

# Clinico-epidemiological Assessment of Feline Infectious Peritonitis at a Teaching Pet Hospital in Bangladesh



A Clinical Report Submitted for Evaluation

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# Clinico-epidemiological Assessment of Feline Infectious Peritonitis at Teaching Pet Hospital in Bangladesh



**This is to certify that I have examined the clinical report and found  
it is complete and satisfactory in all aspects for evaluation**

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## List of abbreviations

Abbreviation	Elaboration
CVASU	Chattogram Veterinary and Animal Sciences University
DVM	Doctor of Veterinary Medicine
FCoV	Feline Corona Virus
FIP	Feline Infectious Peritonitis
n	Number of positive cases
N	Number of total population
p	Probability value
RNA	Ribonucleic acid
RT-PCR	Reverse Transcriptase Polymerase Chain Reaction
SAID	Steroidal Anti-inflammatory Drug
TTPHRC	Teaching and Training Pet Hospital and Research Center

## Abstract

Feline Infectious Peritonitis (FIP) is a highly contagious, potentially fatal viral disease of cats caused by Feline Coronavirus (FCoV). The morbidity and mortality of this disease in cats is very high but scientific studies in FIP are not available in Bangladesh. Therefore, the present study was conducted to evaluate the clinical presentations of FIP, to detect risk factors associated with FIP and describe signs, diagnostic and therapeutic patterns against FIP. The study was conducted at Teaching and Training Pet Hospital and Research Center, Dhaka, Bangladesh (1 to 30 September 2021). Clinico-epidemiological data were collected from April to September 2021, entered into MS excel 2007 and analyzed by STATA-14 software. The descriptive and univariable statistical analysis revealed that the overall prevalence of FIP in cats was 2.3% (Confidence interval: 1.5 to 3.33) during the study period and the prevalence of FIP was significantly higher ( $p < 0.05$ ) in unvaccinated cats (66.7%) than the cats those were vaccinated (32.1%). Listlessness, fluctuating fever, dyspnea, mild to moderate dehydration and ascites were prominent clinical signs of FIP in cats. Antibiotics, steroidal anti-inflammatory drugs, diuretics along with vitamins and minerals supplement were commonly prescribed against FIP. The implementation of the study is that by vaccinating the cats against FIP at young age can reduce the occurrence of this disease. Along with considering the clinico-epidemiological findings, performing rapid kit test or Rivalta's test will be helpful to diagnose the disease. However, affected cats should be treated cautiously and symptomatically to mitigate this disease condition. Therefore, a treatment protocol to manage FIP in cats and avoid antibiotic resistance development should be introduced to the pet hospital.

**Key words:** Cat, Feline Infectious Peritonitis, Risk Factors, Signs, Treatment.

## Chapter 1: Introduction

Feline Infectious Peritonitis (FIP) which is also known as ‘Chronic Fibrinous Peritonitis’ is a fatal immuno-pathological disease of wild and domesticated Felidae (Pedersen, 1995). This viral disease is a fatal immune-mediated disease caused by the virus named as ‘Feline coronavirus’ (FCoV) (Pedersen, 1987). Feline coronavirus belongs to the family Coronaviridae, a group of enveloped positive-stranded RNA viruses that are frequently found in cats (Pedersen, 1976). Approximately 1 of every 200 new feline cases presented to American Veterinary Teaching Hospitals represents a cat with FIP (Rohrbach et al., 2007). It is also a major factor in kitten mortality (Cave et al., 2002). Feline Infectious Peritonitis is distributed worldwide in household and wild cats (Horzinek and Osterhaus 1979). The virus is endemic especially in environments in which many cats are kept together in a small space (e.g., catteries, shelters, pet stores). At least 50% of cats in the United States and Europe have antibodies against coronaviruses (Sparkes et al., 1992; Horzinek et al., 1986). Although the prevalence of FCoV infection is high, only approximately 5% of cats in multiple-cat household situations develop FIP; the number is even lower in a single-cat environment (Pedersen, 1976; Addie et al., 1992). The prevalence of FIP has not been studied yet in Bangladesh.

The clinical presentations of FIP are variable and often complex, depends on the variations in the virus and the nature of the host immune response. Approximately 50% of all cats diagnosed worldwide are less than 2-years-old and purebred (Pedersen, 1995). Two broad forms of the disease have been described across all ages and breeds: ‘effusive’ and ‘non-effusive’. Despite this apparent division, these are not distinct disease entities. Cats with FIP may alternate between forms during the progression of disease (Addie et al., 2004). Furthermore, cats with non-effusive FIP may develop effusions in the terminal stages of disease (Pedersen, 1995). Typically, the cats with effusions have ascites; abdominal effusions, and/or pericardial effusion (Hartmann et al., 2002). The non-effusive form of FIP is often vaguer in its presentation with nonspecific signs including fever, weight loss, lethargy and decreased appetite (Trulove et al., 1992).

