

**MAKERERE**



**UNIVERSITY**

**PREVALENCE AND PREDICTORS OF PARVOVIRUS  
INFECTION IN DOGS ATTENDING PARADISE  
ANIMAL CLINIC(S) IN KAMPALA DISTRICT**

**BY**

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## DECLARATION

I Kitagenda Sulaiman, declare that this research report is my original work and has never been presented anywhere for academic purposes.

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## **LIST OF ABBREVIATIONS**

|        |                                                                  |
|--------|------------------------------------------------------------------|
| CoVAB: | College of Veterinary Medicine, Animal Resources and Biosecurity |
| CPV:   | Canine parvovirus                                                |
| DNA:   | Deoxyribonucleic Acid                                            |
| FAO:   | Food and Agriculture Organisation                                |
| FPV:   | Feline Panleucopenia Virus                                       |
| FPV:   | Feline Panleucopenia Virus                                       |
| MVC:   | Minute Virus of Canine                                           |
| OIE:   | World Organisation for Animal Health                             |
| PCR:   | Polymerase Chain Reaction                                        |
| RIM:   | Rapid Immuno Migration                                           |
| UVA:   | Uganda Veterinary Association                                    |

## **DEFINITION OF THE KEY TERMS**

**Canine Parvo Virus:** Canine parvovirus is a contagious virus mainly affecting dogs transmitted directly or indirectly through faeces. It belongs to the family parvoviridae.

**Vaccine:** A vaccine is a biological preparation that provides active acquired immunity to a particular infectious disease. A Vaccine typically contains an agent that resembles a disease causing microorganism and is often made from weakened or killed forms of microbe, its toxins or one of its surface proteins.

**An immunoassay** is a test that relies on biochemistry to measure the presence/or concentration of an analyte. The analyte can be large proteins, anti-bodies that an animal has produced has a result of an infection or small molecules.

## ABSTRACT

Canine Parvovirus is a highly contagious disease of dogs that cause gastrointestinal illness in puppies. The study reported 221 (57.55%) out of 384 of the positivity rate, and of these, 49 died, representing a fatality rate of 22.17% of the positive cases. The majority of these fatality cases (96%) occurred in dogs below 3 Months of age (63.3% less than 2 months and 32.7% less than 3 months) indicate a lack of primary and early vaccination to provide protective immunity since most dogs were not vaccinated against CPV. Samples were taken from dogs of 2 months (32.0%), 3 months (20.6%), 4 months (18.2%), 8 months (10.2%), 1 year (14.6%), and 2 years (4.4%). Only (19.0%) of the dogs studied were vaccinated, and the rest (81.0%) had no history of vaccination against Canine parvovirus (CPV). The study revealed that the difference in average weights between the CPV positive (CPV+) group of dogs and CPV negative (CPV-) group of dogs is 1.42, 95% CI [1.38, 1.47]. Of the 384 samples collected and tested, 138/384 male dogs were CPV+ and 116/384 female dogs were CPV+, 83/384 male dogs were CPV negative and 47/384 female dogs were CPV negative. A significant number of dogs which were not vaccinated 169 (44.0%) were parvovirus positive (+). Most of the sampled dogs were cross-German shepherd dogs and German shepherd dogs (58.4%), local dogs were (25.3%), and Maltese dogs were (12.0%). A multivariate regression was performed to ascertain the effects of a dog's age, sex, breed, and vaccination status on the likelihood that a dog will contract the CPV virus. The gender of the dog owner, occupation, age, and education were also regressed against CPV prevalence. The multivariate regression model was statistically significant:  $F(15, 367) = 12.87, p = .000$ . The model explained 31.0% ( $R^2$ ) of the variance in CPV prevalence. The individual predictors were examined further and indicated that the age of the dog ( $t = 11.37, p < .00$ ) was a statistically significant predictor of CPV among dogs in Kampala. The prevalence of CPV in dogs increases by 17% with each age increase in the dog's age. The risk factors identified in this study can be used as prognostic indicators for veterinarians faced with CPV cases. The study recommends that to limit environmental contamination and spread to other susceptible animals, dogs with confirmed or suspected CPV enteritis must be handled with strict isolation procedures (e.g., isolation housing, gowning and gloving of personnel, frequent and thorough cleaning, footbaths, etc.). To prevent and control CPV, the study recommends that owners vaccinate their dogs with a modified-live vaccine at 6–8, 10–12, and 14–16 weeks of age, followed by a booster administered 1 year later and then every 3 years.

## **CHAPTER ONE**

### **INTRODUCTION**

#### **1.1 Background**

The study investigated the prevalence of CPV as well as its potential risk factors. Canine parvovirus (CPV) is an infectious disease that attacks puppies at the age of one to six months. The haemorrhagic enteritis is the main cause of death in infected dogs (Mia & Hasan, 2021).

CPV-2 is the main cause of the canine Parvovirus not CPV-1 or MVC(Minute virus of canine) which causes mild sickness. (J.E Sykes., 2013).

Canine parvovirus type 2 (CPV-2) of the Parvoviridae family is an ubiquitous virus with worldwide distribution (Decaro et al., 2013) and is considered as a major viral pathogen of dogs. CPV-2 is a small, non-enveloped single-stranded DNA virus with three antigenic variants, CPV-2a, CPV-2b and CPV-2c (Decaro & Buonavoglia, 2012). The virus replicates in rapidly dividing cells of lymphoid tissues, intestinal crypt epithelial cells, precursor cells in the bone marrow and myocardiocytes in puppies under the age of one month (Goddard & Leisewitz, 2010) CPV-2 causes acute enteritis with high mortality rates in young animals and also affects adults (Oluwayelu et al., 2024)Clinical symptoms include anorexia, depression, vomiting, profuse hemorrhagic diarrhea, abdominal pain, dehydration and pyrexia, while the more severe hematological alteration is leukopenia as a result of destruction of hematopoietic progenitor cells in the bone marrow (Kanter et al., 2021).

Limited studies have been done in Kampala to investigate the prevalence of canine viral diseases and their predictors (Kankya et al., 2022) but some researchers have done some work on free roaming dogs in Entebbe (Tayebwa et al., 2024). Dogs of all ages can be affected by CPV(Qiet al., 2020) (Le et al., 2020) Severe infection is most common in puppies between six and four months old (Muñoz et al., 2021).

All breeds of dogs are susceptible(Pan et al., 2023). Crossbreds are less susceptible in comparison to pure breeds like Rottweilers, Doberman Pinchers, English Springer

Spaniels and German Shepherd, the exception to this being Toy Poodles and cocker Spaniel (Gülersoy & Naseri, 2022)

## **1.2 Statement of the Problem**

This study investigated the prevalence of CPV as well as its potential risk factors. Globally, more priority and focus has been dedicated to rabies due to its zoonotic importance than other canine viral diseases (CPV among others), (WHO, 2024) In Africa, Uganda and Kampala in general less emphasis is on parvovirus, most emphasis is on Rabies. The government of Uganda and most organizations including Uganda Veterinary Association, Food and Agriculture Organization, International Animal Organization, Makerere College of Veterinary and Biosecurity, put more emphasis on Rabies than parvovirus. A gap in veterinary diagnostics, awareness and less research data available on CPV causing a huge public health gap.

Therefore, monitoring CPV2 spread is an important part of prevention. However, prevalence and epidemiological characteristics of CPV2 have not been systematically evaluated and analyzed in Uganda. Therefore, a systematic review was performed (O'Doherty, 2023).

A furthermore over time, the virus has mutated and emergence of variant antigenic strains of; CPV-2a, CPV-2b and CPV-2c (Kurucay et al., 2023) led to vaccine failure due to lack of specific vaccines on local markets making control and prevention more difficult.

