Prevalence of canine infectious diseases in Gujarat, India: A brief review

Abhi Desai, Krunal Solanki, Harsh Jani and Rajaram Patel

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Abstract

Dogs are one of the most common and well-liked pets in Gujarat, India. People have a different perception and are more open to the idea of having a pet as a companion. Interactions between humans and dogs, as well as close living, pose a significant risk for the development of zoonotic diseases, including diseases that can be carried by dogs. There are many diseases of dogs that have been reported from Gujarat state but not concisely reviewed. Having rich natural resources habitant in wildlife sanctuaries and national park and wild animals, it always under the risk of disease outbreaks. The correct knowledge of vaccination, education on health management, and knowledge of diseases affecting pets are required in order to prevent and control diseases not only in dogs but also important for wild animals. The focus of the current review is on describing dog diseases that are prevalent specifically in Gujarat and southern part of state.

Keywords: Canine infectious, diseases in Gujarat, zoonotic diseases

Introduction

Many infectious diseases are widespread among dogs in India and the rest of the world, but a few serious illnesses are more common in Gujarat and the southern parts of the state. These diseases include canine distemper virus infection, canine gastroenteritis, canine parvovirus infection, canine leptospirosis, canine babesiosis, rabies, and other Infectious diseases seen in dogs pose considerable danger not only to the health of the dogs but also to the human population. Even though veterinary medicine has come a long way in recent years, infectious diseases continue to be a major concern for zoonotic transmission and for dog populations. These diseases have a negative impact on the health of dogs, and many of them are fatal. Several factors contribute to the occurrence of major infectious diseases in canines in the Gujarat and south region of state. These factors include a high population density, poor hygiene, inadequate vaccination, and a lack of awareness regarding zoonotic diseases among both pet owners and the general population. Outbreak of different diseases in pet are preventable, treatable but fatal, too. Due to climatic favoring conditions, there are many disease have been reported from dog population. Various, Bacterial, viral, protozoal, fungal and other diseases are often reported despite of vaccination. Deadly diseases like canine distemper and rabies seen in stray dogs as they are devoid of vaccination. There is no any state policy or social organization set up that covers vaccination to stray dogs. Dog owners should vaccinate their pets annually to avoid the worst possible situation in India (Desai et al., 2021) [9]. As a consequence of this, it is extremely essential to have an understanding of the epidemiology, clinical manifestations, and treatment of these diseases in order to successfully prevent and manage these diseases. The purpose of this review article is to provide an overview of the most common canine diseases that are frequently reported from Gujarat and the southern part of state. This overview will cover the diseases' etiologies, clinical signs, diagnostic methods, treatment options, and some prevention strategies.

Canine Distemper (CD)

Canine distemper virus is a highly infectious and fatal virus (Desai et al., 2021) [9]. It has a worldwide distribution with wide range of hosts which includes members of the families Canidae, Ailuridae, Hyaenidae, Mustelidae, Procynaidae, Ursidae, Viverridae, and felidae (Quinn et al., 2011) [30].
Occurrence of CD has also been reported in several wildlife species including foxes, skunks, raccoons, black footed ferrets and lions. (Appel and Summers, 1995) CDV belongs to the genus Morbillivirus, Subfamily paramyxovirinae, and family paramyxoviridae and in order of mononegavirales. (Desai et al., 2021) It is a single stranded, non – segmented, negative sense RNA that has an envelope and having a size of 150-300 nm size (Murphy et al. 1999). The CDV genome is made up of seven structural proteins: haemagglutinin (H), large protein (L), phosphoprotein (P), nucleocapsid protein (N), fusion protein (F), and matrix protein (M), in addition to one non-structural protein (C) produced via an alternative open reading frame in the P gene (Joshi et al., 2022). The virus is relatively labile and it is transmitted by direct contact or by aerosols, Infection of CDV spreads most commonly in young dogs, usually between 3 to 6 months of age because in this age maternally derived immunity declines. (Quinn et al., 2011) CDV usually occurs in winter season, and it causes disease mostly in non-vaccinated pet puppies and dogs. (Desai et al., 2021) The virus primarily replicates in the upper respiratory tract, spreads to the tonsils and bronchial lymph nodes, and later reaches to various organs including ocular, brain, lymphoid organs, urinary bladder, respiratory system and GIT (Pardo et al., 2005). CDV is a highly immunosuppressive virus, and it causes immunosuppression. The main reason behind it is lymphocytolysis and leukopenia upon viral replication. (Quinn et al., 2011) In CNS, viruses infect both neurons and glial cells and may persist there for very long periods. Dogs with adequate humoral and cellular immunity might show clinical signs but will clear the virus from most tissue within 3 weeks. However, from CNS, lungs and skin viruses can be shed for several months. If there is inadequate immune response, severe clinical disease is seen at 2-3 weeks with death by 3-4 weeks. Recovered dogs can shed viruses for 2-3 months. Initial clinical sign of the disease is pyrexia. Though pyrexia is biphasic, usually initial elevation of temperature may not be noticed. During the second period of pyrexia, oculo-nasal discharge, pharyngitis, and tonsillar enlargement become evident (Quinn et al., 2011) Coughing, vomiting and diarrhea are often consequences of secondary infections. Skin rashes and pustules may be present on the abdomen. Dogs with neurologic signs may develop hyperkeratosis of the footpads and nose due to the epithelial damage referred to as “hard pads”. Common neurologic signs include paresis, myclonus & seizures. Chronic distemper encephalitis, also called old dog encephalitis condition is marked by ataxia, compulsive movements such as head pressing also known as “chorea”. (Kahn and Line, 2010) One of the most consistent postmortem findings of CDV is Thymic Atrophy (Kahn and Line, 2010). Diagnosis of CDV can be done by clinical signs observed in affected animals, viral antigen can be done by immune fluorescence. Eosinophilic inclusions can be demonstrated in nervous and epithelial tissues. Sensitive molecular methods for the detection of CDV RNA in clinical samples include one step, nested and real-time RT PCR and lateral flow essay. Prevalence of canine distemper in south Gujarat was reported 14/18 (77.77%) in the research conducted by Desai et al. (2021) in the year 2020. Prevalence of canine diseases in Gujarat presented in Table 1.