The morbidity and mortality rates due to FIP in cats were reported to be 90% and 100%, respectively (Hok, 1993). The diagnosis of FIP is difficult using non-invasive methods. Reverse

Transcriptase Polymerase Chain Reaction (RT-PCR) on blood (not available in Bangladesh), effusions or tissue and serum antibody tests (available in Bangladesh) have been considered to be helpful in supporting a clinical diagnosis of FIP (Pedersen, 1983) but they must be considered together with the patient's history and other clinico-pathological findings and can never be used alone (Addie et al., 2004).

The most consistent laboratory finding in cats with FIP is an increase in total serum protein concentration (Hartmann et al., 2002). This is found in approximately 50% of cats with effusion and 70% of cats without effusion (Sparkes et al., 1994). This increase in total protein is caused by increased globulins, mainly which lead to a decrease in the albumin-to-globulin ratio (Shelly et al., 1988). Total protein in cats with FIP can reach high concentrations of up to 12 g/dL (120 g/L) and more. If the total serum protein concentration is 120 g/L or greater, the likelihood of FIP is 90% (Hartmann et al., 2003).

Rapid kit test for FIP is commonly used in the hospitals. Feline Infectious Peritonitis antigen rapid test device is a lateral flow immunochromatographic assay for the qualitative detection of FIP viral antigens in feline feces or ascites. Sensitivity and specificity of this test is 84.6% and 100%, respectively (FASTest FIP) (Addie et al., 2015).

Because FIP is an immune-mediated disease, treatment is aimed at controlling the immune response to FCoV, and the most successful treatments consist of relatively high doses of immuno-suppressive and anti-inflammatory drugs. Cats with FIP should also be treated with broad-spectrum antibiotics and supportive therapy (e.g., subcutaneous fluids) for as long as they are comfortable (Watari et al., 1998).

Feline Infectious Peritonitis is a highly contagious and fatal disease for cat, the detail clinico-epidemiological study regarding the disease is important to prevent and control the disease. So far very few studies for feline infectious peritonitis have been documented in Bangladesh. Therefore, the present study conducted during the clinical rotation of Doctor of Veterinary Medicine (DVM) internship program at Teaching and Training Pet Hospital and Research Center (TTPHRC), Dhaka, facilitated opportunity to view overall clinical representation of FIP with its drug prescription pattern. The specific objectives of this study were to i) estimate the prevalence of FIP in cat presented at the TTPHRC, ii) determine the association of FIP in cats and the

selected factors, iii) describe the observable clinical signs of FIP and iv) evaluate the pattern of drugs prescribed against FIP in cats.



## Chapter 2: Materials and methods

A one-month clinical rotation (in October 2021) was completed at the selected placements in Dhaka metro and adjacent areas, Bangladesh as a part of the DVM internship program. One of the placements was at Teaching and Training Pet Hospital and Research Center (TTPHRC). The hospital belongs to Chattogram Veterinary and Animal Sciences University (CVASU). The hospital was set up for providing hands-on training to the interns and postgraduate veterinary doctors in 2018. It has a well-equipped operation theater, x-ray, ultra-sonogram and laboratory facilities. It provides different services like treatment, vaccination, deworming, health check-up and surgery to both pet animals and birds. Additionally, exotic and zoo animals are brought here for treatment and health checkup. So, it is a good source of different clinical cases of pet animals. This hospital deals with almost 25 cases per day on average. After initial registration and history taking, each case undergoes a proper clinical examination. The assigned clinical faculty or veterinarian records clinico-epidemiological findings of each individual case in the structured record keeping sheet.

For the present study, both prospective and retrospective hospital data recorded during April to September 2020 were used. During this period, clinico-epidemiological data of 1269 individual cats were the existing paper-based recording system in TTPHRC of which 29 were diagnosed as Feline Infectious Peritonitis (FIP) which were used as cases for the study. Twenty-nine non-FIP random controls were also selected from the same population and the following data were extracted: address, date of registration, breed, age, sex, vaccination status, de-worming history, duration of illness, vomiting status, body fluid effusion history, respiration, rectal temperature and results of the performed laboratory tests. Diagnosis and drug prescription data were also recorded. Drug prescription data consisted of trade name of the main and supportive drugs, dose, route and duration of the administration.