## **1.3 General objectives of the study**

To determine the prevalence and predictors of dogs with parvovirus attending Paradise Animal clinic outlets in Kampala district

## **1.4 Specific Objective**

- i. To determine prevalence of canine parvovirus infection for cases brought at Paradise Animal Clinic outlets around Kampala district.
- ii. To determine the predisposing factors associated with the occurrence of CPV infection presented at Paradise Animal Clinic and its outlets around Kampala district.

### **1.5 The significance of the study**

The study could make dog owners aware of the dangers of parvovirus and make them more vigilant as far as vaccination is concerned. It will also create awareness of how to reduce the incidence of the disease through sanitary measures. The study will provide data on the prevalence and predisposing factors of CPV. This will guide the design and implementation of control measures to prevent the spread of disease complex. Providing feedback to the relevant stakeholders will sensitize them on the extent of the problem in the study area. This will eventually help boost the canine sector in terms of dog's health and mortalities will be reduced.

### **1.6 Justification of the study**

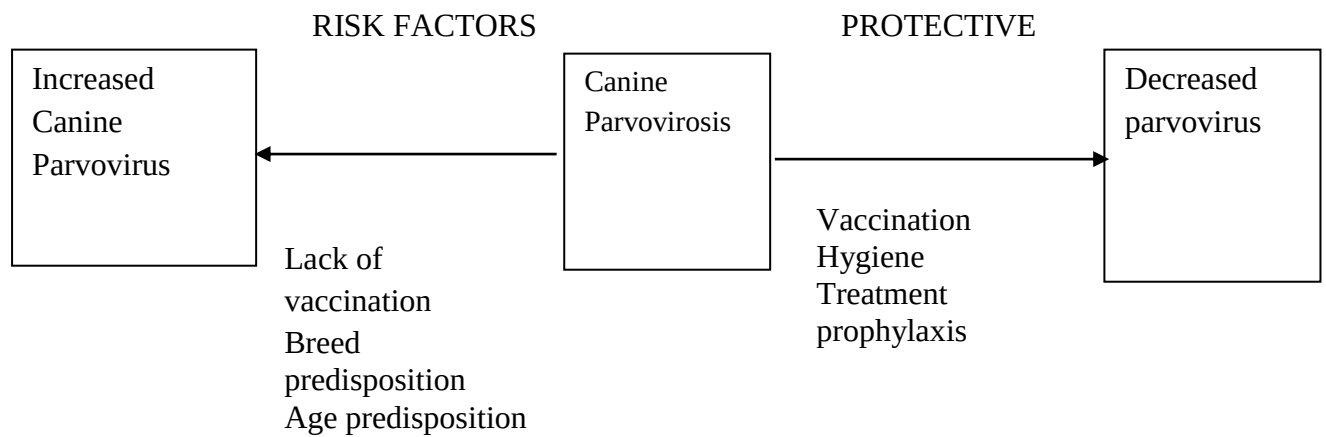
The Ugandan dog population has grown time to time, many households own dogs lately, this is attributed to increased demand for companion animals and security (guard dogs). However, many cases of canine mortalities (below six months) are attributed to CPV (Adam et al., 2024, Qi et al., 2020).

At the end of the study, mortalities associated with parvoviruses should significantly reduce due to good practices like vaccination, good hygiene and proper therapeutic regimen.

The study will present the ways in which other mutant strains can be combated. Furthermore, the study will show the importance and relevance of CPV in regard to other canine immunisable diseases of priority to dog owners.

### **1.7 Conceptual Framework**

There are several interlinked factors driving to the spread of CPV, among which are the dog breeds, age of the dog, veterinary and treatment routines and dog hygienic practices, see figure 1 below.



### 1. 8 Scope of the study

The study was carried out among Paradise Animal clinics in Kampala district between June 2023 and July 2023. The clinic was started in 2008 as a private clinic and it has been in existence for about 15 years now. The Clinic is located in four different divisions of Kampala with eight different outlets in total where clients take their pets for treatment; Nakawa (Ntinda, Kitintale, Mbuya), Makindye (Kibuli, Kansanga), Rubaga (Busega) and Kawempe (Kyebando, Kawempe) divisions.

The study focused on the prevalence and predictors of parvovirus in dogs brought at paradise animal clinic and all its outlets around Kampala metropolitan area between June and July 2023. The study took a period of 2 months that is, data collection, data entry and cleaning, data analysis and report writing.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Canine parvovirus

Canine parvovirus, the causative agent of acute haemorrhagic enteritis and myocarditis in dogs (Mazzaferro, 2020), is one of the most important pathogenic viruses. It is a highly contagious and often fatal disease. CPV-2 was first recognized in 1977 and since then it has been well established as an enteric pathogen (Carrino et al., 2022) of dogs throughout the world with high morbidity (100%) and frequent mortality up to 10%(Kelman et al., 2020) .

The virus is believed to have originated as a host range variant from feline panleucopenia virus (FPV), include a direct mutation from FPV, a mutation from a FPV vaccine virus and the adaptation to the new host dog via non-domestic carnivores, like mink and foxes. The disease is characterized by two prominent clinical forms, enteritis with vomiting and diarrhoea in dogs of all ages (Chethan et al., 2023) and myocarditis and subsequent heart failure in pups of less than 3 months of age (Dines et al., 2023). The virus was named CPV-2 in order to differentiate it from a closely related parvovirus of canine known as CPV-1 or Minute Virus of Canine (MVC). MVC, a completely from different parvovirus, had not been associated with natural disease until 1992 (Decaro et al., 2020) . MVC may cause pneumonia, myocarditis and enteritis in young pups or transplacental infections in pregnant dams, with embryoresorptions and fetal deaths.

CPV-2infections have been emerged to be a problem in dogs in recent times around the world. The disease has also been reported in high proportions in dogs in India with high level of casualties even in vaccinated populations. CPV is highly contagious with a wide a rapid and spread among dogs of all ages globally resulting in outbreaks high morbity rates(Jyothi et al., 2024)(Kelman et al., 2020). The disease is highly infectious and is spread from dog to dog by direct or indirect contact with their faeces(Balboni et al., 2021, Mia & Hasan, 2021) .

Several diagnostic assays ranging from clinical picture, serology to molecular techniques have been developed for detection of the disease (Abousenna et al., 2024,

Dik & Şimşek, 2021) . Again, both inactivated and live attenuated CPV vaccines both as monovalent and along with vaccines against other diseases have been developed and used for the control of the disease (Lencina et al., 2023, Elbagory & Khodier, 2021). However, despite proper vaccination of animals, vaccine failure has been linked to presence of maternal antibodies and emergence of new variants (Gamage et al., 2020, Dall'Ara et al., 2021). So, this review on CPV is aimed to provide detailed information about the disease including diagnosis, immune prophylaxis, treatment, etc. for the scientific fraternity, students, teachers, diagnosticians, practitioners, pet owners, kennel club owners, pet shop owners, defence personnel and lastly the general public so that it can be managed and controlled in a highly scientific and efficient manner.

## **2.2 Etiology**

### **Origin**

CPV is thought to have originated from the feline panleukopenia virus or a closely related virus (Hoang et al., 2020), it is a single-stranded DNA virus that replicates in rapidly dividing cells (Desai et al., 2020) and has overtime developed many variants which are resistant to many common detergents, disinfectants as well as changes in PH (Peng et al., 2023).

