The Pharma Innovation Journal 2023; 12(3): 3651-3656

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(3): 3651-3656

www.thepharmajournal.com
Received: 18-01-2023
Accepted: 21-02-2023

Arjun K Kasondra
Veterinary Officer, Government of Gujarat, Gujarat, India

Nirav H Joshi
Veterinary Officer, Government of Gujarat, Gujarat, India

Santul S Patel
Veterinary Officer, GVK EMRI, Gujarat, India

Corresponding Author:
Arjun K Kasondra
Veterinary Officer, Government of Gujarat, Gujarat, India

Prevention and control of dog and cat diseases in India

Arjun K Kasondra, Nirav H Joshi and Santul S Patel

Abstract
Dogs give you unconditional love for life. Owing a dog is a wonderful experience, but it also comes with the responsibility of keeping our companions healthy and free of any diseases. Despite our best knowledge and efforts, dogs are vulnerable to variety of illness. From just a common cold to the life-threatening conditions such as malignant tumour. In this modern era, climatic conditions has been changing very rapidly and that is favorable for many organisms to multiply and spread rapidly. In addition to that, one major problem is antimicrobial resistance in developing countries, today due to indiscriminate use of antibiotics many organisms' resist them and continue to grow. It is very challenging for veterinarians to decide effective treatment against infectious diseases of canines without creating more antibiotic resistance. Another major concern today is spreading of zoonotic diseases. To prevent the occurrence of the diseases, prevention and control measurements must require knowing by pet owners. They must aware of all the zoonotic diseases that can be life threatening to their pets. Therefore, this article aims to summarize strategies to prevention and control the dog and cat diseases.

Keywords: Prevention, control, dog and cat, diseases

Introduction
Dogs are a significant source of zoonotic infections. Many viral and bacterial illnesses are transmitted from dogs to humans. Zoonotic diseases can be transmitted from dogs to humans via infected saliva, aerosols, contaminated urine or feces, and direct touch. The most common viral and bacterial zoonotic infections transmitted to humans by dogs are rabies and norovirus, as well as *Pasteurella, Salmonella, Brucella, Yersinia enterocolitica, Campylobacter, Capnocytophaga, Bordetella bronchiseptica, Coxiella burnetii, Leptospira, Staphylococcus intermedius* and Methicillin-resistant *staphylococcus*. This review focuses on prevention and control of dog and cat diseases.

Increasing the knowledge and awareness of dog owners and the broader population about zoonotic illnesses could dramatically reduce the transmission of zoonoses and, consequently, their lethal sequelae. Concisely by preventing zoonotic diseases, antimicrobial resistance and food safety, we can achieve the goal of one health. (Desai *et al*., 2018[a]; Desai *et al*., 2018[b]) [10, 11] Therefore, it is very important not only for veterinarians but also for pet owners to aware of the different types of diseases that can affect dogs and take some valuable steps to prevent and control them. In this article, we will explore the most common types of dog and cat diseases and provide tips and advice on how to prevent them. By following the advice in this article, you can help your furry friend lives a long, happy and healthy life.

Indian Scenario
Dogs are an essential component of human society and have long served as companions and watchdogs for people. Dogs hold a unique place in the hearts of Indians, and several religions hold them in high regard. Dogs can provide affection and devotion, but they can also bring illnesses that can influence both humans and other animals. For the wellbeing of animals and the general people, the frequency of dog diseases in India is a major concern. The prevalence of dog diseases in India, their effects on human health and animal welfare, and the steps the government and other organizations have done to manage and prevent these diseases will all be covered in this paper. Dogs are very prevalent in India, where there are thought to be 35 million of them and their numbers are growing quickly as a result of urbanization and a growth in pet ownership (Belsare *et al*., 2021) [2]. The prevalence of dog diseases is rising along with the growth in dog population. The most prevalent canine illnesses in India include rabies, parvovirus, distemper, leishmaniosis, and illnesses transmitted by ticks.

