

## Popular Article

### Overview of Emerging and Re-emerging Zoonoses in India

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#### Abstract

Emerging and re-emerging zoonotic diseases causes high morbidity and mortality in many countries of the world. These diseases constitute the major threats to human and animal health. They are caused by all types of pathogenic agents, including bacteria, parasites, fungi, viruses and prions. These diseases capable of being transmitted naturally between animals and humans. They reduce animal health and productivity and produce great economical losses to the animal industries. The emergence and re-emergence of several zoonotic diseases in the past require a systematic surveillance and evaluation of disease control programme. This article focuses on emerging and re-emerging zoonotic diseases aetiology, transmission, occurrence and their zoonotic importance.

#### Introduction

The word 'Zoonosis' was first given by Rudolf Virchow in 1880 to include collectively the diseases shared in nature by man and animals. Zoonoses are "those diseases and infections which are naturally transmitted between vertebrate animals and man". Zoonoses include only those infections where there is either a proof or strong circumstantial evidence for transmission between animals and man (WHO 2011). An emerging infectious disease is one that has appeared and affected a population for the first time, or has existed previously but is rapidly increasing, either in terms of the number of new cases within a population, or its spread to new geographical areas. In now days many emerging and re-emerging diseases are zoonotic in origin, approximately 60% of all human infectious diseases recognized so far, and about 75% of emerging infectious diseases that have affected people over the past three decades, have originated from animals. Nipah virus, Crimean-Congo haemorrhagic fever and avian influenza A(H5N1) are examples of diseases that have recently emerged and have affected the WHO South-East Asia Region. Among those zoonoses recognized today as particularly important are anthrax, plague, brucellosis, Bovine tuberculosis, leptospirosis, salmonellosis, spotted fever caused by Rickettsia, rabies, several common arthropods borne viral infections (arboviral infection), certain parasitic diseases, especially cysticercosis, hydatid disease, trypanosomiasis and toxoplasmosis.

Disease emergence often follows ecological change caused by human activities such as agricultural changes, urbanization, migration, deforestation and dam building (Pal, 2007). In addition, international travel and commerce, industrialization of food product, breakdown of public health measures and microbial adaptation also led to the emergence of the zoonotic diseases (Dasseberger, 2000; Chug, 2008). Brucellosis and rift Valley fever are considered as an occupational viral zoonosis of veterinarians, livestock handlers, abattoir workers, dairy farmers and laboratory workers (Pal *et al.*, 2012).

## Classification of Zoonotic Diseases

Now days advanced laboratory techniques and confirmative diagnosis increased awareness between medical and veterinary scientists, more than 300 zoonoses are now recognised. The emphasis was given on the importance of collaboration and team work in identifying emerging zoonotic diseases. The emergence and re-emergence of zoonoses resulted into huge financial losses in many countries of the world including India.

### (A) According to the etiological agents

**Table-1. On the basis of etiological agents' common zoonotic diseases are describe in table-1**

<b>Bacterial zoonoses</b>	anthrax, brucellosis, plague, leptospirosis, salmonellosis, lyme disease, bovine tuberculosis
<b>Viral zoonoses</b>	rabies, arbovirus infections, KFD, yellow fever, influenza, CCHF, nipa virus, hanta virus, avian influenza
<b>Rickettsial zoonoses</b>	murine typhus, tick typhus, scrub typhus, Q-fever
<b>Protozoal zoonoses</b>	toxoplasmosis, trypanosomiasis, leishmaniasis
<b>Helminthic zoonoses</b>	echinococcosis (hydatid disease), taeniasis, schistosomiasis, dracunculiasis
<b>Fungal zoonoses</b>	deep mycosis - histoplasmosis, cryptococcosis, superficial dermatophytes
<b>Ectoparasites</b>	scabies, myiasis

### (B) According to the mode of transmission

**Table-2 Classification on the basis of mode of transmission.**

Direct zoonoses	These are transmitted from an infected vertebrate host to a susceptible host (man) by direct contact, by contact with a fomite or by a mechanical vector. e.g. rabies, anthrax, brucellosis, leptospirosis, toxoplasmosis.
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Cyclozoonoses	These require more than one vertebrate host species, but no invertebrate host for the completion of the life cycle of the agent, e.g. echinococcosis, taeniasis.
Metazoonoses	These are transmitted biologically by invertebrate vectors, in which the agent multiplies and/or develops and there is always an extrinsic incubation (prepatent) period before transmission to another vertebrate host e.g., plague, arbovirus infections, schistosomiasis, leishmaniasis.
Saprozoonoses	These require a vertebrate host and a non-animal developmental site like soil, plant material, pigeon dropping etc. for the development of the infectious agent e.g. aspergillosis, coccidioidomycosis, cryptococcosis, histoplasmosis, zygomycosis.