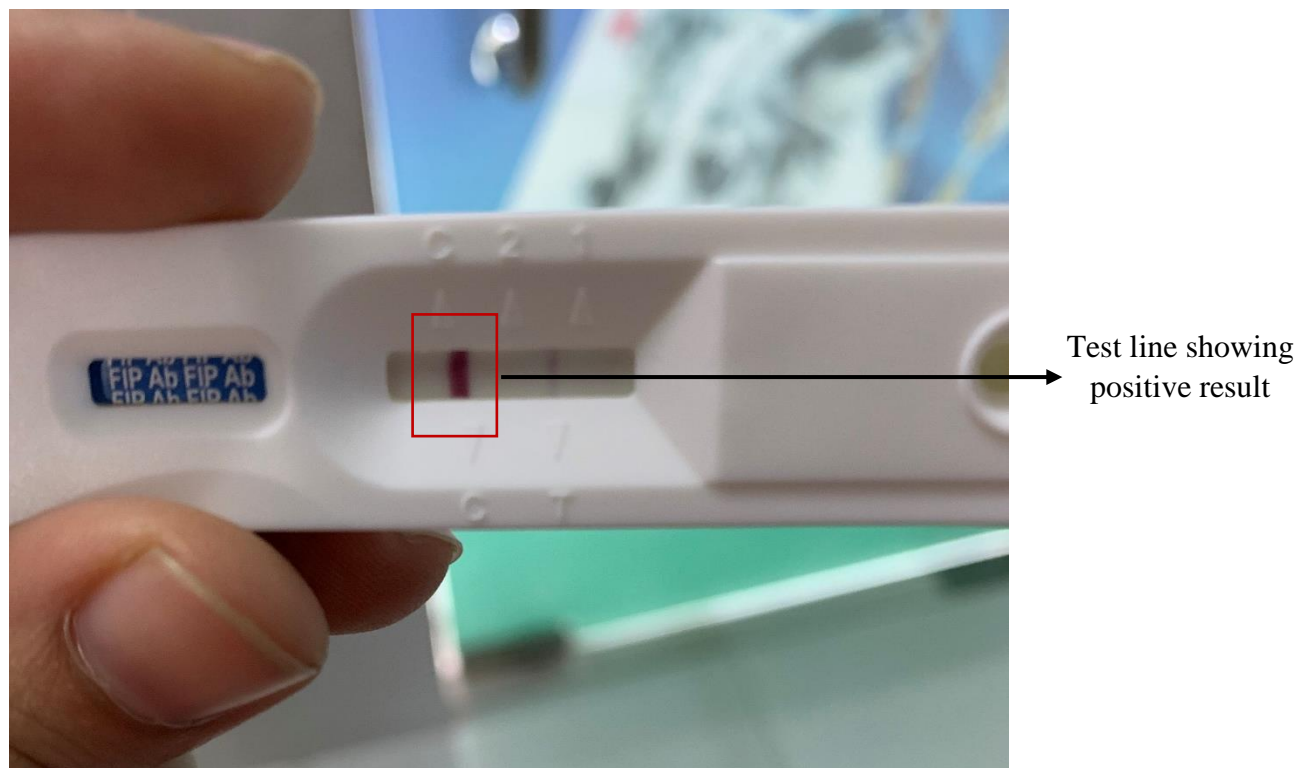
Diagnosis of the FIP cases was performed based on clinico-epidemiological findings along with the laboratory findings, for example fluid assay (total protein and albumin to globulin ratio) wherever necessary or possible. Total protein in cats with FIP can reach high concentrations of up to 12 g/dL (120 g/L) and more where albumin to globulin ratio is less than 0.8 (Hartmann et al., 2003). The cats that manifested listlessness, lethargy, decreased or absent appetite, fluctuating fever, increased of body fluid effusion, difficulty in breathing or dyspnea were

initially suspect for Feline Infectious Peritonitis. Finally, it was being confirmed by rapid diagnostic test kit and/or Rivalta's test.

**Case definition:** A cat was considered as a FIP positive case if it was positive to either of the rapid kit test or Rivalta's with clinical signs of listlessness, lethargy, decreased or absent appetite, fluctuating fever, increased of body fluid effusion, difficulty in breathing (Hartmann., et al 2003).