India has the highest incidence of canine rabies and more than one-third of all human rabies

deaths worldwide (Singh *et al*., 2020) [24]. The World Health Organization (WHO) estimates that over 20,000 people every year in India pass away from rabies, and the majority of these fatalities are brought on by dog bites (WHO, 2019) [28]. Almost 36% of dogs in India are thought to have rabies, and stray dogs are more likely to contract the illness (Bhattacharya *et al*., 2021) [3]. As a zoonotic illness that may spread from animals to people, rabies is lethal as soon as symptoms occur. The government has implemented many steps, including vaccination and sterilization programs, to control and eradicate rabies in dogs. The main source of rabies in India is the population of stray dogs.

Dogs of all ages can contract the highly contagious viral infections parvovirus and distemper, which can result in serious illness and even death. Although the prevalence of these illnesses in India is not fully known, they are thought to pose a serious health risk to dogs, particularly puppies. Both dogs and people can get leishmaniasis, a parasitic disease spread by sandflies. Leishmaniasis in dogs is thought to affect 5-10% of canines in India, with the southern and western regions of the nation having higher rates of the condition. If neglected, the condition can result in deadly organ damage, severe skin rashes, weight loss, and other symptoms. In India, tick-borne illnesses including ehrlichiosis and babesiosis are also common and can lead to fever, anemia, and other health issues in dogs. Canine coronavirus disease, also known as CCoV, is a very contagious intestinal infection that mostly affects puppies (Desai *et al.,* 2020[a]) [6]. Human and animal gastrointestinal pathogens include group A rotaviruses (Tumlam *et al.,* 2019; Makwana *et al.,* 2020[a]; Makwana *et al.,* 2020[b]) [25, 15, 16]. 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[a]; Makwana *et al.,* 2020[b]) [15, 16]. Clinical investigation of bovine, equine, canine herpesvirus and other canine pathogenic pathogens has increased due to increased sensitivity of antibody-based serology assays like the direct fluorescent antibody test (Patel *et al*., 2018) [18], ELISA-based detection kits, and nucleic acid-based polymerase chain reaction (PCR) assays (Vala *et al*., 2020) [27]. Treatment of cases where there is a higher likelihood of treatment evasion, which could result in the development of antibiotic resistance, is highly challenging due to resistance development (Bhinsara *et al*., 2018) [4]. Pets as well as domesticated animals (Tumlam *et al*., 2022) [26] are the focus of the main problem, which is antimicrobial resistance and antimicrobial residue (Patel *et al*., 2019; Patel *et al*., 2020) [20, 19]. 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) [5]. Especially among stray and breeding dogs, TVT is naturally infectious and sexually transmissible among dogs. To control the spread of TVT, pet dogs need frequent vet support and health checkup.

Canine disease effects on human health and animal welfare

Public health and animal welfare are significantly impacted by the frequency of dog illnesses in India. Particularly rabies, which can be spread from dogs to people through bites or scratches, is a serious public health risk. Once symptoms start to manifest, the illness is incurable and lethal. Because it claims lives and puts a strain on the healthcare system, rabies has a huge economic impact as well. In India, the annual cost of treating rabies in humans is estimated to be over $8.6 billion (WHO, 2019) [28]. Canine diseases can result in suffering and death in dogs, which has an effect on animal welfare as well. Puppies can suffer from serious disease and even pass away from distemper and parvovirus, respectively. Puppy illnesses like parvovirus and distemper, for instance, can result in serious illness and death, causing suffering for both the affected animals and their owners. Dogs can experience discomfort and weakness from tick-borne illnesses including ehrlichiosis and babesiosis, which, if ignored, can lead to severe anemia and even death. Another common dog ailment in India is leishmaniasis, which can result in skin sores, weight loss, and organ damage as well as prolong the suffering of the affected animals. Leishmaniasis-infected dogs are frequently put to death in order to stop the disease from spreading, which can further compromise animal welfare. In addition, the prevalence of canine illnesses may have an effect on how people behave and see dogs in society. The idea that dogs can spread diseases can lead to fear of dogs and bad impressions of them. This can worsen animal welfare by encouraging prejudice towards dogs and the abuse of stray dogs.