### (C) According to the reservoir host

**Anthropozoonoses-** Infections transmitted to man from lower vertebrate animals e.g. rabies, leptospirosis, plague, arboviral infections, brucellosis and Q-fever.

**Zooanthroposes-** Infections transmitted from man to lower vertebrate animals e.g. streptococci, staphylococci, diphtheria, enterobacteriaceae, human tuberculosis in cattle and parrots.

**Amphixenoses-** Infections maintained in both man and lower vertebrate animals and transmitted in either direction e.g. salmonellosis, staphylococcosis

### 3. Factors Influencing Prevalence of Zoonoses

- (A) Ecological changes in man's environment
- (B) Handling animal by-products and wastes (occupational hazards)
- (C) Increased movements of man
- (D) Increased trade in animal products
- (E) Increased density of animal population
- (F) Transportation of virus infected mosquitoes
- (G) Cultural anthropological norms

### 4. Emerging zoonotic viral diseases

#### 1. Avian Influenza

Avian Influenza also known as fowl plague, bird flu. Avian influenza refers to certain viral infections or diseases often seen among wild birds, water fowl and poultry. It is caused by a strain of the influenza virus called “type A”. According to the United Nations Food and Agriculture Organization, viruses are thought to be circulating endemically in poultry in Bangladesh, China, Egypt, India, Indonesia and Viet Nam. The primary risk factor for human infection appears to be direct or indirect exposure to infected – live or dead – poultry, contaminated environments<sup>6</sup> and young age.

Avian influenza A(H7N9) had previously been isolated only in birds. Bird species known to be susceptible to the virus included quail, geese, pigeons, Muscovy and Pekin ducks. Live bird markets have been shown to be reservoirs of avian influenza A(H7N9) infection. The main exposures and routes of transmission to humans remain unknown. Antiviral medicines are effective if used in the early stages. Anyone in the family developing fever after body aches or running nose-like symptoms should contact the nearest health centre or doctor.

## **2. Chikungunya**

Chikungunya is a viral illness spread by the bite of infected mosquitoes and clinically resembles dengue fever. After more than 20 years, chikungunya is being reported again in India, Indonesia, Maldives and Thailand, and in 2012 cases were reported for the first time from Bhutan. Chikungunya virus, an alphavirus, belongs to the *Togaviridae* family of arboviruses. The mosquitoes *Aedes aegypti* and *Aedes albopictus*, which transmit mosquito-borne viruses such as dengue, also transmit chikungunya to humans. Humans are the main reservoir for this disease in Asia, although monkeys are an important reservoir in Africa. The disease is transmitted through the bite of female infected mosquitoes. Incubation period: usually 3–7 days, but can range from 2–12 days. Typical symptoms are a sudden onset of fever, severe headache, chills, nausea and vomiting, and severe joint pains that may persist for weeks or months. Symptomatic treatment of acute infection for pain and fever with anti-inflammatory drugs usually suffices.

## **3. Dengue**

Also known as breakbone fever or, for severe dengue, as dengue haemorrhagic fever or dengue shock syndrome. Dengue is a mosquito-borne viral infection that has become a major international public health concern. It is found in tropical and subtropical climates worldwide, mostly in urban and semi-urban areas. The four distinct but closely related serotypes of dengue virus (DEN-1, DEN-2, DEN-3 and DEN-4) are members of the virus family *Flaviviridae*. Dengue is a risk to humans living in tropical and subtropical urban locations in dengue endemic areas, particularly during the rainy season. Dengue viruses are transmitted to humans through the bite of infective female *Aedes* mosquitoes. The average incubation period is 4–6 days after a mosquito bite. There is no specific drug or vaccine available for treatment of dengue. Paracetamol is the drug of choice to bring down fever and alleviate joint pain.

## **4. Ebola virus disease**

Also known as Ebola haemorrhagic fever. Ebola virus disease (EVD) is a severe, often fatal illness in humans. EVD outbreaks have a case fatality rate of up to 90%. Ebola first appeared in 1976

in two simultaneous outbreaks, in Nzara, Sudan, and in Yambuku, Democratic Republic of Congo. Ebolavirus belongs to the Filoviridae family (filovirus). Ebolavirus comprises 5 distinct species: 1. Bundibugyo ebolavirus (BDBV) 2. Zaire ebolavirus (EBOV) 3. Sudan ebolavirus (SUDV) 4. Reston ebolavirus (RESTV) 5. Taï Forest (formerly Côte d'Ivoire ebolavirus) ebolavirus (TAFV). Fruit bats of the Pteropodidae family are considered to be the natural host of the Ebola virus.