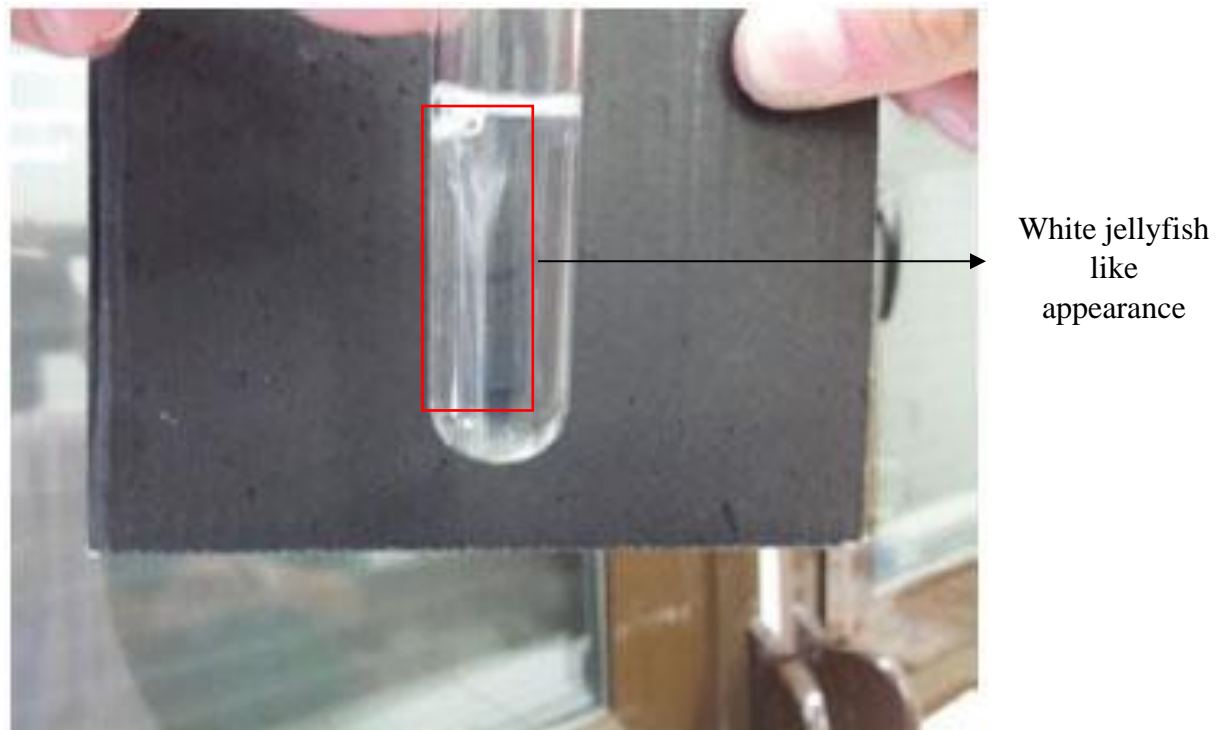
**Control definition:** Cats that were registered in TTPHRC from April to September, 2021 except the FIP positive cats were considered as control.

In case of rapid kit test, cat's whole blood, serum, plasma or effusion fluid was being collected where antibody of FIP virus might be present. The kit that was used in hospital during the study period was FASTest FIP. The sensitivity and specificity of this test is 84.6% and 100%, respectively (Addie et al., 2015).



**Figure 1:** Feline Infectious Peritonitis positive in kit test

The Rivalta's test can be used to differentiate transudates from exudates. A reagent tube was filled with 5 mL distilled water; 1 drop of acetic acid (98%) was added, and the tube content was thoroughly mixed. On the surface of this solution, 1 drop of the effusion fluid was carefully



**Figure 2:** Feline Infectious Peritonitis positive in Rivalta's test

layered. If the drop disappeared and the solution remained clear, the Rivalta's test was defined as negative. If the drop retained its shape, stayed attached to the surface, or slowly floated down to the bottom of the tube (drop- or jellyfish-like), the Rivalta's test was defined as positive.