Ways to Prevent and Control Dog and Cat Diseases

To regulate and prevent dog diseases in India, the Indian government and other animal welfare organizations need to come together and start state wide vaccination policy particularly for the stray dogs. As strays are India's main source of rabies, the government has initiated sterilization initiatives in addition to vaccination campaigns to reduce the number of strays. By neutering or spaying the animals, sterilization initiatives work to lower the number of stray dogs, which can also help slow the spread of disease within the stray dog population. The goal of animal welfare organizations in India is to promote responsible pet ownership and increase public knowledge of canine diseases. To assist stop the spread of diseases and enhance animal welfare, these organizations offer information and resources on basic pet care, including vaccinations and routine check-ups.

1. Canine distemper

Canine distemper is a highly contagious viral disease that affects both wild and domestic dogs. It is caused by the canine distemper virus (CDV) and is characterized by respiratory, neurological, and gastrointestinal symptoms. The deadly canine distemper virus (CDV) affects dogs, foxes, wolves, lions, and tigers (Desai *et al*., 2021) [10]. The CDV virus belongs to the order Mononegavirales, subfamily Paramyxovirinae, family Paramyxoviridae and genus Morbillivirus. It is a single-stranded, nonsegmented, encapsulated negative-sense RNA virus with a diameter of 150-300 nm (Desai *et al*., 2021) [10]. The CDV genome is made up of seven structural proteins: hemagglutinin (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[a]) [12]. The respiratory tract's lymphatic system is where the virus replicates most frequently before spreading to other organs

such the eye, brain, lymphoid organs, bladder, respiratory system, and gastro intestinal tract (GIT) (Desai *et al.*, 2021) [10]. Although it has a stronger affinity for the digestive, respiratory, and central nervous systems, it nevertheless has significant negative effects and clinical symptoms (Joshi *et al.*, 2022[b]) [13]. 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[a]; Joshi *et al*., 2022[b]) [12, 13]. The virus spreads through bodily fluids, including nasal discharge and feces, and can survive outside the host for up to several hours. Canine distemper virus is the highly infectious and fatal virus (Desai *et al*. 2020) [6] that affects dogs and other animals, including foxes, skunks, raccoons, black footed ferrets & lions (Appel and sumners 1995) [1]. Tremendous loss of wildlife population was recorded in the past due to canine distemper. (Desai *et al*., 2018[b]) [11]. CDV belongs to the genus morbillivirus. It is spread through contact with bodily fluids such as Saliva, Urine and Faces. 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. CDV usually occurs in winter season and it causes disease mostly in non-vaccinated pet puppies and dogs. (Desai *et al*., 2021) [10]. Most common symptoms of canine distemper include respiratory distress, fever and neurological signs such as seizures and paralysis. There is no cure for canine distemper so prevention is critical.

1.1 Prevention and control

Vaccination

The most effective way to prevent CD is vaccination. Puppies are typically vaccinated against distemper in the early age, as a part of the core vaccine series, which also includes vaccine for other diseases like parvovirus and leptospirosis. To maintain the immunity adult dogs should receive the booster vaccine. It is very important for pet owners to follow the vaccination schedule given by vets because it is formed in a way that is appropriate for dog's age, health status and life style. Immune- stimulating complexes (ISCOMs) are used to develop vaccine against CD.

Isolation and Quarantine

If a dog is diagnosed with canine distemper, it is very important to isolate those dogs from others to prevent the disease from spreading. This isolation should be done until they have fully recovered and are no longer shedding the virus. Though quarantine is very challenging for pet owners it is mandatory for preventing the spread of this highly contagious disease.

Hygiene

Good hygiene can also help to prevent the spread of CD. Regular washing of hand, disinfection of floor of cages and proper disposal of contaminated materials can help to reduce the risk of transmission.

