLUENZA

H1N1 infection, also known as swine flu (swine influenza), is a respiratory disease caused by influenza viruses that infect the respiratory tract of pigs; and is

often characterized by a barking cough, increased nasal secretions, decreased appetite, and general lethargy. In majority of the cases, close association with pigs was associated with swine flu infection. Transmission of swine flu between humans is through ingestion or inhalation of droplets produced when infected patients cough or sneeze. Transmission will not happen through cooked pork products. The incubation period for swine flu is 1 to 4 days. Manifestations of H1N1 influenza are not different from those of normal seasonal influenza.^{2,3}

MONKEYPOX

Monkeypox was first reported in 1958. Multiple outbreaks of a pox-like disease were observed among monkeys which were kept as colonies for medical research, hence the name “monkeypox.” Monkeypox is a rare disease and the virus causing the infection is called monkeypox virus (belonging to *Orthopoxvirus* genus in the family Poxviridae). The original source of the monkey pox virus in the nature monkeypox is still not identified. African rodent species are believed to be involved in transmission. The symptoms of the infection are similar to symptoms of smallpox, albeit being milder. Monkeypox begins with fever, headache, muscle aches, and exhaustion.

Lymphadenopathy is a major symptom of monkeypox, which is not reported in small pox. The incubation period for monkeypox is usually 7 to 14 days, after which the symptoms start. After the appearance of fever the patient develops skin rashes within 1 to 3 days, often beginning on the face and then spreads to rest of the body.¹

NIPAH VIRUS DISEASE

Nipah virus infection is a recently emerging zoonosis that infects both animals and humans and causes severe debilitating disease. Bats belonging to Pteropodidae family (fruit bats) are regarded as the natural host of the virus. The virus was first identified during an outbreak of the disease in 1998 in Kampung Sungai Nipah, Malaysia. Pigs acted as the intermediate hosts in this specific outbreak. In humans, NiV infection presents a wide variety of clinical manifestations, which range from asymptomatic infection to acute respiratory syndrome and fatal encephalitis. The recent outbreak of NiV has led to panic in Northern Kerala.⁴

CHIKUNGUNYA

Chikungunya is an infection, first detected in Makonde Plateau of Africa in 1952, and is caused by the chikungunya virus. The main symptoms include fever and arthralgia. These symptoms are seen after an incubation period

of 2 to 12 days. Other symptoms may include headache, joint swelling, skin rashes, and muscle pain.

Most symptoms usually start to subside within the 1st week, but in some cases, the joint pain may continue for months. The human–human transmission is carried out by two types of mosquitoes *Aedes albopictus* and *A. aegypti*. They are mostly active during the day time. The virus may get transmitted between different types of animals, including birds and rodents. It is believed that people once infected become immune.^{1,3}

SARS/MERS

Severe acute respiratory syndrome is an acute infection caused by a coronavirus, characterized by severe respiratory illness. The infection is believed to be caused by transmission of the virus from camels to humans. This limits the human-to-human spread. Outside the Arabian Peninsula, the biggest outbreak was reported in the Republic of Korea in 2015. The incidence was tracked down to a traveler who had returned from the Arabian Peninsula. The SARS has flu-like symptoms that usually begin 2 to 7 days after infection and is an airborne virus, which means that it spreads in a way similar to colds and flu.²

DENGUE

Dengue is a mosquito-borne tropical disease caused by dengue virus. The principal vector identified is the mosquito species *A. aegypti*, which has been closely associated with human dwellings since historic times. Humans not only provide the mosquitoes with blood meals but also water-holding areas which are needed to complete their development. The symptoms start to appear usually after an incubation period of 3 to 14 days and the condition is transmissible through blood. Symptoms, which usually begin 4 to 6 days after infection and last up to 10 days, may include sudden high fever, severe headache, severe joint and muscle pain, nausea, and vomiting. This may develop into dengue hemorrhagic fever, hepatomegaly, and failure of circulatory system. The disease may

progress to massive hemorrhage, shock, and death. This is referred to as the dengue shock syndrome.^{2,3}

CONCLUSION

In the 20th century, humanity was successful in launching a defensive campaign against infectious pathogens with the help of antibiotics and vaccines. The results obtained were so rapid and effective that U.S. Surgeon General William H. Stewart in 1969 said that it was “time to close the book on infectious disease.” But humanity and medical science had underestimated the power of enemy and natural selection.

The harsh reality is that pathogens apparently can adapt to every chemical that researchers have developed.⁵ Scientific and technological advances will play a critical role in our ability to combat the challenges presented by various infectious diseases in the 21st century. Application of advanced molecular techniques like functional genomics and proteomics will be an important part of this process and it will largely depend on not only the sequencing of human genome, but also on the genetic profiling of a wide array of microbial pathogens.⁶

REFERENCES

1. Taylor LH, Latham SM, Woolhouse ME. Risk factors for human disease emergence. *Phil Trans R Soc Lond B* 2001 Jul;356(1411):983-989.
2. Binder S, Levitt AM, Sacks JJ, Hughes JM. Emerging infectious diseases: public health issues for the 21st century. *Science* 1999 May;284(5418):1311-1313.
3. Daszak P, Cunningham AA, Hyatt AD. Emerging infectious diseases of wildlife—threats to biodiversity and human health. *Science* 2000 Jan;287(5452):443-449.
4. Cohen ML. Changing patterns of infectious diseases. *Nature* 2000 Aug;406(6797):762-767.
5. Morens DM, Folkers GK, Fauci AS. The challenge of emerging and re-emerging infectious diseases. *Nature* 2004 Jul;430(6996):242-249.
6. Smolinski, MS.; Hamburg, MA.; Lederberg, J. *Microbial threats to health: emergence, detection, and response*. Washington (DC): National Academies Press; 2003.