

## Effect of climatic changes on the prevalence of zoonotic diseases

Neelam Sachan<sup>1</sup> and V.P.Singh<sup>2</sup>

College of Veterinary Science and Animal Husbandry  
Pt. Deen Dayal Upadhyay Pashu Chikitsa Vigyan Vishwa Vidyalaya Evam Go  
Anusandhan Sansthan, Mathura-281001

1. Department of Veterinary Public Health Email- neelamvet@rediffmail.com

2. Department of Livestock Products Technology Email-vetvpsingh@rediffmail.com

### Abstract

Combustion of fossil fuels and human activities has led to sharp increase in greenhouse gases in the atmosphere. These climate changes have tremendous effect on prevalence of zoonotic diseases. The changes in climate may increase the insect vectors, prolong transmission cycles or increase the importation of vectors or animal reservoirs. It may also have an adverse effect on biodiversity, distribution of animals and microflora which may lead to emergence of zoonotic disease outbreaks. A historical perspective on major vector-borne diseases such as arboviral encephalitides, dengue fever and Rift Valley fever, Lyme disease, West Nile virus, malaria, plague, hantavirus pulmonary syndrome and dengue fever have been shown to have a distinct seasonal pattern and in some instances their frequency has been shown to be weather sensitive. Because of the sensitivities of the vectors and animal hosts of these diseases to climactic factors, climate change-driven ecological changes such as variations in rainfall and temperature could significantly alter the range, seasonality and human incidence of many zoonotic and vector-borne diseases. The evolution of emerging zoonotic diseases globally during the period 1996 to 2007 was Ebola haemorrhagic fever, Rift Valley fever, avian influenza H5N1, plague and Nipah virus. Whereas, bird flu and swine flu like diseases are still creating havoc for human and animal health worldwide. It is a today's and tomorrow's demand that interdisciplinary communication between health professionals, veterinarians, environmental scientists, ecologists, geographers and economists seeking to understand climate change will be key to protecting people in India and worldwide against these threats. Rigorous cross-disciplinary studies using a variety of methodological tools will enable us to predict the transmission dynamics of diseases under different climate scenarios and estimate the cost-effectiveness of mitigation strategies. In this text some of important diseases which are dependant on global warming and climate changes have been discussed taken for and can change their prevalence rate is considered for discussion.

**Key words:** Global warming, zoonotic diseases, avian influenza, swine flue, Japanese encephalitis, nipah virus, rabies, leptospirosis

Global climate change is inevitable and the combustion of fossil fuels has resulted in a build-up of greenhouse gases within the atmosphere, causing unprecedented changes to the earth's climate. Human activities have caused a sharp increase in greenhouse gases including carbon dioxide, nitrous oxide and methane in the atmosphere. These greenhouse gases traps heat and light from the sun in the earth's atmosphere which increases the temperature. Earth is currently warming it is a reality and the factors responsible for this change are called climate drivers and the relative impact or index of each factor's importance to climate change is called its radiative forcing. The scientists found that the combined radiative forcing due to increases in CO<sub>2</sub>, methane and

nitrous oxide is the largest climate driver and its rate of increase during the industrial era is very likely to have been unprecedented in more than 10,000 years. Furthermore, the carbon dioxide radiative forcing increased by 20% from 1995 to 2005. Significant anthropogenic contributions to radiative forcing were also found to have come from several other sources including tropospheric ozone changes due to emissions of ozone-forming chemicals, direct radiative forcing due to changes in halocarbons and changes in surface albedo due to land-cover changes and deposition of black carbon aerosols on snow. However the impacts of each of these factors were relatively small compared to the impacts of anthropogenic greenhouse gases. Finally an increase in solar

irradiance since 1750 was estimated to have caused a forcing that contributed to the recent warming of the earth. However, the impact of the increase in the amount of sunlight striking the earth each year during this ~250 year time span was estimated to be only about 1/20th of the warming impacts of anthropogenic greenhouse gas emissions.