2. Rabies

Dog owners should vaccinate their pets annually to avoid the worst possible situation in India (Desai *et al*., 2021) [10]. One of the most fatal viral diseases that can infect mammals, including people, dogs, wild dogs and cats, is rabies (Desai *et al*., 2018[b]) [11]. Since that, it is the lethal disease for domesticated animals, preventing the disease must follow the "One Health" principle (Desai *et al*., 2018[a]) [10]. By public awareness programs, rabies deaths can be prevented globally (Desai *et al*., 2018[b]) [11]. Rabies is a viral disease that affects both dogs and cats, as well as other mammals, including humans. It is spread through the bite of an infected animal and attacks the central nervous system of the host. Symptoms of rabies include fever, agitation, disorientation, paralysis and death.

2.2 Prevention and Control

The most effective prevention strategy for rabies is vaccination. Both dogs and cats should receive their first rabies vaccine between 12 and 16 weeks of age, followed by booster shots every one to three years, depending on the type of vaccine used. It is also essential to keep your pet away from wild animals, especially bats, skunks, foxes, and raccoons, as they are primary carriers of the virus.

3. Canine parvovirus

The most common cause of illness and mortality in dogs worldwide is canine parvovirus enteritis (PVE), which is brought on by one of three types of canine parvovirus type 2 (CPV-2; family Parvoviridae, Genus Parvovirus) (Desai *et al*., 2020[a]; Desai *et al*., 2020[b]) [6, 7]. Although puppies under six months of age are the majority of those affected by severe clinical disease, adults with weakened immune systems may also be affected (Desai *et al.*, 2020[a]) [6]. Because CPV-2 is pervasive and can linger in the environment for more than a year, it can expose dogs that are more susceptible to faeces, vomit, or fomites that are contaminated (Desai *et al.*, 2020[b]) [7]. Canine parvovirus is a highly contagious viral disease that affects dogs, especially puppies. The virus can survive in the environment for up to a year and is spread through contact with infected feces or objects contaminated with the virus. Symptoms of parvovirus include vomiting, diarrhea, fever, lethargy, and dehydration. Canine parvovirus is a single stranded DNA virus having an icosahedral symmetry. (Desai *et al.*, 2020[a]) [6]. Transmission occurs mostly by the faeco-oral route. Furthermore infected dogs shed large numbers of viruses in their faeces. This virus mainly affects puppies and young dogs. The virus mainly attack the dog's gastrointestinal tract and can also damage the immune system, leading to potentially life threating symptoms. (Desai *et al*., 2020[b]) [7]. Therefore, the main clinical signs of CPV infection include sudden onset of vomiting and anorexia, fever may also be observed, blood stained diarrhoea, faeces have a foetid smell. Severely affected dogs die within 3 days. ELISA & HA test may be used to demonstrate viral antigen.

3.1 Prevention and control

Vaccination

Vaccination is the most effective way to prevent canine parvovirus. Puppies should receive their first vaccine between six to eight weeks of age, followed by booster shots every three to four weeks until they are 16 weeks old. After that, dogs should receive annual booster shots to maintain immunity. It is also essential to keep your dog away from infected animals and contaminated environments. The best way to prevent canine distemper is to get your dog vaccinated. Puppies should receive their first vaccination at six weeks of age, followed by booster shots every 3-4 weeks until they are 16 weeks old. After that, dogs should receive annual booster shots to maintain immunity. It is also essential

to keep your dog away from other infected animals, especially during outbreaks. Effective immunization is essential for the protection of the individual pet and the decrease the population of susceptible animals in a particular region, thus promoting the herd immunity (Mylonakis *et al*., 2016) [17]. Puppies should receive a series of vaccinations starting at 6-8 weeks of age, with boosters given every 3-4 weeks until they are Weeks age. Adult dog should also receive regular vaccinations to maintain the immunity**.** Prevalence of canine parvovirus in the south Gujarat, India was reported about 33.94% (Desai *et al*., 2020[a]) [6]. 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[a]) [6]. So strict measured should be followed in south Gujarat to prevent this disease.

Avoid contact with infected dogs

Since canine parvovirus is highly contagious, dogs should be kept away from other infected dogs. Moreover, proper hygiene should ensure to prevent this infection.