### **Viral structure and resistance**

Canine parvovirus belongs to genus Parvovirus and family Parvoviridae (Bahoussi et al., 2022, Péntzes et al., 2020). The genome is a single stranded negative sense DNA having size of 5.2 Kb (Nair et al., 2024) (Kumari et al., 2021) in length which has two promoters resulting in the expression of three structural (VP1, VP2 and VP3) and two non-structural proteins (NS1 and NS2) through alternate splicing of the viral mRNAs. VP2 (64 kDa) is an NH<sub>2</sub>-terminally truncated form of VP1 (84 kDa) and is the major component of the capsid. VP3 is derived from VP2 by posttranslational proteolytic cleavage and is present only in complete (DNA-containing) virions (López-Astacio, Adu, Lee, et al., 2023). Empty particles do not contain VP3 protein. Trypsin treatment of full particles cleaves VP2 to VP3 protein. CPV-2 has icosahedral symmetry, 25 nm in diameter and non-enveloped with a linear, single stranded DNA genome (Arora et al., 2021). The crystal structures of CPV-2 have been determined and their basic

capsid organizations are similar. The 60 protein subunits of which about 5–6 copies of VP1 and 54–55 copies of VP2 that make up the capsid have a common structure, arranged with T=1 icosahedral symmetry (Ros et al., 2020, López-Astacio, Adu, Lee, et al., 2023) .

There is some evidence that the VP1 terminus is internal and may help neutralize the DNA. The main structural motif is an eight stranded, antiparallel  $\beta$ -barrel, which also has been found in most other viral capsid structures. The  $\beta$ -barrel motif contains only approximately one-third of the amino acid composition of VP2, the major structural protein in most parvovirus that comprises about 90% of the capsid (López-Astacio, Adu, Goetschius, et al., 2023). The remaining two-thirds is present as large loops connecting the strands of the  $\beta$ -barrel. The loops form much of the capsid surface, onto which a number of biologic features, such as host species and tissue tropism, receptor binding and antigenic properties have been structurally and genetically mapped (Emmanuel et al., 2021, Zhang et al., 2023). Replication occurs in the nucleus of dividing cells and infection leads to large intra nuclear inclusion bodies. Other characteristic features of the parvoviral capsid include spike like protrusions at the icosahedral threefold axes, a 15-A Canyon-like depression about the fivefold axes and a dimple-like depression at the icosahedral twofold axes. Antigenic regions have been mapped to the threefold protrusion whereas the twofold depression has been implicated in the attachment of host cell factors (Pu et al., 2024). The particle has a molecular weight (MW) of 5.5 to 6.2  $\times 10^6$  Da. Approximately 50% of the mass is protein, and the remainder is DNA. Because of the relatively high DNA-to-protein ratio, the buoyant density of the intact virion in cesium chlorid (CsCl) is 1.39–1.42 g/cm<sup>3</sup>. Finally, the sedimentation coefficient of the virion in neutral sucrose gradients is 110–122 S (López-Astacio, Adu, Lee, et al., 2023).

### **2.3 Global Distribution**

Canine parvovirus infection occurs worldwide in domestic dogs and other members of the dog family. Incidence is higher in animal shelters, pet stores, and breeding kennels. (Qi et al., 2020). In the East Africa region, it is known to affect most domestic and wild animals mainly of the canine family (Tegegne et al., 2023). In Uganda Parvovirus is common among puppies below 6 months, and in recent times has killed most puppies in Kampala and other districts in Uganda. It is also the

number one killer for none vaccinated puppies below six months. As per the independent new journal, it was reported to have killed dozens of puppies in Gulu city (Independent\_UG, 2022). Numbers of how many were wiped visa vie those that survived was not verified by the independent newspaper.

Parvovirus can affect dogs at any age (Badwaik et al., 2022). Severe infection is most common in puppies between 6 weeks and 4 months old. All breeds of dogs are susceptible. The crossbreeds are less susceptible in comparison to pure breeds like Rottweilers, Doberman Pinchers, English Springer Spaniels and German Shepherd, the exception to this being Toy Poodles and cocker Spaniels (Uddin et al., 2021).

CPV affects only dogs, and cannot be transmitted to humans or other species. If a dog survives the first 4 days, they will usually recover rapidly and become immune to the virus for life. Most puppies die without medical treatment (Decaro et al., 2020, Nandi & Kumar, 2010).

The CPV infection is more severe in young puppies especially those younger than 3 months of age (Piegari et al., 2020). All infected dogs may not necessarily exhibit clinical manifestations but they may shed the virus in feces during the acute phase of enteric fever and show significant rise in the serum antibody titres (Abayli et al., 2022).

CPV-2 is one of the most important pathogens in dogs, and despite the continual development of vaccines against CPV-2, CPV-2 is still circulating in the canine population. The CPV-2a/2b/2c variant has replaced the original CPV-2 virus and seems to exhibit accelerated transmission (Hao et al., 2022). In china, a study showed a positive rate of 88.29% (98/111) of CPV-2 among screened dogs (Fu et al., 2022). Contrastingly, CPV-2a was found to be the prevalent antigenic type in France, Taiwan and Italy (Alexis et al., 2021). However, both CPV-2a and CPV-2b have been found to be distributed in equal proportion in Spain and U.K. (O'Doherty, 2023). A recent study in Vietnam also reported endemicity of CPV-2 (Bui et al., 2023), a recent study in South America by (Grecco et al., 2024) shows existence CPV infections in the region, in Canada North America, a study by (Canuti et al., 2022) reports endemicity of the disease ,

CPV-2 for the first time was isolated in India in 1982 (Singh et al., 2022). After that, a large number of CPV outbreaks have been reported from different parts of India (Jayappa et al., 2024, S. K. Behera et al., 2024).

The incidence of CPV-2 variants in dogs were reported from different states of India, Kolkatta (Abhiram et al., 2023), West Bengal (S. K. Behera et al., 2024), Uttar Pradesh (Kumar, 2010). It was also found that CPV-2b variants are more common in Northern India especially in Bareilly region compared to CPV-2a (Nandi & Kumar, 2010). However, these observations were in contrast with the findings of a researcher (H. Reddy et al., 2024), who reported that CPV-2a is the major antigenic variant prevalent in Southern and Central India, based on VP2 gene sequences. Further, based on VP2 gene sequences, it was revealed that the Indian isolates formed a separate lineage distinct from the South East Asian isolates and the canine parvovirus isolates in India appear to have evolved independently without any distinct geographical patterns of evolution. Occurrence of CPV-2c was first reported in India in 2010 (Nandi & Kumar, 2010) based on the sequence analysis of CPV-2b positive sample. Its presence in India supports the assumption that CPV-2c is reaching a worldwide distribution and provides new information to understand.

## **2.4 Transmission**

Canine parvovirus spreads through oral contact within infected faeces or contaminated surfaces (e.g., soil, shoes, dog toys etc.) (Parrish & Sykes, 2021). The source of CPV infection is faecal waste from infected dogs. It has been diagnosed wherever groups of dogs are found: dog shows, obedience trials, breeding and boarding kennels, pet shops, animal shelters, parks and playgrounds (Hurley et al., 2021). Dogs that are confined to a house or yard and are not in contact with other dogs have much less chance of exposure to CPV. It's easily transmitted via the hair or feet of infected dogs and also by contaminated objects such as cages or shoes. CPV is hardy and can remain in faeces-contaminated ground for 5 months or more if conditions are favourable. The faeces of infected dogs contaminate the places such as Veterinary hospitals pet shops, boarding kennels and commercial breeding establishments. These contaminated premises serve as source of secondary infection to the susceptible canine population (Marenzoni et al., 2021)