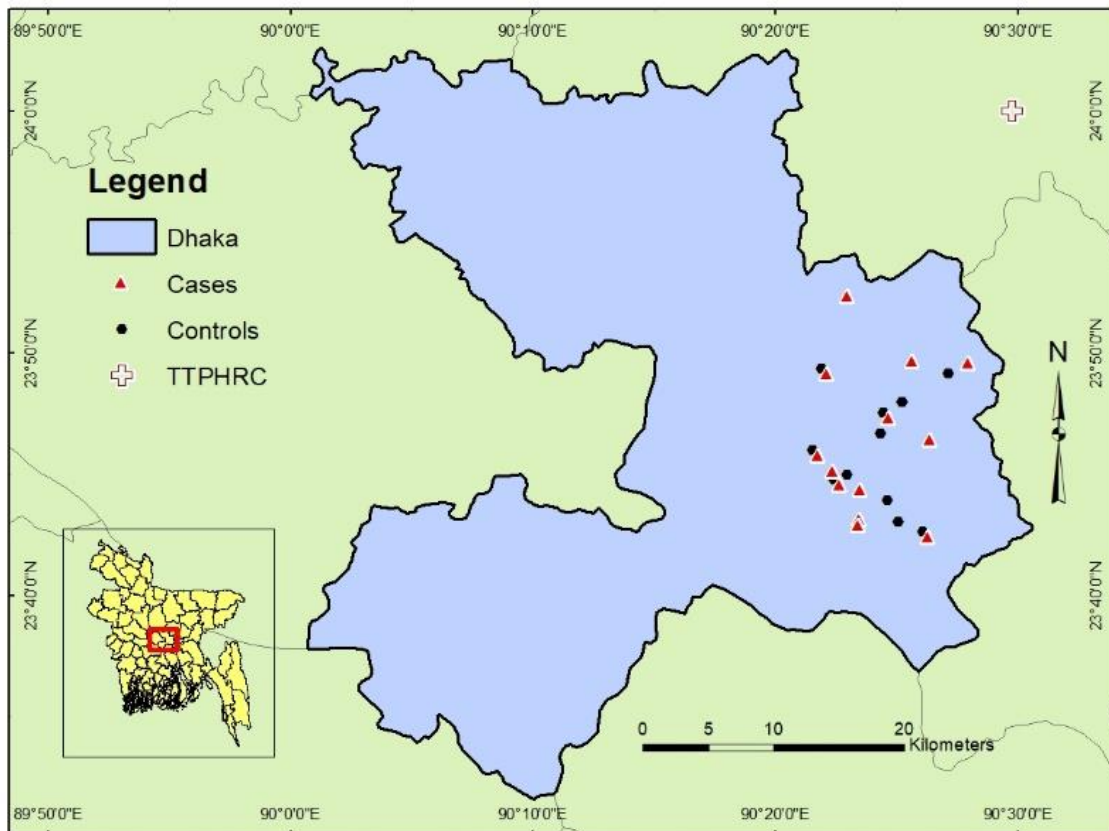
The Rivalta's test has a sensitivity of 91.3%, specificity of 65.5% (Fischer et al., 2012), positive predictive value of 86% and a negative predictive value of 97% (Hartmann et al., 2003).

All data obtained were entered into Microsoft Office Excel-2007, USA (MS excel 2007). Data were cleaned, sorted and coded in MS Excel 2007 before exporting to STATA-14 (Stata Corp, 4905, Lakeway Drive, College Station, Texas 77845, USA) for descriptive and univariable statistical analysis. The prevalence of FIP was calculated by the number of cases of FIP divided

by the total number of cases presented in TTPHRC during that period. Frequency distribution of the case was presented according to categories of each selected factors (Duration of illness, temperature, dehydration, respiration and effusion of body fluid).

Fisher's exact test was performed to assess associations between the binary response variable of FIP and the selected independent variables (breed, gender, age, vaccination and deworming). The results were expressed in frequency number, percentage, and p value.

The spatial distribution of the cases and controls (Figures 3) was produced by collecting spatial data from online portfolio GPS Geoplaner (<http://www.geoplaner.com/>) and analysis of spatial data were done by using QGIS software version 2.18.13 (<http://qgis.org/downloads/>).



**Figure 3:** Spatial distribution of Feline Infectious Peritonitis positive and negative cats in Teaching and Training Pet Hospital and Research Centre, Purbachal, Dhaka (April to September, 2021).

### Chapter 3: Results

The prevalence of FIP in cats was 2.3% (95% Confidence interval: 1.5 to 3.33) during the study period (n=29, N=1269).

The distribution of FIP prevalence is displayed in Table 1. The prevalence of FIP was greater in exotic breeds (53.6%) than the local breeds (41.2%) and cats up to 8 months of age (61.9%) than the cats above 8 months (43.2%). On the other hand, male (48.3%) and female (51.7%) cats almost had same prevalence of FIP. However, none of these results are statistically significant ( $p>0.05$ ). Only the prevalence of FIP was significantly higher ( $p<0.05$ ) in unvaccinated cats (66.7%) than the cats those were vaccinated ( $p=0.02$ ).