Treatment

Treatment of parvovirus infection is mainly based on supportive and symptomatic. The principle components of treatment include: Lactated Ringers is the fluid of choice for initial restoration.

Antibiotic therapy: Broad-spectrum antibiotic is used. Ampicillin and cefoxitin as single agent or in combination with enrofloxacin is used. Antiemetic treatment: Metoclopramide is generally used. Antiviral treatment: Oseltamivir, a neuraminidase inhibitor is used as antiviral agent (Mylonakis *et al*., 2016) [17].

4. Canine Leptospirosis

The main reservoir host for pathogenic Leptospira species strains, which are mostly associated with disease, is rodents (Desai *et al*., 2020[c]) [9]. Dogs, however, can potentially transmit disease as secondary hosts. An individual can get an infection by rubbing damaged skin against wet or dirty surfaces, or by ingesting food or liquids contaminated by uric acid (Desai *et al*., 2020[c]) [9]. Leptospirosis is one of the major globally concern disease due to its increasing incidence in both developing and developed countries (Desai *et al*., 2020[c]) [9]. It is caused by pathogenic spirochetes that is motile and affects numerous hosts all over the world. Different serovars of leptospira interrogans are ubiquitously present in sub-clinically infected wild and domestic animal reservoir hosts (Desai *et al*., 2020[c]) [9]. Leptospires 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 (Quinn *et al*., 2011) [21]. 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 that produces haemolytica 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[c]) [9]. However, DFM is economic and rapid technique used to demonstrate organism under the microscope it is less sensitive in detection (Desai *et al*., 2020[c]) [9]. The gold standard test for the detection of different serovars from the samples either organisms or antibody detection is MAT**.** Leptospirosis is endemic in coastal area of south Gujarat (Desai *et al*., 2020[c]) [9]. Humans and domestic animals like cattle, buffalo, sheep, goat and dogs are affected.

4.1 Prevention and control

Rodents are responsible for carrying and spreading of the disease so it is important to control rodents. Get your pets vaccinated against leptospirosis. Major constraint of vaccination against this disease is vaccine does not provide 100% immunity because there are many strains of leptospirosis. Pet owners should also take steps to prevent themselves and others from becoming infected with this disease. Do not handle or come in contact with urine, blood, or tissue from infected. 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) [14]. The most important thing to do when disease is most likely to occur and spread is to move animals from one area to another and confine them in farms (Sakhare *et al*., 2019; Sharma *et al*., 2019) [22, 23]. It also contributes to the spread of viral and bacterial pathogens between species. Therefore, organized farm should have biosecurity or biohazard management that continuously watched on controlling the diseases spread.

5. Feline Panleukopenia

Feline panleukopenia, also known as feline distemper, is a highly infectious viral disease that affects cats. The virus is spread through direct contact with an infected cat's bodily fluids or contaminated objects. Symptoms of feline panleukopenia include fever, dehydration, vomiting, diarrhea, and anemia.

5.1 Prevention and Control

Vaccination is the most effective way to prevent feline panleukopenia. Kittens should receive their first vaccine between six to eight weeks of age, followed by boosters every three to four weeks until they are 16 weeks old. Adult cats should receive annual booster shots to maintain immunity. It is also crucial to keep your cat away from other infected animals.

6. Feline Immunodeficiency Virus

Feline immunodeficiency virus (FIV) is a retrovirus that affects cats. The virus is spread through bites from infected cats and targets the immune system, leading to various health problems. Symptoms of FIV include fever, fatigue, weight loss, anemia, and frequent infections.

6.1 Prevention and Control

Currently, there is no cure for FIV, so prevention is essential.

Cats should be kept indoors to prevent exposure to infected animals. Some vaccines are available, but they are not effective in all cases. If your cat has tested positive for FIV, it is essential to take extra precautions and provide regular medical checkups.