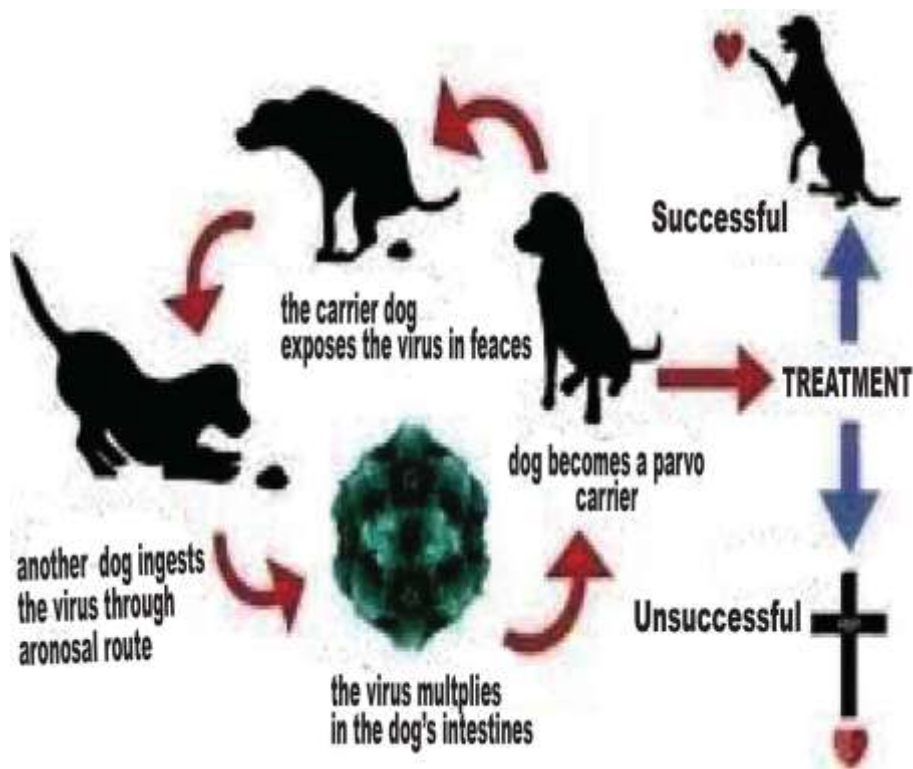


**Figure 1: Life cycle of canine parvovirus,** (Strays, 2020).

## 2.5 Pathogenesis

The virus enters orally (Mia & Hasan, 2021). There is a 3–7 day incubation period before the puppy seems obviously ill. Upon entering into the body, it replicates to large numbers in the lymph nodes (Ogbu et al., 2017).

After a couple of days, significant amounts of virus have been released free into the bloodstream. Over the next 3–4 days, the viruses go to new organs containing the rapidly dividing cells like the bone marrow and the delicate intestinal cells and form large eosinophilic intra nuclear inclusion bodies. Within the bone marrow, the virus is responsible for destruction of young cells of the immune system and then knocking out the body's best defence mechanism. The virus causes most devastating effects in the gastro-intestinal tract (Mylonakis et al., 2016).

Canine parvoviral infections are characterized by a drop in white blood cell count due to the bone marrow infection. It is in the gastrointestinal tract where the heaviest damage occurs (Schoeman et al., 2013). The normal intestine possesses little finger-like protrusions called “villi.” Having these tiny fingers greatly increases the surface area available for the absorption of fluid and nutrients. To make the surface area

available for absorption, the villi possess “microvilli” which are microscopic protrusions. The cells of the villi are relatively short-lived and are readily replaced by new cells. The source of the new cells is the rapidly dividing area at the foot of the villi called the Crypts of Lieberkuhn.

The parvovirus enters through the crypts of lieberkuhn, making the virus blunt and unable to absorb nutrients leading to diarrhoea (M. Behera et al., 2014)(Parrish & Sykes, 2021). The barrier separating the digestive bacteria from the blood stream is broken leading to bloody diarrhoea (Ramos et al., 2021) and bacteria can enter the body causing widespread infection. The diarrhoea and vomiting lead to extreme fluid loss and dehydration until shock, leading to death. Without the intestinal barrier, invasion of other opportunistic bacteria is eased leading to other infections (Khatri et al., 2017).

## **2.6 Symptoms of Canine Parvovirus**

Canine parvovirus (CPV) is the most dangerous and contagious virus that affects unprotected dogs. When it was first discovered in 1978, most of the puppies under 5 months old and 2–3% of older dogs died from CPV. CPV infection is now considered most threatening to puppies between the time of weaning and 6 months of age. Adult dogs can also contract the virus, although it’s relatively uncommon. Diarrhoea occurs in dogs of any age but appears in serious proportions in puppies (Parrish & Sykes, 2021). Dogs with enteritis act like they are in extreme pain. Early symptoms are depression, loss of appetite, vomiting, high fever and severe diarrhoea (Lubis et al., 2023).



***Figure 2: A case of canine parvovirus infection with severe diarrhoea and vomiting undergoing treatment***

There is a slight fever in the initial stage of the disease but gradually turn to subnormal level with advancement of vomiting and diarrhoea(Nandi & Kumar, 2010, K. B. Reddy et al., 2015). There is no consistent character of the stool, it may be watery, yellow in color or tinged with frank blood in severe cases. Rapid dehydration is a danger, and dogs may continue to vomit and have diarrhoea until they die, usually 3 days after onset of symptoms.

The course of illness is also highly variable depending on the infectious dose of the virus and clinical signs usually develop from 3 to 5 days following infection and typically persist for 5–7 days (K. B. Reddy et al., 2015). The morbidity and mortality vary according to the age of the animals; the severity of challenge and the presence of inter current disease problems, puppies can die suddenly of shock as early as 2 days into illness.

The signs associated with myocarditis include lethargy, coughing, difficult breathing, irregular heartbeat, weight loss and edema (Dines et al., 2023)

## **2.7 Diagnosis**

The common signs for enteritis in the diagnosis of CPV include depression, vomiting, diarrhea, anorexia and fever. The tests should be performed on any dog with diarrhoea that is also exhibiting signs of systemic disease: vomiting, lethargy, fever, loss of appetite, dehydration or dogs with unusually copious, smelly/bloody diarrhoea, or any

dog with known exposure to parvovirus within a period of 14 days of developing diarrhoea. The diagnostic tests which were employed earlier include HA (Haemagglutination) (Sharma et al., 2019), Electron Microscopy EM) (Schmitz et al., 2009), Enzyme Linked Immunosorbent Assay (E LISA) (Abousenna et al., 2020)(Proksch et al., 2015) , Latex Agglutination Test (LAT)(M. Appel et al., 1979), Fluorescent Antibody Test (FAT), CIE test, Virus neutralization test, PCR and RE digestion, real time PCR , loop-mediated isothermal amplification(LAMP) (Rajkhowa et al., 2021) but they have varying degree of sensitivity and specificity and sometimes yielding false positive cases, though in Uganda, not all the above are available in veterinary diagnostic laboratories.

The Parvo Witness Test is a diagnostic tool used to detect the presence of the canine parvovirus (CPV) in dogs. The principle was an immunochromatographic assay, and the specimen included the canine feces. The test has high Sensitivity and specificity (100% and 98.8% respectively). The canine CPV Ab test is based on a sandwich lateral flow immunochromatographic assay. The test card has a testing window for the observation of assay running and result reading. The testing window has an invisible T (test) zone and a C (control) zone before running the assay. When the treated sample is applied to the sample hole on the device, the liquid will laterally flow through the surface of the test strip and react with the pre-coated CPV recombinant antigens. If there are CPV antibodies in the specimen, a visible T line will appear. The C line should always appear after a sample is applied, which indicates a valid result. By this means, the device can indicate the presence of CPV antibodies in the specimen.

The test procedure is done as follows, a buffer is dispensed upto the graduated mark in a tube, a rectal swab is inserted into the tube and thoroughly mixed, the tip of the swab is broken at the blue line, tube is inverted and contents dispensed onto the strip. on the strip, results are read 10 minutes later, where the positive and negative results are marked by the control lines.



**Figure 3: Parvo witness test strips** (Witness-parvo, 2017)

## 2.8 Immunization

The biggest problem in protecting a puppy against canine parvovirus infection ironically stems from the natural mechanism of protection that has evolved. Puppies obtain immunity by immunisation. There are different types of vaccines used, these include; Killed and Modified CPV Vaccine, Recombinant Vaccine, DNA Vaccine and Peptide Vaccine (Dahiya et al., 2012, Cunha et al., 2020)

The commonly used vaccines in Uganda include Parvovirus by zoetis, Biocan parvovirus and the Hipra-Dog parvovirus vaccines. According to many Veterinary practitioners Hipra-Dog Parvovirus vaccines is believed to more effective among the ones on the market.