Zoonotic diseases are defined those which can be passed between vertebrate animals and humans. The term was originally used to describe a group of diseases that humans may acquire from domestic animals. This definition has since been modified to include all human diseases that are acquired from or transmitted to any other vertebrate. Infections may be naturally transmitted between animals and humans. The majority of pathogen species causing disease in humans are zoonotic which are estimating over 60% of all human diseases. Zoonotic diseases are common throughout the world and in developing countries it constitutes an important threat to human health. A high proportion of notifiable human diseases are zoonotic. They exclude diseases transmitted from human to human via an arthropod vector (e.g. malaria). Zoonotic diseases have both direct and indirect effects on livestock health and production. Indirect effects occur as a result of the risk of human disease, the viability of livestock producers through barriers to trade, the costs associated with control programs, the increased cost of marketing produce to ensure it is safe for human consumption and the loss of markets because of decreased consumer confidence.

#### **Important zoonotic diseases**

Global warming, climate change and extreme weather events have an adverse effect on biodiversity, distribution of animals and microflora, all of which may increase the likelihood of emergence of zoonotic agents and infectious disease outbreaks. The emergence of the new cholera strain O:139 and outbreaks of West Nile virus, Rift Valley fever and Dengue fever in new geographical areas have been linked with the El Niño oscillation. Bovine Spongiform Encephalopathy (BSE) is transmitted from sheep to cattle and then from cattle to human beings in the form of the new variant Creutzfeldt-Jacob Disease nvCJD as a consequence of human action. The spread of the West Nile virus in the United States in recent years may be linked to global warming and may have implications for other vector-borne diseases. A historical perspective on major vector-borne diseases such as arboviral encephalitides, dengue fever and Rift Valley fever may be considered.

The evolution of emerging zoonoses globally during the period 1996 to 2007 may be the concerned issues. The Ebola haemorrhagic fever, Rift Valley fever, avian influenza H5N1, plague and Nipah virus are

examples of newly emerging zoonotic diseases. The direct and indirect socioeconomic impact of BSE/nvCJD, SARS, avian influenza H5N1, and neglected zoonotic diseases such as rabies, brucellosis, cysticercosis and hydatidosis may gets attention. The Bovine Spongiform Encephalopathy (BSE) like diseases needs to employ a complete 'feed to food/farm to fork' concept in food safety which in this case required an international ban on the use of meat and bone meal in animal feed for ruminants. The human form of the disease nvCJD can also be transmitted through blood transfusion from humans to humans and a study suggests that a significant number of potential blood donors in the United Kingdom (UK) may be incubating the disease. The true burden of zoonoses is difficult to estimate due to underreporting, misdiagnosis, insufficient laboratory diagnostic facilities and lack of awareness among the public and health professionals.

#### **Avian influenza**

The avian influenza epizootic which commenced in late 2003 severely affected poultry production and consumption and directly impacted the livelihood of millions of people. Given the cyclic pattern of pandemic influenza outbreaks and ongoing exposure of humans to A/H5N1 virus across the globe, there is every possibility that a potential pandemic influenza strain may evolve. WHO, FAO and OIE work together through a number of established detection and response frameworks including the Global Outbreak Alert and Response Network (GOARN), the Global Early Warning System (GLEW - WHO, FAO and OIE), the Information Network of Food Safety Authorities (INFOSAN emergency -WHO/FAO) and the Crisis Management Centre (FAO/OIE).

There are also frameworks aimed at strengthening national surveillance and response capacity under the International Health Regulations 2005 (WHO), the Global Framework for progressive control of Transboundary Animal Diseases (GF-TADs - FAO/O Zoonotic diseases are important in the SEA region because of the close everyday interactions between the human and animal world, deep-rooted sociocultural practices, high relative density of human and animal populations, intensification of the farming system, changing food habits and lifestyles of the people. Avian influenza (H5N1) outbreaks were first reported in the SEA region in 2003. Sporadic outbreaks are continuing in many countries including in Bangladesh (2007), India (2006-2007), Indonesia (2004-2007), Myanmar (2006-2007) and Thailand (2003-2006). All these countries with the exception of Indonesia adopted a stamping-out policy for the control and eradication of avian influenza outbreak in poultry. Human H5N1 cases were reported from only Thailand

and Indonesia. The major challenge in AI control is to reduce human exposure to the H5N1 virus and if possible to bring down the case fatality rate.

#### **Swine flu**

The viral infection is transmitted to humans who are in contact with swine; although there are several cases of swine flu in people who had no known exposure to either infected people or pigs. Once the species barrier is crossed, human to human transmission can occur with casual contact or airborne transmission like when one sneezes or coughs. Eating pork products will not cause one to develop the swine flu. Basically this flu is passed from one person to another like any cold or flu infection.