### Table 1: Prevalence of Canine disease in Gujarat

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Diseases</th>
<th>Place</th>
<th>Prevalence</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Canine parvoviral infection</td>
<td>Nalsari</td>
<td>63/145 (43.44%)</td>
<td>Mehta et al., 2017</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Narsari</td>
<td>62.29%</td>
<td>Pandya et al., 2017</td>
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<tr>
<td></td>
<td></td>
<td>South Gujarat</td>
<td>35/73 (47.94%)</td>
<td>Shama et al., 2018</td>
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<tr>
<td></td>
<td></td>
<td>Narsari</td>
<td>37/109 (33.94%)</td>
<td>Desai et al., 2020</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Narsari</td>
<td>34/50 (68%)</td>
<td>Mehta et al., 2020</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anand</td>
<td>145/1540 (9.42%)</td>
<td>Patel et al., 2022</td>
</tr>
<tr>
<td>2</td>
<td>Canine distemper</td>
<td>Anand</td>
<td>14/18 (77.77%)</td>
<td>Desai et al., 2021</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ahmedabad</td>
<td>07/09 (88.88%)</td>
<td>Joshi et al., 2022</td>
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<tr>
<td></td>
<td></td>
<td>Vadodara</td>
<td>01/02 (50%)</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Canine leptospirosis</td>
<td>Narsari</td>
<td>26/56 (46.42%)</td>
<td>Desai et al., 2020</td>
</tr>
<tr>
<td>4</td>
<td>Canine corona viral infection</td>
<td>Narsari</td>
<td>05/109 (4.58%)</td>
<td>Desai et al., 2020</td>
</tr>
<tr>
<td>5</td>
<td>Canine babesiosis</td>
<td>Gujaratt</td>
<td>15.81%</td>
<td>Jadhav, 2015</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Anand and Surat</td>
<td>16/79 (20.25%)</td>
<td>Bilwal et al., 2017</td>
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<td></td>
<td></td>
<td>Junagadh</td>
<td>61/375 (16.27%)</td>
<td>Murabiya et al., 2018</td>
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<tr>
<td>6</td>
<td>Hepatozoon infection</td>
<td>Junagadh</td>
<td>21/317 (6.62%)</td>
<td>Kumar et al., 2018</td>
</tr>
<tr>
<td>7</td>
<td>Canine demodicosis</td>
<td>Ahmedabad</td>
<td>04/177 (02.62%)</td>
<td>Anikat et al., 2021</td>
</tr>
<tr>
<td>8</td>
<td>Canine pyoderma</td>
<td>Saurashtra region</td>
<td>23/340 (5.54%)</td>
<td>Satasiya et al., 2022</td>
</tr>
<tr>
<td>9</td>
<td>Dermatophytosis</td>
<td>Ahmedabad</td>
<td>09/177 (05.08%)</td>
<td>Anikat et al., 2021</td>
</tr>
<tr>
<td>10</td>
<td>Canine scabies</td>
<td>Ahmedabad</td>
<td>05/177 (02.82%)</td>
<td>Anikat et al., 2021</td>
</tr>
<tr>
<td>11</td>
<td>Tick infestation</td>
<td>Ahmedabad</td>
<td>24/177 (13.56%)</td>
<td>Anikat et al., 2021</td>
</tr>
</tbody>
</table>

