

# Overview of Emerging Zoonoses in India: Areas of Concern

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## Abstract

Zoonotic diseases shared by vertebrates and humans in Nature. An updated literature survey indicated that 816 of 1407 (58%) human pathogens which included viruses with prions (208), bacteria with rickettsia (538), fungi with microsporidia (317), protozoa (57) and helminths (287) were zoonotic, were capable of being transmitted naturally between animals and humans. Of these 77 (37%), 54 (10%), 22 (7%), 14 (25%) and 10 (3%) were emerging or re-emerging, respectively. The risk factors precipitating the occurrence of EZD are many and are in a state of continuous evolution and agents relevant to South-East Asia. These include avian influenza, rabies, Japanese encephalitis, leptospirosis, Hanta virus, SARS, Nipah virus, cysticercosis, echinococcosis and schistosomiasis. In addition, plague and anthrax are also considered important in India.

**Keywords:** Zoonoses; Emerging zoonoses; Public health; India

## Introduction

Zoonoses are infectious diseases shared by vertebrates and humans in Nature. An updated literature survey (Woolhouse and Gowtage-Sequeria, 2005) indicated that 816 of 1407 (58%) human pathogens which included viruses with prions (208), bacteria with rickettsia (538), fungi with microsporidia (317), protozoa (57) and helminths (287) were zoonotic, i.e., capable of being transmitted naturally between animals and humans. Of these 77 (37%), 54 (10%), 22 (7%), 14 (25%) and 10 (3%) were emerging or re-emerging, respectively. One of the most striking aspects of new, emerging and re-emerging zoonotic diseases has been the unexpected nature of their occurrence. In fact, at least in the developing countries, this can be considered as a major concern calling for a resolution. Emerging infections usually prove more threatening because we have little information about their origin and many of their epidemiological features remain unknown. The magnitude of their economic impact is also not too well delineated.

## Emergence of infectious diseases

Last few decades, especially after 1970, have been momentous in the history of veterinary medicine as an array of new infectious agents/diseases depicting animal-human connection were reported and researched across the globe. The pathogens/ infections discovered during the period included Kyasanur Forest Disease virus (1957), Rota virus (1973), Ebola and Hantaan viruses (1977), toxigenic *S. aureus* (1981), *E. coli* O157:H7 (1982), bird flu H5N1 virus (1997), Nipah virus (1999) and Severe Acute Respiratory Syndrome virus (SARS, 2003) to name only a few. A need also arose to define new or previously known diseases which appeared in modified form in respect of their time-space distribution and the characteristics of their causal agents. These were designated emerging diseases (ED). The idea of emerging zoonoses evolved in 1980(s) with the advent of severe outbreaks of diseases mostly of viral origin in different parts of the world. It has been shown that emerging and re-emerging diseases are more likely to be zoonotic. Available data also indicate that it is more likely that an emerging/re-emerging pathogen/disease turns out to be of viral origin. The work of Woolhouse and Gowtage-Sequeria demonstrated that as many as 177 (13%) of the total pathogens surveyed were emerging or re-emerging, and of these 130 (73%) were classified as zoonoses [1].

The Report of the WHO/FAO/OIE Joint Consultation on Emerging

Zoonotic Diseases (EZD), Geneva (2004) provided a working definition of EZD as follows: "An emerging zoonosis is a zoonosis that is newly recognized or newly evolved, or that has occurred previously but shows an increase in incidence or expansion in geographical, host or vector range". By inference it can be assumed that a disease need not necessarily be a new one in time-space framework to be classified as emerging. It can be a well-known disease as well. That is important in India's context. We have had rabies, salmonellosis, leptospirosis and tuberculosis for long and yet the maladies strike us regularly at places of their choosing-may be in their newer (modified) versions. A related term re-emerging zoonosis (REZ) is used to refer to a well-known disease which was managed/controlled to a level that posed no imminent danger to the animals and humans but has since reversed its course to show an increasing trend in respect of its incidence. Tuberculosis in humans in this country and elsewhere has assumed a dangerous posture on account of its linkage with HIV/AIDS and emergence of drug resistant strains.