## 2.9 Therapy

Restoration of electrolytes and fluid balance is the most important goal of therapy (Yogesh, 2022, Sari et al., 2024). The affected dog should be put under broad spectrum antibiotic umbrella (ampicillin, penicillin-streptomycin, chloramphenicol, erythromycin, gentamycin, Sulphur antibiotics (Schirò et al., 2022) Norfloxacin and nalidixic acid have been proved to be effective against canine haemorrhagic gastroenteritis (Mehta et al., 2020). Symptomatic treatment with steroid, and non-steroid inflammatory drugs like diclofenac, anticholinergics like atropine sulphate, broad spectrum antibiotic like penicillin-streptomycin and gentamycin, fluid and electrolyte may save the life of the animal. As soon as the problem is recognized, fluid therapy should be started. Supplementation of these fluids with bicarbonate may be recommended. Metabolic acidosis develops if the diarrhoea is severe and potassium or Sodium supplementation in the form of potassium chloride or Sodium chloride may be necessary to maintain electrolyte balance. All oral intakes must be

withheld in case of severe vomiting and should be given parentally (Sari et al., 2024, Suvethika & Kumar, 2021).

During the early phase of the disease, the application of hyperimmune serum may help to reduce the virus load and render the infection less dramatic. Such treatment has been shown to reduce the mortality and shorten the length of the disease however hyperimmune serum is difficult to obtain. In case of vomiting, chlorpromazine or metaclopramide (Reglan), out of which Reglan can be given at 0.5 mg/kg bodyweight parenterally at 8 h interval (Orhan et al., 2024). To correct the gastric problem cimetidine, ranitidine, famotidine and to check diarrhoea, loperamide or bismuth sub nitrate or other astringent preparations may be given (Nandi & Kumar, 2010). A dog with persistent vomiting should not be given any food until the diarrhoea and vomiting subsides.

## **CHAPTER THREE**

### **MATERIALS AND METHODS**

#### **3.1 Study design**

This study involved a cross-sectional descriptive type of approach. This design was observational in nature that involves the different agencies, persons and groups concerned about dogs with parvovirus. On the other hand, this form of study design involved manipulation of variables and the designs are moderately expensive. Further, the study design involved special data collection about the dogs with parvovirus including questions about the past, hence such a study design is difficult in recalling past events as may also contribute to re-call biases.

This study involved collecting data at that defined time where the researcher recorded the information presented from the cases brought at Paradise Animal Clinic and its branches. The data collected in this research helped to answer research questions of interest as the information about dogs with parvovirus represents what is going on at only one point in time. The survey design was opted in this study because it is relatively quick and easy to conduct (no long periods of follow-up) (Olsen & St George, 2004).

#### **3.2 Study area**

This research involved dogs brought at Paradise Animal Clinic and its outlets around the Kampala District. The Clinic is located in four different divisions of Kampala with eight different outlets in total, where clients take their pets for treatment; Nakawa (Ntinda, Kitintale, Mbuya), Makindye (Kibuli, Kansanga), Rubaga (Busega) and Kawempe (Kyebando, Kawempe) divisions.

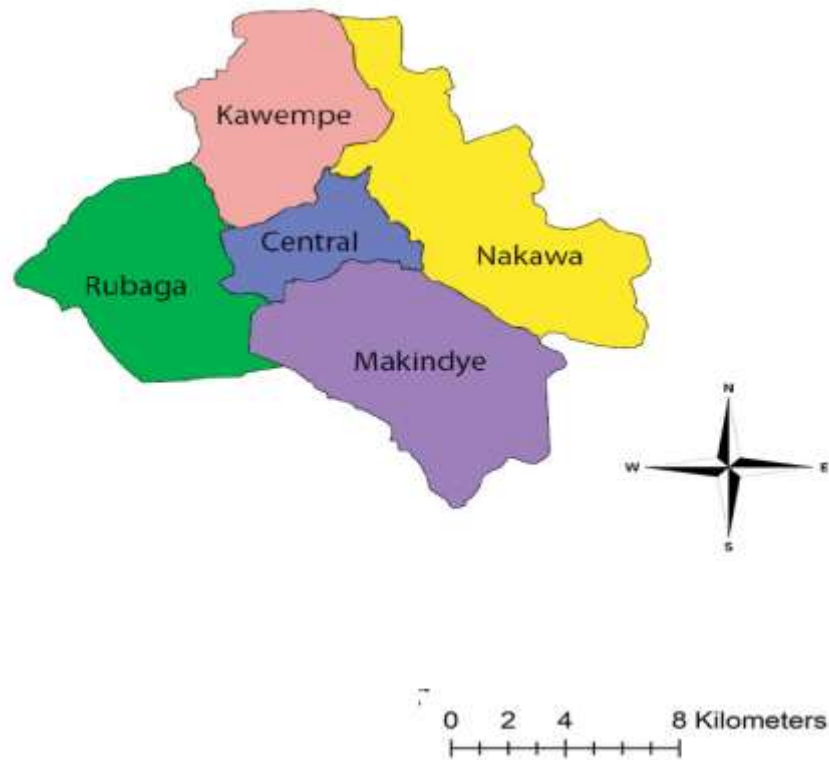


**Figure 4: Map of the study area**

### **3.3 Selection criteria**

The researcher during the renascence survey, purposively selected dogs with parvovirus among those presented with Parvovirus at Paradise Animal Clinic and its branches.

#### **3.3.1 Study population selection**

The study population included dogs with parvovirus brought at Paradise Animal Clinic and its outlets around Kampala District. Data was collected and documented using the daily clinic records and survey questionnaire. This involved engaging the customers of different areas for Paradise Animal Clinic.

This study may have involved dogs from other districts other than Kampala, but this study focused mainly on those that were brought at Paradise Animal Clinic and its outlets.

### **3.4 Sampling strategy**

#### **3.4.1 Quantitative study**

The primary study unit involved testing for canine parvovirus on dogs that were brought at Paradise animal clinic and its outlets. The selection of study of dogs with parvovirus was purposive based on records that were used at Paradise Animal Clinic and its outlets. Using a sample size formula by Kish Leslie for cross-sectional studies (Kish, 1965).

$$n = \frac{z^2 P (1-P)}{e^2}$$

$$e^2$$

Where n= required sample size

Z= the normal curve constant that represents the level of confidence (1.96)

e= the desired level of precision estimated at 95%

p= the estimated proportion of attribute that is present in a population (50%) and q is the 1-p.

In this study we estimate the error margin at 5% (0.05). This therefore results into the confidence interval at 95%. It is also estimated that we can access data from 50% of the population dogs with parvovirus in Kampala district.

$$n = \frac{1.96^2}{0.05^2} \times 0.5 \times 0.5 = 384$$

$$0.05^2$$

By substituting for n =384 dogs were enumerated and markers put on them.

NOTE: To determine the sample size from unknown population, the P=0.5

### 3.5 Data collection

Data collection involves sample collection, laboratory analysis and data analysis.

Data was collected using the methods below:

**Survey questionnaire:** First, with the help of the structured questionnaire shown in Appendix I, a survey was conducted to assess dogs with parvovirus and how the issue was handled by the owners and the clinic. The survey questionnaires had close ended questions mainly targeting quantitative research

#### 3.5.1 Field Test Analysis

Faecal samples were collected from dogs marked for research, and the witness parvo test was used for detection. The CPV rapid Ag test that detects the canine parvo virus antigen using monoclonal antibodies in the faecal matter was used, which features a one-step testing procedure and is quick and accurate as described by the manufacturer (Walter-Weingärtner et al., 2021). The test procedure was done as follows, a buffer was dispensed up to the graduated mark in a tube, a rectal swab was inserted into the tube and thoroughly mixed, the tip of the swab was broken at the blue line, the tube was inverted and contents dispensed onto the the strip, results were read 10 minutes later, positive and negative results were identified by looking at marked control lines on the strip.