## **5. Nipah virus**

Nipah virus (NiV) was first recognized in 1999 during an outbreak among pig farmers in Malaysia. Its name originates from Sungai Nipah, a village in the Malaysian Peninsula where pig farmers became ill with encephalitis. Since then, there have been NiV outbreaks almost every year in South Asia, causing severe disease and death in people and thus making it an emerging disease of serious public health concern.<sup>37</sup> The virus infects a wide range of animals and causes severe disease in pigs, and this has resulted in significant economic losses for farmers in Malaysia.

## **6. Novel human coronavirus**

Coronaviruses are a group of viruses which infect humans and animals. They usually cause mild to moderate upper and lower respiratory tract infection, and can sometimes also cause gastroenteritis. Human coronaviruses were first identified in the 1960s and they are believed to cause a significant percentage of all common colds in adults. Novel human coronaviruses have recently been discovered, which have jumped from animals to infect humans, with serious socioeconomic consequences. A highly publicized novel human coronavirus is severe acute respiratory syndrome coronavirus (SARS-CoV).

## **4. Emerging zoonotic bacterial diseases**

### **1. Anthrax**

Also known as woolsorter's disease, splenic fever. Anthrax is a bacterial disease that usually Worldwide. Usually outbreaks are sporadic and small, but outbreaks of epidemic proportion can occur if contaminated animal feed becomes a common source of infection affects herbivorous animals, but outbreaks involving humans are increasingly being reported. Reservoir hosts include domestic and wild animals such as cattle, buffalo, sheep, goats, pigs and horses. Although anthrax spores can live in the soil for many years, anthrax infection in humans is rare. Skin contacts with, or inhalation of, aerosolized spores and consumption of undercooked or raw meat or dairy products from infected animals can cause the disease. Incubation period: 1–7 days for the cutaneous form; 12 hours–5 days for the gastrointestinal form; and 1–5 days for the pulmonary form.

## **2. Botulism**

Human botulism is a serious but relatively rare paralytic disease, caused by one of the most potent toxins that exist. In recent decades, the disease has been linked to foods such as unrefrigerated home-made salsa, honey, and traditionally prepared salted or fermented fish. *Clostridium botulinum*. There are seven recognized types of the toxin that cause botulism, four of which (types A, B, E and, rarely, F) cause human botulism. Types C, D and E also cause illness in mammals, birds and fish. The bacterium, in the form of spores, is commonly found in soil, aquatic sediment, the intestinal content of herbivores and fish. Botulism is caused by a toxin produced by this sporulated form. Type E toxin is associated with fish and marine mammals. foodborne botulism (due to ingestion of pre-formed toxins);  $\rho$  wound botulism (occurs when wounds are infected with *C. botulinum* that secretes the toxin);  $\rho$  infant botulism (typically in children less than 1 year old, after eating bacterial spores from food that develop into toxins in the intestines). supportive care is the mainstay for treatment of botulism. Prolonged intensive care, mechanical ventilation, and intravenous feeding may be required.

## **3. Brucellosis**

Also known as undulant fever, Malta fever, Bang's disease. Brucellosis is one of the world's most widespread zoonoses. The disease affects cattle, sheep, goats, pigs and some other animals. It can be passed to people via direct contact with livestock or through drinking unpasteurized milk from an infected animal. Countries in Asia including China, India, Indonesia and Thailand, and also in South America, the Mediterranean and the Middle East. Various types of the *Brucella* species of bacteria exist (*B. abortus*, *B. melitensis*, *B. uis*, *B. canis*). *B. melitensis* is the most virulent and causes the most severe and acute cases of brucellosis. Major reservoirs are cattle and buffalo (*B. abortus*), sheep and goats (*B. melitensis*), swine (*B. suis*) and dogs (*B. canis*). Person-to-person transmission is rare. People in close contact or working with animals are at greater risk of developing the disease. However, the majority of cases are caused by consuming raw, unpasteurized milk or cheese from infected goats or sheep. Gradual onset of persistent fever, chills, sweating, headache, muscle pain, backache, joint pain, fatigue, weakness and weight loss. Medical advice must be sought. There is no vaccine available for humans, but an extended course of antibiotics is recommended.