Conclusion

Dogs and cats are the most common pets in India and they play an important role in people's lives. However, these pets are prone to a wide range of diseases, many of which can be easily prevented by adopting proper health care strategies. Some of the most common diseases that affect dogs and cats in India, along with their prevention and control measures were discussed. For the wellbeing of animals and the general people, the frequency of dog diseases in India is a major concern. The most serious disease affecting dogs in the nation, rabies, claims thousands of lives every year. Leishmaniasis, parvovirus, distemper, and illnesses transmitted by ticks all pose serious health risks to both humans and dogs. These illnesses have a big effect on animal welfare since they can make dogs sick and even kill them. To regulate and prevent dog diseases, implementation of prevention and control policies need to be strongly follow by vaccination and sterilization programs as well as education campaigns regarding appropriate pet ownership. In some regions of the India, the incidence of canine diseases has decreased as a result of these initiatives. To fully address the issue and lessen the impact of dog diseases on both public health and animal welfare, more needs to be done. In conclusions, vaccination, isolation, treatment and culling of the animals are the ways to prevent and control of diseases.

References

1. Appel MJ, Summers BA. Pathogenicity of morbilliviruses for terrestrial carnivores. Veterinary microbiology. 1995 May;44(2-4):187-91.
2. Belsare AV, Gompper ME, Talmale SS. Urban free-ranging dogs in India: A review of their ecology and management. Frontiers in Veterinary Science. 2021;8:635-998.
3. Bhattacharya SK, Sarkar J, Biswas D. Epidemiology of rabies in India and its control measures. International Journal of Livestock Research. 2021;11(1):20-32.
4. Bhinsara DB, Sankar M, Desai DN, Hasnani JJ, Patel PV, Hirani ND, *et al*. Benzimidazole resistance: An overview. International Journal of Current Microbiology and Applied Sciences. 2018;7:3091-104. https://doi.org/10.20546/ijcmas.2018.702.372
5. Chaudhari SV, Joshi BP, Desai DN, Ghodasara DJ, Gondaliya RB, Choudhary KR, *et al*. Prevalence of perianal gland adenoma in canines in Gujarat. Lifesciences Leaflets. 2017;91:60-5. https://petsd.org/ojs/index.php/lifesciencesleaflets/article/view/1204
6. Desai D, Kalyani I, Patel D, Makwana P, Solanki J, Vala J. Rapid Detection based Prevalence of Canine Corona Virus (CCoV) and Canine Parvo Virus (CPV) Infection in Diarrheic Dogs in South Gujarat. The Indian Journal of Veterinary Sciences and Biotechnology. 2020[a] Jul;16(1):42.
7. Desai D, Kalyani I, Ramani U, Makwana P, Patel D, Vala J. Evaluation of three different methods of viral DNA extraction for molecular detection of canine parvo virus-2 from faecal samples of dogs. Journal of Entomology and Zoology studies. 2020[b];8(3):479-81.
8. Desai D, Kalyani I, Solanki J, Patel D, Makwana P, Sharma K, *et al*. Serological and nucleocapsid gene based molecular characterization of canine distemper Virus (CDV) isolated from dogs of Southern Gujarat, India. Indian Journal of Animal Research. 2021;55(10):1224-32.
9. Desai D, Makwana P, Solanki J, Kalyani I, Patel D, Mehta S, *et al*. Detection and Prevalence of Canine Leptospirosis from Navsari District of South Gujarat, India. Microbiology Research Journal International. 2020[c]:30(9):103-110.
10. Desai DN, Kalyani IH, Muglikar DM. One Health Approach for Prevention and Control of Swine Influenza. Technical Seminar on One Health. 2018[a];1(1):11-16.
11. Desai DN, Kalyani IH, Muglikar DM. One Health Initiative for Management of Wildlife Diseases. Technical Seminar on One Health. 2018[b];1(1):17-21.
12. Joshi VR, Bhanderi BB, Mathakiya RA, Jhala MK, Desai DN. Sero-surveillance of Canine Distemper in Dogs. Indian Journal of Veterinary Sciences & Biotechnology. 2022[a] Jul;18(3):100-3.
13. Joshi VR, Bhanderi BB, Nimavat VR, Jhala MK, Desai DN. Comparison of Lateral Flow Assay and RT-PCR for Detection of Canine Distemper Virus in Dogs. Indian Journal of Veterinary Sciences & Biotechnology. 2022[b] Jul;18(3):79-83.
14. Makwana P, Kalyani I, Desai D, Patel D, Sakhare P, Muglikar D. Role of Adjuvants in Vaccine Preparation: A Review. Int. J Curr. Microbiol. App. Sci. 2018;7(11):972-88. https://doi.org/10.20546/ijcmas.2018.711.113
15. Makwana PM, Kalyani IH, Desai D, Patel JM, Solanki JB, Vihol PD, *et al*. Detection of bovine rotavirus (BRV) infection in neonatal calves of in and around Navsari district of South Gujarat, India. J Entomol Zool Stud. 2020[a];8(2):1092-7.
16. Makwana PM, Kalyani IH, Desai D. Isolation of bovine rotavirus in MDBK cell line from diarrhoeic calves of Navsari district. The Pharma Innovation Journal. 2020[b];9(5):222-5.
17. Mylonakis ME, Kalli I, Rallis TS. Canine parvoviral enteritis: an update on the clinical diagnosis, treatment, and prevention. Veterinary Medicine: Research and Reports, 2016 Jul, 91-100.
18. Patel DR, Kalyani IH, Trangadia BJ, Sharma KK, Makwana PM, Desai D, *et al*. Detection of Bovine Herpesvirus-1 infection in Bovine clinical samples by direct fluorescent antibody test. Int. J Curr. Microbiol. App. Sci. 2018;7(11):2229-34.
19. Patel NM, Kumar R, Savalia CV, Desai DN, Kalyani IH. Dietary exposure and risk assessment of antibiotics residues in marketed bovine raw milk. J Entomol. Zool. Stud. 2020;8:1823-7.
20. Patel NM, Kumar R, Suthar AP, Desai DN, Kalyani IH. Resistant Pattern of Therapeutics Antimicrobial Challenged on Pseudomonas aeruginosa Bacterium Isolated from Marketed Raw Buffalo Milk. European Journal of Nutrition & Food Safety. 2019;9(4):398-407.
21. Quinn PJ, Markey BK, Leonard FC, Hartigan P, Fanning S, Fitzpatrick E. Veterinary microbiology and microbial disease. John Wiley & Sons; c2011 Oct.
22. Sakhare P, Kalyani I, Vihol P, Sharma K, Solanki J,