#### 3.5.2 Data collection

**Document Review:** Documentary materials about the dogs with parvovirus were reviewed. These included data from journals, articles annual reports and other finding from the clinical cases of admitted dogs. Secondary data was reviewed to assess the impact of parvovirus on the dog population in Kampala. The risk factors were collected using Kobocollect software.

### 3.6 Study instruments and tools

**Questionnaires:** Structured questionnaires were used to generate quantitative data during the descriptive cross-sectional study (refer to the Appendix I).

Semi structured interview checklist and guides: A number of semi-structured interview guides were used to conduct a qualitative component of the study (refer to the Appendix (II)).

The study involved looking at different factors and how significant they can be in this research: these included the breed of the dog, the age of the dog, the sex of the dog, the vaccination status, the occupation of the owner and their level of education and the location of the places of diagnosis. There were 384 questionnaires issued to 384 owners.

### **3.7 Pre-testing process**

Prior to data collection, well designed research tools were discussed and agreed upon with the supervisor. The approved tools were pretested on two participants experiencing similar environments as the study samples. The pre-testing process provides the researcher an opportunity to assess the error that was made during the construction of research tools such as inaccurate wording, coding, interviewers' bias, trimming of the relatively lengthy questionnaires (just in case), fatigue, all these anomalies were corrected, deleted and omitted.

### **3.8 Data analysis and Management**

#### **3.8.1 Quantitative Data**

A database consisting of questionnaire data was established in Microsoft Excel®. The number of dogs was tabulated according to age, sex, breed, pedigree, origin and purpose of keeping the dogs. Further statistical analysis was carried out using Stata version 11/ SE for Windows (Stata Corp, College Station, TX). The outcome of interest were further statistically analysed using chi-square and regression to assess the impact of dogs with parvovirus brought at Paradise Animal Clinic Descriptive statistics was computed and presented. The research assistants were trained guided and supervised on the procedures of using the designed study instruments and tools. Interviewing during key informant interviews were also conducted by the researcher assisted by note-takers and research assistant. It was a participatory type of facilitation during the qualitative data collection.

### **3.9 Ethical considerations**

A clearance letter was sought from the School of Biosecurity, Biotechnical and Laboratory Sciences Ethical Review Committee at the College of Veterinary, Animal, Resources and Biosecurity, Makerere University. These sections on ethical considerations were also included review of the proposal by the College and Department committees. Further, it is also noted that while conducting interviews to the study respondents, issues of informed consent was first sought. In addition, issues of confidentiality were adhered to when conducting this study and the purpose for which this study is conducted were communicated to the respondents.

## CHAPTER FOUR

### RESULTS

#### 4.1 Demographic Characteristic of the Dogs

The study reported 221(57.55%) out of 384 of the positivity rate, and of these, 49 died, representing a fatality rate of 22.17% of the positive cases. Of the 384 samples collected and tested, 135/384 male dogs were CPV+ and 116/384 female dogs were CPV+. The majority of these fatality cases (96%) occurred in dogs <3 Months of age (63.3% less than 2 months and 32.7% less than 3 months) indicate a lack of primary and early vaccination to provide protective immunity since most dogs were not vaccinated against CPV. Only (19.0%) of the dogs studied were vaccinated, and the rest (81.0%) had no history of vaccination against Canine parvovirus (CPV). A study has revealed that the difference in average weights between the CPV+ group of dogs and CPV- group of dogs is 1.42, 95% CI [1.38, 1.47]. The majority of these fatality cases (96%) occurred in dogs <3 months of age (63.3% less than 2 months and 32.7% less than 3 months), indicating lack of the primary and early vaccination to provide protective immunity since most of the dogs were not vaccinated against CPV. Samples were taken from dogs of 2 months (32.0%), 3 months (20.6%), 4 months (18.2%), 8 months (10.2%), 1 year (14.6%), and 2 years (4.4%). Only (19.0%) of the dogs studied were vaccinated and the rest (81.0%) had no history of vaccination against Canine parvovirus (CPV). A significant number of dogs which were not vaccinated 168 (54.0%) were parvovirus positive (+). Most of the sampled dogs were cross-German shepherd dogs and German shepherd dogs (58.4%), local dogs were (25.3%), and Maltese dogs were (12.0%).

**Table 1: Demographic Characteristic of the Dogs**

| <b>Variable</b>           | <b>Category</b>       | <b>n (%)</b> |
|---------------------------|-----------------------|--------------|
| <b>Sex</b>                | Male                  | 220 (57.6)   |
|                           | Female                | 163 (42.7)   |
| <b>Age</b>                | 2 months              | 340 (89.0)   |
|                           | 3 months              | 75 (19.6)    |
|                           | 4 months              | 70 (18.3)    |
|                           | 8 months              | 39 (10.2)    |
|                           | 1 year                | 56 (14.7)    |
|                           | 2 years               | 17 (4.4)     |
|                           |                       |              |
| <b>Breed</b>              | German Shepherd       | 115 (30.1)   |
|                           | Maltese               | 46 (12.0)    |
|                           | Cross German Shepherd | 109 (28.5)   |
|                           | Local dog             | 97 (25.4)    |
|                           | Cross Labrador        | 6 (1.6)      |
|                           | Doberman              | 4 (1.0)      |
|                           | Boerboel              | 7 (1.8)      |
|                           |                       |              |
| <b>Vaccination Status</b> | Yes                   | 73 (19.1)    |
|                           | No                    | 311 (81.4)   |

#### **4.2 Demographic characteristic of the dog owner**

Of the reported 221 (57.55%) positive cases of 384 dogs, 85 positive cases were from Nakawa, 88 were from Makindye, 25 were from Kawempe, and 23 were from Rubaga. The average age of the dog owners with the CPV in Kampala was 48.6 years. Most respondents with more positive dog cases with CPV were self-employed dog owners, with 103 positive cases. The study also revealed that dogs are largely owned by men. The study shows that 66.5% of men own a dog, compared to 33.85% of their female counterparts

**Table 2: Demographic characteristic of the dog owner**

| <b>Variable</b>   | <b>Category</b> | <b>n(%)</b> |
|-------------------|-----------------|-------------|
| <b>Gender</b>     | Male            | 221 (57.6)  |
|                   | Female          | 163 (42.4)  |
| <b>Occupation</b> | Formal employed | 140 (36.4)  |
|                   | Self employed   | 180 (46.9)  |
|                   | Business        | 54 (14.1)   |
|                   | Civil servant   | 10 (2.6)    |
|                   |                 |             |
| <b>Division</b>   | Nakawa          | 137(35.7)   |
|                   | Makindye        | 151(39.3)   |
|                   | Kawempe         | 51(13.3)    |
|                   | Rubaga          | 45(11.7)    |

#### **4.3 Sero prevalence of canine parvovirus infection in Kampala district**

Of the 384 samples collected and tested, 137 (35.7%) were from Nakawa, 151 (39.3%) were from Makindye, 51 (13.3%) were from Kawempe, and 45(11.7%) were from Rubaga. Samples were taken from dogs of 2 months 127 (33.1%), 3 months 75 (19.5%), 4 months 70 (18.2%), 8 months 39 (10.2%), 1 year 56 (14.6%), and 2 years 17 (4.4%). Only 73 (19.0%) of the dogs studied were vaccinated and the rest 311 (81.0%) had no history of vaccination against Canine parvovirus (CPV). A significant number of dogs which were not vaccinated 168 (54.0%) were parvovirus positive (+). Most of the sampled dogs were cross-German shepherd dogs and German shepherd dogs (58.4%), local dogs were (25.3%), and Maltese dogs were (12.0%). A total of four independent variables were the focus of this study which included: 1) Breed of the Dog, 2) Age of the Dog, 3) Vaccination Status of the dog, and 4) Location (division) of the dog. Each of these independent variables was believed to influence canine parvovirus status of the dog in Kampala district. However, there is no particular treatment for the disease that can only be prevented through vaccinating all puppies with Parvo vaccines