### Rabies

One of the most fatal viral diseases that can infect mammals, including people, dogs, wild dogs, and cats, is rabies (Desai et al., 2018) Since that, it is the deadliest disease for domesticated animals, preventing the disease must follow the "One Health" principle (Desai et al., 2018) By public awareness programs, rabies deaths can be prevented globally (Desai et al., 2018) One of the most severe viral infections to affect mammals, including dogs and people, is rabies. It is a lethal illness brought on by rabies virus infection. All around the planet, including North America, Central and South America, Asia, Africa, the Middle East, and some regions of Europe, the rabies virus is present. When one infected animal bites another, the virus is spread. Transmission by a different method is uncommon. In North America, the skunk, fox, raccoon, coyote, and bat are significant carriers of the disease, whereas foxes are the primary reservoir in Europe. The primary reservoir is not...
animals but rather stray canines in Asia, Africa, and Latin America. Human infections and mortality are more frequent in these regions. Following the bite, the rabies virus enters the host animal’s peripheral nerves, reproduces, and travels to the salivary glands. Peripheral nerves are any nerves outside of the brain and spinal cord. In this instance, saliva contains the virus. The rabies virus is short lived outside of a mammal’s body. The incubation period (the stretch of time before clinical symptoms manifest) can last anywhere from ten days to a year or more. The incubation period in dogs normally lasts between two and four months. The following factors affect how quickly clinical symptoms appear: 1) The infection location - the virus spreads more quickly to neural tissue the closer the bite is to the brain and spinal cord. 2) How bad the bite was. 3). The quantity of virus that the bite released. The illness develops gradually after being bitten by a rabid animal. The dog’s attitude changes noticeably during the prodromal phase (Initial phase). Active pets grow anxious or timid, whereas quiet animals become irritated. This stage can last two to three days. Following this stage, the clinical disease might take one of two known forms: When a rabid dog exhibits signs of a depraved appetite, such as devouring and chewing on rocks, dirt, and trash, it develops furious rabies (Pica). The rabid animal eventually goes into paralysis and might not be able to eat or drink. Fear of water, or hydrophobia, is not a symptom of canine rabies. It is a characteristic of human rabies. Finally, the dog has a massive seizure and dies. In dogs, dumb rabies is the more prevalent kind. The face is distorted, the limbs gradually become paralyzed, and swallowing is difficult. Dog owners frequently believe their pets have an obstruction in their mouth or throat. Examining should be done carefully because saliva can spread rabies. The dog eventually goes into a coma and passes away. Only a thorough examination of the brain can determine if someone has rabies. This illness cannot be detected in a living animal. Your veterinarian may advise sending the proper brain samples for testing if there is a strong suspicion that the animal has rabies or if an animal exhibiting rabies signs passes away suddenly. This may be necessary if there has been human exposure. The mainstay of rabies prevention is vaccination. Although vaccination encourages the formation of antibodies, it only works if it is administered prior to the virus invading the nervous system. Dog, cat, horse, and ferret rabies immunizations now are very secure and efficient. The virus is extremely immunosuppressive and increases the host’s vulnerability to secondary infections, which are the main cause of death (Joshi et al., 2022). The virus is extremely immunosuppressive and increases the host’s vulnerability to secondary infections, which are the main cause of death (Joshi et al., 2022). In severely affected pups there may be extensive hemorrhage occurs in the intestinal lumen. Therefore, the main clinical signs of CPV infection include sudden onset of vomiting and anorexia, fever may also be observed, blood stained diarrhea, feaces have a fetid smell. Severely affected dogs die within 3 days. Diagnosis of the CPV infection can be done by presence of basophilic intranuclear inclusions in cardiac myocytes that is confirmatory. ELISA & HA test may be used to demonstrate viral antigen. LFA test was used to detect canine parvovirus in the research conducted by Desai et al. (2020) [7]. Prevalence of canine parvovirus in the south Gujarat was reported about 33.94% (Desai et al., 2020) [7]. Similarly the age wise prevalence of CPV are found to be 41.26% in < 3 months of dogs, 25% in the 3 to 6 months of dogs while only 20% in the 6 to 12 months of dogs. (Desai et al., 2020) [7]. Prevalence of canine diseases in Gujarat presented in Table 1.

