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## Emerging and re-emerging zoonoses of India originating from dogs and cats

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**ABSTRACT:** Kissing pets, swimming, or sleeping with them can invite zoonotic infections in the human population, some of which can also be transmitted *via* vectors like fleas, ticks, and mites, while others can be transmitted through food contaminated with animal hair, saliva, urine, and faeces. Children, pregnant women, elderly people, and others with their immune systems compromised are at high risk of contracting zoonotic diseases which may be emerging or re-emerging in nature. Awareness is the key to unlocking the healthy lifestyle that humans can enjoy with their pets. Dogs and cats are not just sentinel animals in the streets; rather, they have become indispensable members of our family. Therefore, their diseases too get an opportunity to infect humans.

**Key words:** Dogs and cats, emerging and re-emerging zoonosis

Pets are used as companions also there have many advantages for societies in households, contributing to the used as physically, socially and emotionally for children (Wong, *et al.*, 1999). There are 223 million dogs and 220 million cats. Zoonosis is any disease or infection that is naturally transmitted between vertebrate animals and humans (WHO, 2021). The zoonotic diseases that are newly recognised or newly evolved, or that have occurred previously but show an increase in incidence or expansion in geographical, host or vector range, are said to be emerging in nature (Kumar *et al.*, 2015). The major contributing factors to the zoonoses are global travel, illegal animal trade, population growth, urbanization, climate change, antibiotics, pesticides, increased pet populations, and greater animal product usages (Chomel, *et al.*, 2007).

Re-emerging zoonosis is defined as a disease that was previously well known and thus managed or controlled to a level that posed no imminent danger to humans or animals but has recently shown an increased incidence of disease (Kumar *et al.*, 2015). Dogs and cats act as an important source of emerging and re-emerging zoonotic diseases being transmitted to humans *via* direct contact, aerosols, or fomites. Vectors such as fleas, ticks, and lice of dogs and cats also play an important role in disease transmission (Wright *et al.*, 2020). Further, acts such as kissing, sleeping, and swimming with pets can predispose humans to such zoonotic infections (Chomel and Sun, 2011). Climate change can also be regarded as an important factor influencing the vector population and their activity (Bouchard *et al.*, 2019). Thus, the change in socio-economic, environmental, or ecological characteristics of

the host may lead to the emergence and re-emergence of zoonotic diseases. In this review paper, we have discussed some of the common emerging and re-emerging zoonotic diseases where dogs and cats act as an important source.

### **Viral zoonotic disease**

Rabies is transmitted by direct contact of broken skin or mucous membrane with the infected saliva of dogs and cats. It was found that 99% of rabies cases are dog-mediated and children below 15 years of age are most vulnerable (WHO, 2021). Rabies is a viral disease that causes about 59,000 deaths of humans annually in over 150 countries, out of which 95% of cases are reported from Africa and Asia (WHO, 2021). From very ancient times, water bodies have played an important role in preventing rabies. The union territories of India such as Lakshadweep, Andaman and Nicobar Islands have been rabies free since time immemorial, but the importation of dogs and their breeding may provoke disease emergence in the future (Sudarshan *et al.*, 2006). At present, it can be considered a re-emerging zoonotic disease in all those countries in which it was once eliminated but has regained its occurrence. The reason behind it can be attributed to poor vaccination practices and a less effective surveillance. Similarly, cow pox is also a viral disease-causing clinical manifestation in both humans and cats. Though rodents are the reservoir of cowpox virus, humans can acquire the infection from cats engaged in hunting rodents (Vorou *et al.*, 2008). The virus was once very prevalent in cattle, but nowadays the virus is most commonly recognised in domestic cats in Europe (Chomel, 2014). Other viral infections such as rotavirus can also be spread from dogs and cats to humans *via* the faecal oral route and, therefore,



are of zoonotic importance (De Grazia, 2007; German, 2015). Cases of avian influenza have been reported in both dogs and cats (Harder and Vahlenkamp, 2010) with zoonotic potential. However, some cases reveal that humans can act as a source of H1N1 infection for pets (Sponseller *et al.*, 2010).

### Bacterial zoonotic disease

It is often criticised for food poisoning and the dissemination of antibiotic resistance genes to other bacterial species (Wang *et al.*, 2017). It is being seen as an emerging zoonotic pathogen due to the selection of methicillin-resistant strains (Stein, 2009). *Staphylococcus aureus* is a common commensal on the skin and mucous membranes of cats, dogs, humans and other animals (Faires *et al.*, 2009). Close contact with pets may allow Methicillin Resistant *Staphylococcus aureus* to colonise human skin and mucous membranes (Stein, 2009). This can make the treatment difficult and sometimes failure. The cat scratch disease is a bacterial disease caused by *Bartonella henselae* which is transmitted by cat bites or scratches. Immunocompromised people and children between 5 and 14 years of age are most susceptible to this disease. About 40% of cats carry this infection at some point in their lives without any signs of illness. The cats themselves are infected by flea bites or flea droppings (that stick to their nails or teeth while catching the flea) or by fighting with other infected cats (Klotz *et al.*, 2011). The same can be transmitted to humans by being bitten or scratched by cats. Cats can also play an important role in the transmission of tularemia, which is a bacterial disease caused by *Francisella tularensis*. Though cats are accidental hosts for tularemia, they may act as an important source of infection for humans. Ticks, on the other hand, are the biological vector of this infection and act as an inter-epizootic reservoir (Gyuranecz *et al.*, 2011). Therefore, they play an important role in the transmission and maintenance of infection in nature. The infection can be transmitted to humans mainly *via* cat bites or scratches, or through flea and tick bites (Gerhold and Jessup, 2013). Lyme disease is a vector-borne disease caused by the spirochetal bacteria *Borrelia burgdorferi* and transmitted to humans by the bite of infected blacklegged ticks (Talbot *et al.*, 2021). Many wildlife species, including rodents, may act as a reservoir of the infection (Anderson, 1989). However, the dogs and cats may carry the infected adult ticks (about 3 mm in size) on their bodies, which can be passed to humans. Ticks can transmit the infection to humans or other animals *via* their saliva, but it requires about 36 to 48 hours of attachment to transmit the infection. The disease is endemic in temperate regions of the northern hemisphere, with sporadic occurrences in Europe and Asia.