**Table 3: Parvovirus prevalence in Kampala and fate of the dog after contracting CPV**

|                          |                 |           | Fate of the dog after contracting the virus |       | Total  |
|--------------------------|-----------------|-----------|---------------------------------------------|-------|--------|
|                          |                 |           | Alive                                       | Dead  |        |
| <b>Parvovirus status</b> | <b>Positive</b> | Frequency | 172                                         | 49    | 221    |
|                          |                 | %         | 77.8%                                       | 22.2% | 100.0% |
|                          | <b>Negative</b> | Frequency | 163                                         | 0     | 163    |
|                          |                 | %         | 100.0%                                      | 0.0%  | 100.0% |
| Total                    |                 | Frequency | 335                                         | 49    | 384    |
|                          |                 | %         | 87.2%                                       | 12.8% | 100.0% |

The study reported 221 out of 384 of the positivity rate and of these 49 died after failure to respond to treatment representing fatality rate of 22.17% of the positive cases. The majority of these fatality cases (96%) occurred in dogs <3 months of age (63.3% less than 2 months and 32.7% less than 3 months), indicating lack of the primary and early vaccination to provide protective immunity since most of the dogs were not vaccinated against CPV. Canine parvovirus (CPV) is a highly contagious cause of serious and often fatal disease in dogs worldwide despite the availability of safe and efficacious vaccines. It has remained a common and important cause of morbidity and mortality in young dogs. Dozens of dogs in Kampala city have succumbed to the parvovirus disease, which attacks puppies aged between four weeks and six months.

#### **4.4 Predictors of CPV in dogs**

A multivariate regression was performed to ascertain the effects of a dog's age, sex, breed, and vaccination status on the likelihood that a dog will contract the CPV virus. The gender of the dog owner, occupation, age and education were also regressed against CPV prevalence. The multivariate regression model was statistically significant:  $F(15, 367) = 12.87, p < 0.001$ . The model explained 31.0% ( $R^2$ ) of the variance in CPV prevalence.

**Table 4: Predictors of CPV in dogs**

| <b>Factors</b>                       | <b>Coef.</b> | <b>Std. Err.</b> | <b>T</b> | <b>P&gt;t</b> | <b>[95%<br/>Conf.</b> | <b>Interval]</b> |
|--------------------------------------|--------------|------------------|----------|---------------|-----------------------|------------------|
| <b>Age</b> of the Dog                | .1684278     | .0148095         | 11.37    | <b>0.000</b>  | .1393058              | .1975499         |
| <b>Sex</b> of the dog                | -.0454749    | .0475236         | -0.96    | 0.339         | -.1389276             | .0479778         |
| <b>Vaccination</b><br>Status         | .0390858     | .0572561         | 0.68     | 0.495         | -.0735053             | .151677          |
| <b>Breed of the dog</b>              |              |                  |          |               |                       |                  |
| German Shepherd                      | -.2619894    | .2112583         | -1.24    | 0.216         | -.6774182             | .1534393         |
| Maltese                              | -.2271502    | .2162768         | -1.05    | 0.294         | -.6524475             | .198147          |
| Cross German<br>shepherd             | -.2144506    | .210477          | -1.02    | 0.309         | -.6283429             | .1994417         |
| Local dog                            | -.1850629    | .212035          | -0.87    | 0.383         | -.602019              | .2318931         |
| cross Labrador                       | -.4245587    | .2652994         | -1.60    | 0.110         | -.9462565             | .0971391         |
| Boerbels                             | .0824786     | .2594434         | 0.32     | 0.751         | -.4277037             | .5926608         |
| <b>Gender</b> of the<br>dog owner    | .0196262     | .0479885         | 0.41     | 0.683         | -.0747407             | .1139931         |
| <b>Age</b> of the dog<br>owner       | -.0026076    | .0018062         | -1.44    | 0.150         | -.0061593             | .0009442         |
| <b>Education</b> of the<br>dog owner | .008044      | .0067912         | 1.18     | 0.237         | -.0053106             | .0213986         |
| <b>Employment</b><br>status          |              |                  |          |               |                       |                  |
| Formal<br>employment                 | -.0090208    | .0664883         | -0.14    | 0.892         | -.1397667             | .1217251         |
| Self employed                        | .0047749     | .0643528         | 0.07     | 0.941         | -.1217716             | .1313214         |
| Business                             | 0            | (omitted)        |          |               |                       |                  |
| Civil servant                        | .0115367     | .137865          | 0.08     | 0.933         | -.2595677             | .2826412         |
| _cons                                | 1.170903     | .2853319         | 4.10     | 0.000         | .6098122              | 1.731994         |

The individual predictors were examined further and indicated that the age of the dog ( $t = 11.37, p < 0.05$ ) was a statistically significant predictor of CPV among dogs in Kampala. The prevalence of CPV in dogs increases by 17% with each age increase in

the dog's age. The findings show that CPV primarily affects puppies that are between the age of 6 weeks to 6 months.

## CHAPTER FIVE

### DISCUSSION

The study shows high incidences of Canine parvovirus status in young dogs in Kampala, with 221 (57.6%) positivity rate. Different breeds of dogs were tested. German shepherd breed recorded the highest percentage of positive cases. Several studies have reported higher prevalence in the German shepherd breed (Khare et al. 2019, Poudel et al. 2020). Since its emergence in the late 1970s, canine parvovirus (CPV) has remained a common and important cause of morbidity and mortality in young dogs (Sunghan et al. 2019, Piegari et al. 2020). It is a highly contagious disease and can occur as an outbreak (Behdenna et al. 2019). Infection is acquired via the faecal-oral route, and virus replication occurs only in rapidly dividing cells such as lymphoid tissues, intestinal crypt epithelial cells, precursor cells in the bone marrow and rarely myocardiocytes in puppies within the first two weeks of life (Radzykhovskiy et al., 2022). Intestinal tract damage increases the risk of bacterial translocation and subsequent coliform septicaemia, which may lead to the development of a systemic inflammatory response that can progress to septic shock and, ultimately, death (Piegari et al. 2020).

Concerning vaccination history, the results indicated a higher percentage of positive cases in unvaccinated dogs than in vaccinated dogs. This corresponds with the findings of (Zourkas et al., 2015, Decaro et al., 2020), who had a prevalence a higher in unvaccinated dogs compared to vaccinated dogs. There was no dependence of the vaccination status of the dogs on the susceptibility to CPV infection in this study. This was similar to work done by (Miranda et al., 2015), who found vaccination status not to be a risk factor for CPV infection but was at variance with recent work done by (Ogbu et al., 2017), implying a dependence of vaccination status on the susceptibility to CPV infection validating the claim that vaccinated dogs are protected against CPV. The high percentage of positive cases in vaccinated dogs in this study could result from irregular vaccination or improperly maintained vaccines (Decaro et al., 2020). Worthy of note is the possible strain difference between the commercially available vaccine strains and the pathogenic ones causing prevailing infections in Uganda, the latter possible difference calls for the characterization of CPV field isolates in

Uganda. Also, previously infected pens without proper disinfection could be a source of infection to puppies even before vaccination begins (Hurley et al., 2021).