Canine Leptospirosis
Leptospirosis is one of the major globally concern disease due to its increasing incidence in both developing and developed countries (Desai et al., 2020) [10]. It is caused by pathogenic spirochetes, which is motile and affects numerous hosts all over the world. It is re-emerging as an important zoonotic disease. Different serovar of leptospira interrogans are ubiquitously present in sub-clinically infected wild and domestic animal reservoir hosts (Desai et al., 2020) [10]. In 1886, Adolf Weil reported clinical syndrome characterized by splenomegaly, nephritis and jaundice commonly referred as ‘weil’s disease’ that became synonyms of leptospirosis. Leptospirosis is endemic in south Gujarat because the environmental factors such as the high percentage of rainfall leading to water logging and high humidity favors the
occurrence of leptospirosis in these regions. Pathogenic lep
tospoires can persist in the renal tubules or in the genital tract of
carrier animals. Though indirect transmission can occur whenever environmental conditions are favorable, these
organisms are transmitted mostly by direct contact. Leptospoires invades tissue through moist, softened skin or
through the mucous membrane as this is the motile organisms
motility aid the tissue invasion. After entering into the body,
they spread throughout the body via blood stream. Following
appearance of antibodies at about 10 days after infection,
organisms are generally cleared from the circulation.
However, some organisms evade the immune response and
persist in the body. Principally these persisted organisms
found in renal tubules but also in the uterus, eye or meninges.
The most common presentation for canine leptospirosis in
recent years is acute kidney injury. It also causes
hepatocellular injury, which produces hemolytic anemia,
Jaundice, hemoglobinuria and hemorrhage. Diagnosis of
leptospirosis can be done by dark field microscopy (DFM),
microscopic agglutination test (MAT), ELISA & PCR. (Desai
et al., 2020) [10]. Though DFM is the most economic and
rapid technique used to demonstrate organism under the
microscope it is less sensitive in detection (Desai et al.,
2020) [10]. The gold standard test for the detection of different
serovars from the samples either organisms or antibody
detection is MAT. Prevention of leptospirosis in domestic
animals depends primarily on the use of vaccine. As
immunity is serovar specific vaccine should contain the
prevalent leptospiral serovar present geographical region.
Treatment of cases where there is a higher likelihood of
treatment evasion, which could result in the development of
antibiotic resistance, is highly challenging (Bhinsara et al.,
2018) [4]. Pets as well as domesticated animals (Tumlam
et al., 2022) [36] are the focus of the main problem, which is
antimicrobial resistance and antimicrobial residue (Patel et
al., 2019; Patel et al., 2020) [28, 27]. The intimate contact
between dogs and people may operate as a conduit for the
transmission of resistant germs in the opposite direction. The
risk of occupational injury to humans can be decreased by
using protective equipment and avoiding swimming in
contaminated water sources. Since vaccination is the most
effective method of preventing disease from occurring, testing
a rodent control culling program and vaccinating pets can
both contribute to a decrease in the animal population
(Makwana et al., 2018) [18]. Leptospirosis is endemic in
coastal area of south Gujarat (Desai et al., 2020) [10]. Humans
and domestic animals like cattle, buffalo, sheep, goat and
dogs are affected. Prevalence of leptospirosis in dogs in south
Gujarat was reported 46.42% by testing urine and serum
Furthermore, among all samples collected from male and
female, female dogs (55.55%) affected more than the male
dogs (42.10%) (Desai et al., 2020) [10]. Prevalence of canine
diseases in Gujarat presented in Table 1.