The swine flu A (H1N1) is a viral infection that originated from pigs and was first isolated from pigs in the 1930s. The World Health Organization elevated the worldwide pandemic alert level to Phase 5, on April 29, 2009. Phase 5 is called when there is a "strong signal that a pandemic is imminent and that the time to finalize the organization, communication, and implementation of the planned mitigation measures is short." Phase 6 is the highest level. On June 11th the 2010, WHO raised the level to Phase 6 indicating that the flu has spread worldwide.

#### **Japanese encephalitis (JE)**

JE is a major vector-borne zoonotic disease endemic in most countries of the South Eastern Asian Region. The epidemiology of JE remains fairly stable in endemic countries except in those where vaccination campaigns are introduced which have resulted in a dramatic reduction in the incidence of disease in normal conditions.

#### **Nipah virus**

Nipah virus is another emerging regional zoonotic disease of public health significance which has been reported from Bangladesh and India. Little is known about the epidemiology and clinical management of the Nipah virus and there is an urgent need to strengthen capacity for surveillance and laboratory confirmation.

#### **Rabies**

Rabies remains a major public health problem in the Asian region. Dog-mediated rabies is responsible for most human cases although cases of wildlife rabies are also reported in the Indian subcontinent. Rabies vaccine of nerve-tissue origin is being phased out from India and Nepal. The introduction of a more cost-effective rabies vaccination schedule is required to ensure that modern tissue-culture rabies vaccine becomes accessible to the general public. The implementation of a regional rabies control strategy

should be urgently considered.

#### **Leptospirosis**

Leptospirosis is an emerging outbreak-prone disease which is associated with flooding. Major outbreaks have been reported from the states of Gujarat, Orissa, Maharashtra and Tamil Nadu in India and also in Northern Thailand during the last 10 years.

#### **Zoonoses control activities in India**

The importance of zoonoses in context of emerging infectious diseases and socioeconomic development in India, it is utmost important to take care of these diseases. Avian influenza, Japanese encephalitis, Nipah virus, leptospirosis, plague and anthrax are important zoonotic diseases commonly found in India. The plague outbreak in Surat in 1994 provided a good opportunity to review the preparedness levels to combat outbreaks of zoonotic diseases in India. A possible outbreak of SARS in 2003 was averted through appropriate and timely measures taken at ports of entry and by ensuring adequate preparedness for surveillance, laboratory diagnosis and clinical case management. Avian influenza H5N1 outbreaks in poultry during 2006- 2007 were contained at source through coordinated action taken at the state and local levels and no human cases were reported. Activities related to capacity building and strengthening laboratory and surveillance networks for early detection and response for emerging zoonotic diseases may take due attention. Pilot projects for rabies and leptospirosis have been incorporated in the Eleventh Five Year Plan (2007-2011) of the Government of India. The following strategies are of great importance in control of zoonotic disease in India and neighbouring countries:

1. Advocacy, legislation, public awareness and health education programmes should be launched.
2. Appraisal of public health and socioeconomic impacts of zoonoses should be taken care of.
3. Strengthening of surveillance and disease investigation capacities in human and animal populations is a urgent requirement.
4. Networking among epidemiological and laboratory units under public health and animal health sectors are necessary step to be done.
5. Developing prevention and control strategies in animal hosts and vectors should be incorporated in the existing control programmes.
6. Development and harmonization of appropriate cross-border disease surveillance and response activities is utmost important.
7. Medical and veterinary curricula with respect to epidemiology and public health aspects of zoonoses should be modified.

8. Involvement of medical and veterinary institutions, NGOs, international professional associations and animal welfare organizations in zoonoses control activities must be there.
9. Identification of research needs on zoonoses and their promotion for joint studies with the involvement of technical partners is today's needs.
10. Protocol should be designed to verify the absence or elimination of infection from a country.
11. Pilot projects should be developed for specific disease control and elimination.

There is a need for collaboration among medical, veterinary, laboratory and public health professionals, especially in outbreak investigation and research activities. Strengthening surveillance and response capacity, the development of early warning systems and formulating appropriate environmental, energy and economic policies are necessary to control emerging infectious diseases. The establishment of a centre for strategic control and prevention of zoonotic

diseases involving multisectoral collaboration must be launched.

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