**Table 1:** Association between Feline Infectious Peritonitis and selected factors through Fisher’s exact test:

Factors	Categories	FIP		p
		Yes (%)	No	
Breed	Local	7 (41.2)	10	0.56
	Exotic	22 (53.6)	19	
Gender	Male	14 (48.3)	15	1.00
	Female	15 (51.7)	14	
Age	Up to 8 months	13 (61.9)	8	0.27
	Above 8 months	16 (43.2)	21	
Vaccination	Yes	9 (32.1)	19	0.02
	No	20 (66.7)	10	
Deworming	Yes	22 (48.9)	23	1.00
	No	7 (53.8)	6	

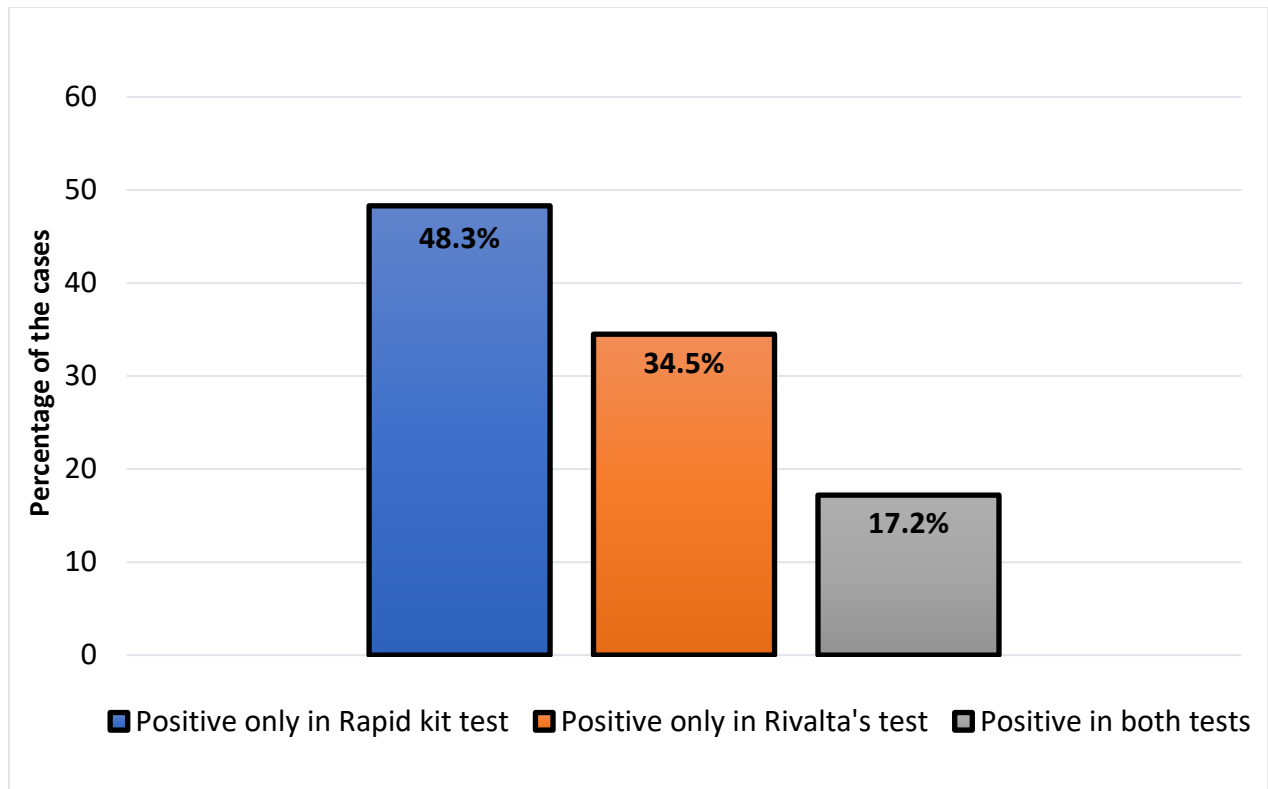
The recorded clinical signs are presented in Table 2. The duration of illness at which the patients were brought to the hospital was recorded to analyze the cautiousness of the owners. Most of the owners brought their pets to the hospital at the 2 to 7<sup>th</sup> days of illness (65.5%). Almost 44.8% of cats with FIP had fever where 41.4% had hypothermia. Dyspnea was found in 69.0% of FIP

positive cats. Mild dehydration was found in 55.2% and moderate dehydration in 44.8%. All FIP positive cats (100%) had ascites registered in TTPHRC.

**Table 2:** Frequency distribution of observable clinical signs in FIP positive cats in TTPHRC (n=29)

Variable/ Signs	Categories	FIP (n%)
Duration of illness (days)	2-7	19 (65.5)
	8-28	5 (17.2)
	>29	5 (17.2)
Temperature	Fever	13 (44.8)
	Normal	4 (14.0)
	Hypothermia	12 (41.4)
Respiration	Dyspnea	20 (66.0)
Dehydration	Mild	16 (55.2)
	Moderate	13 (44.8)
Ascites	Fluid in abdominal cavity	29 (100)

Frequency distribution of the tests performed in diagnosis of FIP presented in Table 3. Among FIP positive cats (n=29), almost 48.3% were tested positive using only rapid kit test, 34.5% were by only Rivalta's test and 17.2% were by using both rapid kit and Rivalta's test for FIP diagnosis.