Canine Babesiosis
Canine babesiosis is a clinically significant and
geographically widespread haemoprotezoan disease of dogs.
(Bilwal et al., 2017) [5]. Babesia canis and Babesia gibboni
are the most common occurring species of babesia in the dog.
As it is a tick borne protozoan disease Babesia canis is
transmitted by Dermacentor reticulatus in Europe, B. vogelli
by Rhipecephalus sanguineus in tropical and subtropical
countries. Babesia gibboni is transmitted by Haemaphysalis
longicorns. The disease has been reported in various states of
India including Gujarat (Bilwal et al., 2017) [5]. The lifecycle
of B. gibboni includes two stage, inside the host RBCs, in
which the sporozoite converts into piroplasm and other inside
the tick vector. (Uilenberg, 2006) [17]. A small form of Babesia
is seen in Geimsa stained peripheral blood smear which is
small and of around 1-3 micrometer diameter, ring-oval-or
comma shaped piroplasm which is indicative of B. gibboni
which can be further confirmed by PCR (Bilwal et al., 2017)
[1]. The parasite can also be transmitted by blood exchange
and transplacental transmission. This parasite generally
destroy circulating erythrocytes. Typical clinical sign of
canine babesiosis include anemia, thrombocytopenia,
leukocyte abnormality, increased liver enzymes and
hyperbilirubinemia, hypokalemia, hyperglobulinemia,
azotemia, metabolic acidosis, and abnormalities of urinalysis
may be observed in some severely affected dogs (Bilwal et
al., 2017) [5]. Naturally, occurring cases of B. gibboni are
having variety of clinical signs ranging from anorexia to
hepatomegaly or splenomegaly. Supportive treatment is
usually given, and it includes fluid therapy, anti-inflammatory
and antipyretics, gastroprotectants, oxygen supplementation
and blood transfusion should be employed. However, Babesia
gibboni required specific drug, which is known as atovaquone
(a quinone antimicrobial medication) and azithromycin.
Prevalence of canine babesiosis in south Gujarat was reported
20.25% in the research conducted by Bilwal et al. (2017) [5]
while 15.81% was reported by Jadhav (2015) [13]. Prevalence
of canine diseases in Gujarat presented in Table 1.

Other Diseases
Other important disease that are of kennel cough, herpes virus
infection, canine ehrlichiosis, and other protozoal and
parasitic infection are common like canine demodicosis,
canine pyodermia, dermatophytosis, canine scabies, and tick
infestation (Anikar et al., 2021) [1]. The detail of the reported
diseases are presented in Table 1. These diseases can be
diagnosed by various ways and commonly treatable.
Hepatozoonosis is a tick-borne disease of dog caused by
Hepatozoon parasite and one of the important disease of
dogs. The improved sensitivity of antibody-based serology
assays like direct fluorescent antibody test (Patel et al., 2018
[26]. ELISA based detection kits and nucleic acid- based
polymerase chain reaction (PCR) assays (Vala et al., 2020) [38]
has increased our clinical investigation of bovine, equine,
canine herpesvirus and other canine pathogenic pathogens.
Canine coronavirus disease, also known as CCoV, is a very
contagious intestinal infection that mostly affects puppies
(Desai et al., 2020) [7]. Human and animal gastrointestinal
pathogens include group A rotaviruses (Tumlam et al., 2019;
Makwana et al., 2020; Makwana et al., 2020) [35, 19, 20]. For
collecting epidemiological information and determining the
origin of unusual rotavirus strains, sequence analysis of the
genes encoding the two outer capsid proteins VP7 and VP4,
the inner capsid protein VP6, and the nonstructural protein
NSP4 is helpful (Makwana et al., 2020; Makwana et al.,
2020) [19-20]. There is a high probabilities of disease
occurrence when animal transported from one place to other,
movement of animals, or confine them together at one place
as organized farm (Sakhare et al., 2019; Sharma et al., 2019)
[31, 33]. Therefore, it causes spreading of disease among dog
population as well as other animal population. It also
contributes to the spread of viral and bacterial pathogens
between species. Along with mast cell tumors, basal cell
carcinomas, histiocytomas, and lymphomas, TVT is currently classed as a round cell neoplasm. However, there have also been reports of other tumor cases, such as perianal gland adenoma (Chaudhari et al., 2017) [16]. Especially among stray and breeding dogs, TVT is naturally infectious and sexually transmissible among dogs. Therefore, canine tumors like TVT and canine memory glad tumors are also common in the Gujarat and southern part of state.

Conclusion
The current review of diseases presented the percent positivity of diseases and reviewed. Canine diseases are preventable through the vaccination; however, every year dog is infected and treated. Many diseases like, canine paroviral infection, canine distemper, canine leptospirosis, canine corona viral infection, canine babesiosis, heptatozoon infection, canine demodicosis, canine pyoderma, dermatophytosis, canine scabies, tick infestation have been reported from different part of Gujarat. There are still many diseases might prevalent in Gujarat but not reported through literature. Due to the stray dog population and not having any vaccination policies, there may be the possibilities in rise of diseases outbreaks.

References
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