A report on the status of zoonoses in South-East Asia (SEA) was presented by WHO (2007) during its Regional Meeting on Zoonotic Diseases held in Jakarta. The role of global warming and climate change in affecting the biodiversity and distribution of animals and microflora with a bearing on emergence of zoonoses was discussed. Zoonotic diseases of SEA were grouped as endemic, re-emerging and emerging diseases with epidemic potential. Issues relating to avian influenza strain H5N1, Nipah virus, rabies, JE and leptospirosis were discussed. The plague outbreak of 1994 helped assess the Indian preparedness to control zoonotic diseases in the country. It was indicated that a possible outbreak of SARS was averted by timely and appropriate interventions at the ports of entry and by adequate support to surveillance, diagnosis and clinical case management [2,3].

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## Risk factors contributing to emergence of zoonoses

The risk factors precipitating the occurrence of EZD are many and are in a state of continuous evolution. This evolution moves alongside the evolution of the societal and demographic patterns across the country. An overview of our census data indicates that the rate of urbanization between 1971 (109 million) and 2000 (286 million) varied approximately between 2.5% and 3.5% which can be considered significant. Such a change affects both rural as well as urban environments. Development projects are also found to influence disease spread patterns world over. India went for massive irrigation projects since independence. We have more than 30% irrigated croplands which produce about 50% of the total food grain production. The number of large dams in the country in 2000 was over 4000. More than half of these were constructed between 1970 and 2000. Nearly 54% of districts in the country house a large dam (height 30 meters or more). These developmental activities enhanced Indian food grain production from 51 million tones (1951) to 200 million tons (2000). However, these statistics are also pointers to the massive ecological/habitat tumult that must have taken place silently over the decades to impact upon the hosts, agents and vectors of infectious/zoonotic diseases and the environment. We wait to see some worthwhile quantitative studies that may reflect upon this vital aspect of veterinary medical research.

India has had an expanse of ecological niches and a rich biodiversity. Forests contributed to this richness in a big way. However, our forest cover as at present is estimated to be a meager 19.5%. Factors like industrialization, overgrazing, commercial and agricultural exploitation, and diversion of forestland to non-forest land and for road construction and river valley projects had considerable adverse impact on forest wealth of the country. It also promoted ecological imbalance affecting pathogen/vector densities and their dissemination, and consequently, to the state of human and animal health. It is estimated that we had been losing natural forests at a fast pace till 1994 when efforts were initiated to reverse the rate of deforestation which was brought down to 0.6% through intensive plantation and conservation drives.

Changing patterns of agricultural and animal husbandry practices correlate well with the microbial and vector types and densities. Areas brought under rice cultivation and piggeries in certain regions had a bearing on the epidemiology of mosquito-borne diseases like Japanese encephalitis especially in South-East Asia. So has been the case with industrial development. Liberalisation in trade (import/export) of livestock and livestock products, shifting animal/bird populations, and fast travel and communication have contributed in creating opportunities for the agents of diseases and vectors to migrate to newer territories. The spread of bird flu in India in recent times is suspected to have adopted this route.

The role of climatic and social factors in the spread of animal pathogens to human communities has been in focus for quite some time. It impacts upon hosts, parasites and vector densities. Climatic conditions determine the nature of the environment at a given place and the epidemiology of most of the zoonotic diseases. Social factors like population density, consumption of wildlife and mobility were found to play part in spread of SARS and avian influenza. Air travel is suspected to contribute to the spread of a number of vector-borne diseases.

## Common Emerging diseases in South Asia

WHO/FAO/OIE identified diseases and agents relevant to South-

East Asia. These include avian influenza, rabies, Japanese encephalitis, leptospirosis, Hanta virus, SARS, Nipah virus, cysticercosis, echinococcosis and schistosomiasis. In addition, plague and anthrax are also considered important in India.

In view of its preponderance in humans and animals diseases like tuberculosis, brucellosis, and salmonellosis and other food-borne illnesses continue to draw attention of epidemiologists and public health veterinarians in the country. According to WHO of the total global cases of tuberculosis, about 30% reside in India. It is estimated that the disease costs India Rs. 13,000 crore per year. An estimate puts the number of people dying of the disease in the country at 37,000 per year, i.e., over 1000 deaths per day. Women and children are the major sufferers. The zoonotic angle of *M. bovis* which could also circulate in a human to human cycle and that too in a more devastating manner than *M. tuberculosis* needs to be probed especially when the prevalence of the disease in the country is on an upward swing.