**Figure 4:** Frequency distribution of Rapid kit test and Rivalta's test for FIP positive cats in Teaching and Training Pet Hospital and Research Center (n=29).

Drugs that were prescribed against FIP were categorized into four categories, which were antibiotic, diuretics, steroidal anti-inflammatory drugs (SAID) and supportive drugs (Table 4).

Commonly prescribed antibiotics for FIP cases were Ampicillin (48.3%), Amoxicillin (20.7%), Ceftriaxone (13.8%), Azithromycin (10.3%) and Doxycycline (6.9%).

Furosemide was used as diuretics in almost 93.1% of FIP cases while Dexamethasone and Prednisolone were used in 34.5% and 13.8% cases, respectively. Vitamin, mineral and amino acid preparations, Dextrose 25% and Fentanyl were used as supportive drugs in 48.3%, 10.34% and 34.5% of FIP cases, respectively.

**Table 3:** Pattern of drugs prescribed for Feline Infectious Peritonitis positive cats in Teaching and Training Pet Hospital and Research Center (n=29):

<b>Drugs</b>	<b>Category</b>	<b>FIP n (%)</b>
Antibiotic	Ampicillin	14 (48.3)
	Amoxicillin	6 (20.7)
	Ceftriaxone	4 (13.8)
	Azythromycin	3 (10.3)
	Doxycycline	2 (6.9)
Diuretics	Frusemide	27 (93.1)
SAID	Dexamethasone	10 (34.5)
	Prednisolone	4 (13.8)
Supportive drugs	Vitamin, mineral and amino acid preparation	14 (48.3)
	Dextrose 25%	3 (10.3)
	Femotidine	10 (34.5)



## Chapter 4: Discussion

Feline Infectious Peritonitis (FIP) is a worldwide disease of domestic and wild felids. Although FIP is the most fatal and prevalent disease of cats, very few research into FIP were performed in Bangladesh. Hence the current study attempted to explore overall clinico-epidemiological features of FIP in TTPHRC, Dhaka which will help understand FIP more distinctly. This section of the report has discussed important findings of the present study and their implications along with limitations and, conclusion and recommendations.

The prevalence of FIP in cats is quite low (2.3%) in the present study which corresponds to the many earlier studies in Germany (1.4%) (Riemer et al., 2016) and China (5%–10%) (Yin et al., 2021).

Cats vaccinated with combined vaccine (feline distemper, rhinotracheitis and feline calicivirus) reduced the chance of getting FIP in this study. Though the combined vaccine given to those cats, were not against FIP virus but it probably boosted the immune system of the cats. The acquired immunity is stimulated when a cat is vaccinated and it boosts humoral immunity which produces feline immunoglobulin classes IgG, IgM, IgA and IgE (Schultz et al., 1974). These immunoglobulins might help the cats fight against FIP virus. There was no significant association between FIP and sex in the present study. However, a couple of earlier study indicated that male cats were more prone to FIP (Worthing et al., 2012; Rohrbach et al., 2001). This may be because sex hormones, especially androgens, have a negative effect on the immune system, increasing the risk of having infection in male (Grossman, 1985).

In case of breed no significant association with FIP was determined although the prevalence of FIP was higher in exotic breed which is supported by Yin et al. (2021). No association was evidenced between FIP and age in the present study which is consistent with previous studies (Pedersen, 1995; Addie and Jarrett, 1998).

Like the current study, similar clinical signs with frequency percentage were found by an earlier study: fever over 39°C: 82% cats and over 40°C: 39%; fever was also found to be more common in effusive FIP (Riemer et al., 2016). Abdominal effusion was observed in all FIP positive cases in the present study. This result corresponds to another study where 80.1% of FIP positive cats

had effusions (Hartmann et al., 2003). Reason of effusion in FIP might be lower concentration of protein in blood which leads to increase capillary permeability and accumulation of fluids in body cavity. Abdominal effusions may lead to dyspnea or difficulty in breathing in several cases (Walter and Rudolph, 1989). In the present study dyspnea was found in 69.0% of FIP positive cats. This is aligned with a study where dyspnea occurred in 35.2% where most common sign was effusions of fluids in the body cavities which creates extra pressure in the diaphragm (Yin et al., 2021). Dehydration is another consequence of fluid effusion which resulted in mild to moderate level of dehydration in most of the cats in this study (Yin et al., 2021). So, the recorded clinical findings of FIP in this study can be used to make presumptive diagnosis of FIP.