However, the incidence of disease is increasing globally and the disease is taking the shape of an emerging zoonotic disease due to the expanding geographical range of ticks (Ogden *et al.*, 2013). The expansion of ticks can be attributed to warm and humid climatic conditions as a result of global warming (Bouchard *et al.*, 2019). Leptospirosis is also re-emerging in several parts of the world due to changes in serovars and climatic changes (Chomel, 2014). Other bacterial diseases such as pasteurellosis, tuberculosis, salmonellosis, colibacillosis, and campylobacteriosis can also be transmitted from companion animals to humans (Garoma and Diba, 2022), but these are now endemic for India.

### Parasitic zoonotic disease

Larvae of *Ancylostoma* spp. and *Uncinaria* spp., on the other hand with a few reported cases, can enter human tissues and cause cutaneous larval migrans and eosinophilic enteritis (Robertson and Thompson, 2002). *Dipylidium caninum* is another parasite that can be transmitted by dogs and cats *via* the faecal oral route and causes anal pruritis in humans (Ramana *et al.*, 2011). *Toxocara canis* and *T. cati* are helminthic parasites that are transmitted from dogs and cats *via* faecal oral routes and cause visceral and ocular larval migrans in humans (Macpherson, 2013). Infected mosquitoes with *Dirofilaria immitis* can transmit the infection to humans (Vezzani *et al.*, 2006). Certain ectoparasites such as *Sarcoptes* and *Notodres* can also be transferred directly from cats to humans, leading to dermatitis (Galdhar *et al.*, 2020). Hydatidosis is one of the important parasitic diseases of humans caused by *Echinococcus* spp. of tapeworm. Humans can get infected after consuming food and water contaminated with infected dog faeces containing parasitic eggs.

### Protozoal and fungal zoonotic disease

The main risks to public health are due to *Toxoplasma*, for human living in a household with a cat with kittens seems to be strongly associated with infection. Many protozoal diseases, such as leishmaniasis, can be transmitted through vectors. The travelling or re-homing of dogs can be spread the vectors to new areas (Maia and Cardoso, 2015).

Many fungal species such as *Microsporum* spp. and *Trichophyton* spp. can be transmitted from dogs and cats to humans *via* direct contact and clinically manifest in the form of ringworm (Simpanya and Baxter, 1996).

### Susceptibility of humans

It has been observed that children less than 5 years of age,

pregnant women, elderly people, and others with their immune systems compromised are at high risk of contracting emerging and re-emerging zoonotic diseases. In altered environmental conditions, including immunocompromised hosts, switching of host species becomes easy (Armstrong, 1993; Carlson *et al.*, 2022; Haag *et al.*, 2019).

### Control

About 58–61% of the human zoonoses come from pets. Zoonoses present a serious health threat to the pet owner. Surveillance is crucial to prevent and control zoonotic diseases. It can be used to detect early infection in humans, dogs and cats, reservoirs, vectors, and endemic areas including the “hotspots”. It helps in the adaptation of control strategies against emerging and re-emerging diseases to improve health status of pet lover. The following four surveillance types can be practiced for the control of zoonoses:

1. Pathogen surveillance to detect and identify pathogens.
2. Serological surveillance to detect the presence of pathogens in the blood of humans or in dogs as well as cats through monitoring immune responses.
3. Syndrome surveillance to determine the propensity of diseases through data analysis based on symptoms. This analysis-based surveillance cannot be used to identify the presence of pathogens.
4. Risk surveillance to detect risk factors responsible for the transmission of disease.

Common process of disease control necessitates providing prompt treatment to affected pet, vaccination of healthy dogs and cats, restricting their movement and suitable tests for appearance of any symptom can also be used for the control of zoonoses. Decontamination of infected materials is needed to reduce the chances of acquiring new infections; for example, safe disposal of contaminated belongings of pet and aborted fetus. Personal hygienic management and usage of personal protective equipment such as gloves, masks, helmets, and goggles need to be practiced. When applicable, thorough disinfection of contaminated materials and areas need to be carried out to assist in reducing the spread of zoonoses.

### CONCLUSION

Pet owners who spend too much time with their pets should avoid kissing, sleeping in bed, and swimming with dogs and cats because they may be predisposed to many zoonotic diseases. Companion animals have not just

reduced the level of anxiety but also improved the quality of human life. However, there are some concerns that need to be addressed. Anthelmintic prophylaxis, ectoparasitic drugs, and vaccination can help keep many zoonotic diseases at bay.

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