## **4. Leptospirosis**

Also known as Weil's disease, rice field worker's disease, rat fever. Leptospirosis is a common, zoonotic, bacterial disease that affects both humans and animals. It is considered an emerging disease as it is increasingly being reported from various parts of the world. Although curable if treated early, it is often misdiagnosed and can be fatal if left untreated. 5 In South-East Asia, leptospirosis

outbreaks in humans are increasingly being reported during the rainy season in India, Indonesia, Sri Lanka and Thailand. Major outbreaks in the Region have been reported in Jakarta, Indonesia (2003), Mumbai, India (2005) and Kurunegala, Sri Lanka (2008). The bacteria *Leptospira interrogans*, of which there are 12 species and over 250 serological variants (serovars). Agricultural and farm workers (rice-paddy and sugarcane workers for example), as well as those who work outdoors or with animals, are particularly at risk. Incubation period: usually 7–10 days. Treatment with effective antibiotics should be initiated as soon as the diagnosis of leptospirosis is suspected.

## **Emerging and/or zoonotic parasitic diseases**

### **Taeniasis/cysticercosis**

The most important tapeworms for humans are *Taenia saginata* and *Taenia solium*. The tapeworm lives in the intestine of humans and the adult stage is known as taeniasis. These humans shed the proglottids containing the eggs in their faeces. The eggs are ingested by cattle (*T. saginata*) or pigs (*T. solium*), where a cysticercus develops in the muscle; this larval stage of tapeworm is known as cysticercosis. *T. solium* and *T. saginata* are distributed worldwide. *T. saginata* can be found worldwide in countries where cattle and buffaloes are raised for human consumption; *T. solium* where pigs are raised for human consumption. *T. solium* (pork tapeworm) and *T. saginata* (beef tapeworm). *T. solium* is responsible for human cysticercosis. Cattle and buffaloes for beef tapeworm and pigs for pork tapeworm. Taeniasis and cysticercosis are parasitic infections related to pig husbandry practice, and poor hygiene and sanitation. Incubation period: For taeniasis (adult worm): 6–8 weeks after ingestion of contaminated pork infected with larvae (cysticerci). The clinical signs and symptoms of human cysticercosis depend on the location and number of larvae in brain, eye or other organs. Seizures, headaches, learning difficulties and convulsions are symptoms of neurocysticercosis. Taeniasis is easily treated with praziquantel or niclosamide.

### **Toxoplasmosis**

Toxoplasmosis is an infection caused by a parasitic protozoon, usually transmitted from animals to humans. It can have severe consequences in pregnant women and individuals with a compromised immune system. The protozoa *Toxoplasma gondii*. Cats and other felines. Intermediate hosts include most species of birds and mammals. Toxoplasmosis is very common: up to 95% of some populations across the world have been infected with *Toxoplasma*. Persons with weakened immune systems may experience severe symptoms if infected with *Toxoplasma*. Accidentally swallowing the parasite through contact with cat faeces that contain *Toxoplasma*, such as while cleaning cat litter. Incubation period: 5–23 days. Primary infections may not produce symptoms. Infection during pregnancy can result in inflammation of

an area behind the retina (chorioretinitis) in the fetus, fluid in the fetal brain (hydrocephaly) or fetal death. Those without symptoms typically do not need treatment. On the advice of health-care providers, different medications are available for those with clinical signs.

## **Trichinellosis**

Trichinellosis is a rare zoonosis caused by roundworms. Humans and domestic and wild animals can be infected and become carriers of the parasites. Trichinellosis has been reported from Bhutan, India, Indonesia and Thailand. *Trichinella spiralis*: *Trichinella* larvae are encysted in muscle tissue of meat from domestic or wild animals. People acquire trichinellosis by consuming raw or undercooked meat infected with the *Trichinella* parasite, particularly from wild game (e.g. boar) or pork. Indeed, cultural factors such as traditional dishes based on raw or undercooked meat or meat-derived products play an important role in how the disease is contracted and spread. Incubation period: 1–2 weeks. Intestinal invasion can be accompanied by gastrointestinal symptoms (diarrhoea, abdominal pain, nausea, vomiting). Larval migration into muscle tissues (one week after infection) can cause uneasiness, eyelid or facial oedema (fluid retention), conjunctivitis, fever-associated chills, muscle pain and itchy skin. Anthelmintics and steroids, applied only at the early stage of infection, are effective. There is no specific treatment for the disease once the larvae have invaded the muscles.

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