Brucellosis is rampant in the bovine population of the country-some of the organized farms showing a prevalence of 20% or more. Mass scale vaccination of animals has not been a regulated practice in this country except in some farms. Human infection most often is associated with *B. melitensis*. The discussion here would confine to some major emerging illnesses.

## Rabies

According to 15 million people are bitten by animals in India every year. The total number of people dying of the disease annually is placed between 25,000-30,000. In more than 90% cases it is the dog (most often stray) that is involved. The incidence of the disease is estimated to be 1.7% which is considered to be on the higher side. The country reports a death every 30 minutes. Stray dogs and only a partial vaccine coverage in humans and native dog population are, therefore, considered to be major risk factors of the disease. Dog population control and compulsory vaccination of dogs have met with only partial success. It is believed that an intensified programme of public education can help in reducing the menace of disease [4].

**Japanese encephalitis:** Japanese encephalitis is endemic in India and many countries of Asia including China and Japan. The total number of cases reported in Asia is placed between 30,000-50,000 per year. The disease first appeared in India in 1955 and the first outbreak occurred in 1973 in West Bengal. However, it was only after 1978 that the disease became widespread. The disease continues to spread to newer areas. As at present 16 states in the country have reported the disease. JE is detected among the rural children often between July-October of the year (rice cultivation) in view of high mosquito activity during this time. Unregulated swine and poultry/bird rearing and poor vaccine cover to humans pose serious risks and challenges. UP has been reporting the occurrence of the disease in its eastern districts for some time now. As many as 1,745 cases were reported from Gorakhpur alone during 2008 with 136 deaths. In 2007 more than 220 people had died in the city [5].

## Avian influenza

The disease is popularly known as bird flu. Increased mixed farming activity, import/export of poultry to meet excessive demands of protein and unregulated marketing in birds and other livestock in congested areas constitute major risk factors. Implementation of effective biocontrol measures and timely detection and notification of cases are serious challenges especially in the developing countries. Avian influenza strain H5N1 wreaked havoc and spread panic when it first appeared in Hong Kong in 1997. It is estimate that about 250 cases

of human disease have been reported from across the world of which nearly 150 have died. The disease has been reported from many south-east Asian countries including India, Pakistan, Bangladesh, China, Japan and Taiwan. The disease has also been reported from many countries in Europe and elsewhere. Three outbreaks of the disease have been reported from India in poultry with no human mortalities. The disease was reported from Navapur, Maharashtra (2006), Manipur (2007) and 13 districts of West Bengal (2008). The economic loss to poultry industry in India was placed at Rs. 30,000 million (2006) and Rs. 6,500 million (2007).

### Leptospirosis

WHO (2007) describes leptospirosis as an emerging outbreak-prone disease in India which is associated with flooding. Outbreaks have been reported from states like Gujarat, Orissa, Maharashtra and Tamil Nadu. Rural farm workers are more vulnerable to the disease. Outbreaks have also been reported from Andaman and Nicobar Islands and areas of south and west in the country. The pathogen has also been recovered from farm animals. Investigations demonstrated the presence of the disease in Delhi and adjoining areas. Prevalence was high during August and September (monsoon season). The role of rodents and domestic animals in harbouring the leptospires has been speculated. A need for intensive surveillance for leptospirosis in the northern parts of India has been suggested [6].

### Salmonellosis

Salmonellosis and other food-borne illnesses have been with us for long, and we have had varied presentations of the field outbreaks. Often the epidemiology of the infections remains obscure or poorly understood. It would be apt to describe salmonellosis in India as an emerging disease with a long history. A large variety of serovars of *Salmonella* have been reported from India involving a range of domestic, wild and aquatic animals and avian species. The disease continues to defy almost all existing theories on its epidemiology on account of the multiplicity of hosts, agents and environment related factors that determine its spread patterns.

### Other diseases

India reported occurrences of diseases like SARS, Nipah virus, plague and anthrax. The first confirmed case of SARS was a 32 year old marine engineer who had sailed from Hong Kong and reached Goa on April 1, 2003. Prompt diagnosis by National Institute of Virology, Pune and medical care prevented further spread of the disease in the country (The Hindu, April 18, 2003). Strict surveillance at the international airports and sea ports particularly on travelers from China, Singapore and Hong Kong was enforced. The WHO has since declared India free of the disease.