Both Rivalta's and rapid kit tests were used in evaluating FIP in this study. Rivalta's test is an easy, inexpensive method that does not require special laboratory equipment and can be easily performed in private practice. It provides very good predictive values and therefore is a helpful diagnostic tool. The Rivalta's test had a sensitivity of 91.3% and specificity of 65.5% (Fischer et al., 2012), a positive predictive value of 86% and a negative predictive value of 97% (Hartmann et al., 2003).

Rapid kit test was used to detect the antibodies of FIP virus in cats' whole blood, serum, or plasma. The kit that was used in the current study to detect FIP virus was FASTest FIP which is a rapid immuno-chromatographic lateral flow test. Test procedure is simple and fastest compared to other diagnostic tests (RT-PCR, serum biochemical test etc.) used in FIP (Addie et al., 2015). The sensitivity and specificity of this test is 84.6% and 100%, respectively.

There is no specific treatment available for FIP and a cat suffering from clinically evident FIP will not be alive for more than 12 months (Pedersen, 1995). Because FIP is an immune-mediated disease, treatment is aimed at controlling the immune response to FCoV, and the most successful treatments consist of relatively high doses of immunosuppressive and anti-inflammatory drugs. Immunosuppressive drugs, such as prednisolone (4 mg/kg administered orally every 24 hours) or dexamethasone (1 mg/kg/day administered orally for four consecutive days every week), may slow down the disease progression but do not produce a cure (Watari et al., 1998). Similar kind of therapeutic principles was followed for treating FIP affected cats in the present exploration.

In general perspective antibiotics are not chosen to treat any viral disease, but feline infectious peritonitis is exceptional for antibiotic use. As FIP caused immuno-suppression, the cats become more susceptible for secondary bacterial infections (Pedersen, 1987). So, in this study, antibiotics were used to prevent secondary infections which might mitigate the disease condition of the cats (Pedersen, 1995). Prescribing multiple antibiotics against different cases of FIP in this study indicate that there is no specific antibiotic which is effective to prevent the secondary bacterial infection. This pattern of antibiotic usage can lead the prescribed antibiotics to be resistant against the bacteria that cause secondary bacterial infection at FIP in cats. Hence, a treatment protocol to manage the secondary bacterial infection and other complications at FIP in cats should be developed at the pet hospital.

Diuretics are commonly used to flush effused fluid in the body (James et al., 2021). In this study furosemide was used as diuretic to reduce the retained fluids in the abdominal cavity in FIP positive cats. A decrease in serum albumin is more extensive in FIP due to protein loss through fluid effusion in abdominal cavity (Hartmann et al., 2003). So, vitamin, mineral and amino acid preparations were used as supportive drugs to compensate protein loss as well as stimulate the immune system in FIP positive cats in TTPHRC (Hartmann et al., 2003).

## **Conclusion and recommendations**

The present study gives a clinico-epidemiological overview of Feline Infectious Peritonitis in domestic cats in Dhaka metro and its surrounding areas. Vaccination status was significantly associated with the lower occurrence of FIP. Though vaccine against FIP virus is not commercially available but combined vaccination against other viral diseases could have boosted the immune system of the cats to fight against FIP. Body fluid effusion was the most common clinical sign where fluctuating fever, dyspnea and mild to moderate level of dehydration were also present. Rapid kit test or Rivalta's test should be performed in the suspected cases presenting the above clinical signs for the confirmatory diagnosis. Therapeutic management should be supportive to check hyperimmune reaction, abdominal effusion and secondary bacterial infection. So, the study signifies the importance of vaccination of pet animals with proper schedule to prevent the disease. A defined treatment protocol to manage FIP in cats should be introduced to the pet hospital and elsewhere. The findings of this study will be helpful for the young veterinarians as well as the veterinary students to diagnose and treat the disease properly.

## **Limitations**

The study was conducted during the DVM internship program within a short period of time. So, a large number of cats along with some more study sites could not be sampled which resulted in a small study population. This could be a cause for getting less significant results which did not allow performing a multivariable analysis in order to determine the potential risk factors. However, the data were collected thoroughly from a structured clinico-epidemiological record keeping sheet to avoid information bias. The pet hospital has a good representation of cat patients from Dhaka Metropolitan areas. To avoid misclassification bias, the cats that were confirmed having FIP through diagnostic tests got selected as the cases. The controls were randomly selected among the registered cats during the study period to avoid selection bias.

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