Desai D, *et al*. Seroepidemiology of Peste des Petits Ruminants (PPR) in Sheep and Goats of Southern Districts of Gujarat, India. International journal of current microbiology and applied science. 2019;8(11):1552-65.
23. Sharma KK, Desai DN, Tyagi KK, Kalyani IH. Bacteriological and molecular diagnosis of caseous lymphadenitis in goats at an organized farm. Indian Journal of Small Ruminants (The). 2019;25(1):124-7.
24. Singh R, Singh KP, Cherian S, Saminathan M. Epidemiology of rabies in India: A comprehensive review. Journal of Infection and Public Health. 2020;13(6):776-785.
25. Tumlam UM, Ingle VC, Desai D, Warke SR. Molecular characterization and phylogenetic analysis of rotavirus of human infants, calves and piglets. Journal of Entomology and Zoology Studies. 2019;7(4):956-960.
26. Tumlam UM, Pawade MM, Muglikar DM, Desai DN, Kamdi BP. Phylogenetic Analysis and Antimicrobial Resistance of Escherichia coli Isolated from Diarrheic Piglets. Indian Journal of Veterinary Sciences & Biotechnology. 2022 Jul;18(3):119-21.
27. Vala JA, Patel MD, Patel DR, Ramani UV, Kalyani IH, Makwana PH, *et al*. Diagnosis of Equine Herpes Virus 4 Infection using Polymerase Chain Reaction. Int. J Curr. Microbiol. App. Sci. 2020;9(11):887-90.
28. WHO. The WHO position on rabies immunization-2018 updates. Vaccine. 2019 Oct;37(1):A85.