An outbreak of Nipah virus associated encephalitis occurred in Siliguri (West Bengal) during January- February, 2001 among the hospitalized patients, family contacts of the patients and medical staff of four hospitals. It was noted that the city is close to the borders with China, Bangladesh and Nepal which might have had a bearing on the spread of the disease. The disease has been reported from Bangladesh. The presence of the virus was demonstrated in 9 of 18 patients [7]. Anthrax is being reported from India in sporadic as well as outbreak forms on a regular basis. Union territory of Pondicherry experienced an outbreak involving 28 human cases during 1999 and 2000 taking the tally to 34 in this region. Cases were also reported from farm animals in the area [8]. Reports have also emanated from Gujarat, Tamil Nadu, Andhra Pradesh and Karnataka where it seems to have become

endemic. A pneumonic plague outbreak occurred in Surat in 1994 which was considered unusual in many respects. It occurred in a period with high environmental temperature (35 degrees C), was not preceded by bubonic disease and had only low mortalities. Only 196 people died in a population of 1.8 million.

### Areas of concern and formulation of management strategies

The major areas of concern involving emerging zoonotic diseases and their control and prevention can be summarized as below: [9]

1. The control and prevention of zoonotic diseases remain primary concern in a country like India where human and animal populations are huge and interactions between the two intimate. Ecological transformation in the country as stated earlier in this paper has been taking place in a rapid manner. The policy document of WHO (2007) outlining a strategic framework for the purpose can help South Asian countries immensely. The main objectives of this strategy are: (i) risk reduction, (ii) establishment of coordinating mechanisms, (iii) strengthening surveillance, response, preparedness and capacity building and (iv) promotion of integrated multidisciplinary approach to research.

2. Some of the major areas of focus would need to be: (i) legislation and public education, (ii) analysis of socio-economic impact of zoonoses, (iii) control and prevention of zoonoses in animals including vector control, (iv) identification of priority zoonoses for appraisal of their risk factors, (v) identification of existing and future challenges in the management of EZZ, (vi) assesment of early warning system needs which would include infrastructural development in animal health services, and cooperation between veterinary and public health authorities and (vii) development of an appropriate strategy towards transboundary surveillance in areas adjoining international borders.

3. It is essential to strive for developing a modern disease surveillance system using new approaches and tools like syndromic surveillance, geographic information system, remote sensing, molecular epidemiology, information technology, bioinformatics, economics and sociology. In view of unpredictable occurrence of many emerging zoonoses it is necessary to develop a forecasting/forewarning system to facilitate timely interventions. This is particularly relevant in case of vector-borne diseases which show preference to specific seasons/ weather conditions.

4. A close networking between veterinary and medical laboratories and professionals at different levels needs to be developed. The professionals must become part of Rapid Response Teams to investigate epidemics of zoonoses. Each district and state in the country needs to be linked through satellite to a designated National Headquarters for collecting real time data on the activity of pathogens and diseases. Our performance in this regard has not been too encouraging. Efficiency in surveillance work is the key to success, for poor surveillance is the most important risk factor for the occurrence of any disease.

5. Establishment of area specific (geographical as well as discipline-wise) diagnostic laboratories is necessary. During epidemics of diseases a huge body of information is collected which must be processed and forwarded to appropriate authorities in the shortest possible time for initiating interventions. It is necessary that the laboratories are networked to facilitate movement of information. Even smaller diagnostic units may also be provided with modern equipment for rapid diagnosis. Facilities for molecular diagnosis are necessary.

It is appropriate to end this write-up on emerging diseases with what Paracelsus (1493-1541), an alchemist and physician genius of Middle Ages, said about a disease and the way to attack it. Allegorically, 'body' and 'all parts' may be taken to mean 'community/society' and 'sectors that constitute the community/society', respectively. He said what modern scientists refer today as 'ecological balance for preventing epidemics of diseases'.

"Once a disease has entered the body, all parts which are healthy must fight it: not one alone, but all. Because a disease might mean their common death. Nature knows this; and Nature attacks the disease with whatever help she can muster" - Paracelsus.

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