Studies have shown that initial clinical signs of canine parvovirus are non-specific and include anorexia, depression, lethargy and fever (Khatri et al., 2017). This often progresses to severe vomiting and small bowel diarrhoea (Adamenkova et al., 2024; Ogbu et al., 2017). Since a clinical diagnosis is not definitive, several laboratory methods including ELISA, immunochromatographic, hemagglutination, virus isolation or polymerase chain reaction-based methods—have been developed to detect CPV in the faeces of infected dogs (Faz et al., 2017), however in Uganda, there is currently RDTs and clinical signs used for diagnosis. In Uganda, the common treatment for parvovirus disease is supportive and symptom-based involving use of anti-emetics to manage severe vomiting, fluid therapy to restore hydration and administration of antibiotics to prevent secondary bacterial infection (Tabary., 2020, Gerlach et al., 2017). The use of non-steroidal anti-inflammatory drugs and anti-cholineergics has been very useful for the latter. Survival rates are considered significantly higher with treatment (64%), with the reported survival rate as low as 9.1% without treatment (Goddard & Leisewitz, 2010). Dogs recovering from CPV infection are thought to generally retain lifelong protective immunity against the strain (Schultz et al., 2010, Kilian et al., 2018).

Education level, dog vaccination status, dog age and dog breeds were found to be the major predisposing factors for CPV in this study. Although this disease can be seen in dogs of any age, puppies between 6 weeks and 6 months appear more susceptible (DiGangi et al., 2021). Certain breeds are at greater risk of developing CPV disease, including the Doberman pinscher, Rottweiler and German shepherd dog (Miranda et al., 2015). However, the reasons for possible breed susceptibility are unknown. Furthermore, a distinct seasonality of CPV disease has been reported in Australia, with a higher incidence of disease occurring during the warmer months. The most commonly reported risk factor for CPV disease is a lack of protective immunity (Decaro et al., 2020, Riedl et al., 2015).

The study reported 221 out of 384 of the positivity rate. and of these 49 died representing fatality rate of 22.17% of the positive cases. The majority of these fatality cases (96%) occurred in dogs <3 months of age (63.3% less than 2 months

and 32.7% less than 3 months), indicating lack of the primary and early vaccination to provide protective immunity since most of the dogs were not vaccinated against CPV. With regards to age, results from this study agree with work done in India (Singh et al., 2022) and Nigeria (Ogbu et al., 2017), which showed a higher prevalence in dogs less than 6 months old at a higher risk of infection. The high prevalence of CPV infection in dogs less than 6 months old could be due to interference of maternal antibodies, improper vaccination protocol, lack of maternal immunity and poor efficiency of the immune system of puppies (Cunha et al., 2020). However, it contrasts with a study in Bangladesh where females dogs were reported to be more susceptible 49.74% than 33.7% males (Hasan et al., 2016).

This study detected the presence of CPV in dogs with diarrhoea and those without diarrhoea. Furthermore, not all dogs presented with diarrhoea tested positive for CPV. However, dogs presented with diarrhoea had a higher prevalence than dogs without diarrhoea which is in agreement with studies by Sen et al., (2019). This study showed that the absence of bloody diarrhoea may not be often presumed to be CPV negative.

CPV is highly stable and ubiquitous in the environment, as it is extremely resistant to pH and temperature changes and to treatment with lipid solvents, trypsin and most disinfectants (Zourkas et al., 2015). Transmission of the virus is usually through direct contact from dog-to-dog, or indirectly via exposure to fomites or environments contaminated with faecal matter (Jyothi et al., 2024, Behdenna et al., 2019).

The limitations of this study involved scarcity of the rapid test kits, inaccessibility to a number of dog owners due to poor road network in the city and having limited breeds variations during the study.

## **CHAPTER SIX**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **6.1 Conclusion**

In conclusion, study shows occurrences of CPV among dogs around Kampala. The high case positivity (+) rate of CPV reported in this study proves that the infection is an important cause of canine deaths in Kampala. The study shows a CPV detection rate of 57.6% in Kampala. It also revealed that the age of dogs influenced the susceptibility to CPV, with German shepherd, local dogs, puppies below 3 months being the most susceptible breeds and age group respectively. CPV is detected in dogs presented with bloody diarrhoea, Lethargy, Vomiting, and Inappetence, as well as in dogs without bloody diarrhoea; hence, the absence of foul-smelling bloody diarrhoea should not be the indicator to rule out CPV in dogs. Identification of risk factors associated with death provides prognostic information for veterinarians when faced with CPV cases, thereby allowing strategic preventive protocols to be developed. Such an understanding of the epidemiology of CPV and identification of the factors that influence outcomes in Kampala is necessary for making a step towards eliminating the disease from the Kampala canine population.

#### **6.2 Recommendations**

Understanding CPV transmission routes, proper isolation of infected dogs from the rest of the healthy dogs should be emphasized to limit contact among the dogs and also limit environmental contamination. The latter should be followed by thorough disinfection of environment, kennels, dog dishes and use proper PPE when handling clinical cases.

Vaccination of dogs by a trained veterinarian using vaccines containing all endemic strains, (for example, Hipradog, and Zoetis) at 6–8, 10–12, and 14–16 weeks, followed by annual boosting is strongly recommended to enable the dogs always have high antibody titres and so have immunity against CPV. The latter should be accompanied by a vaccination certificate to help track the previous dates and the next due dates for the intervention.

Another study about the genotypes of the circulating CPV strains in Uganda is highly recommended. This will guide in the procurement of the correct vaccines targeting the virus. And lastly, concerned bodies like MAAIF, CoVAB, DVOs, Veterinary Officers, Laboratory Technicians, dog owners, dog breeders and animal welfare clubs should prioritize the importance of canine parvovirus as one of the lethal canine infections and treat it with a lot of vigilance.

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## APPENDICES

### Appendix I: Questionnaire

My name is Dr. Sulaiman Kitagenda, a final year MVPM student. I am conducting a study to establish the prevalence of parvovirus brought at Paradise Animal Clinic, Ntinda. A retrospective study between June to July 2023).

The information obtained by the study shall be purely for academic purposes. Your involvement by responding to this questionnaire will be highly appreciated.

#### SECTION A: RESPONDENTS DETAILS

Name (Optional).

Sex (A). Male B. Female

Occupation: .....

Place a tick in the box or against your choice of answer where applicable and give short answers in the space provided.

#### SECTION B: KNOWLEDGE ABOUT THE DISEASE

b) 1. Have you ever heard about parvovirus

|   |     |
|---|-----|
| A | Yes |
| B | No  |

If yes, what do u say about it?

.....

.....

.....

|   |           |
|---|-----------|
| A | Virus     |
| B | Bacteria  |
| C | Accidents |
| D | Others    |

2. What causes parvovirus?

3. How do dogs contract parvovirus?

|   |                  |
|---|------------------|
| A | Contact          |
| B | Injury           |
| C | Not washing dogs |
| D | Poor diet        |

4. Which breeds are mostly affected by parvovirus?

|   |              |
|---|--------------|
| A | Pure Breeds  |
| B | Cross breeds |
| C | Local breeds |
| D | Others       |

5. What age of the dogs are greatly affected

|   |                     |
|---|---------------------|
| A | Old above 10 years. |
| B | Older than 6 months |
| C | Less than 6 months  |
| D | Others              |

6. Have you ever seen a dog die of parvovirus related sickness?

|   |     |
|---|-----|
| A | Yes |
| B | No  |

7. If yes, how did you handle it before death?

|   |          |
|---|----------|
| A | Dust bin |
| B | Buried   |
| C | Burnt    |
| D | Others   |

8. What signs did the dog manifest before death

|   |                  |
|---|------------------|
| A | Lethargy         |
| B | Vomiting         |
| C | Bloody Diarrhoea |
| D | Cough            |
| E | Inappetence      |

### SECTION C: MANAGEMENT PRACTICES

C (a). Have you ever heard of the parvovirus vaccine?

|   |     |
|---|-----|
| A | Yes |
| B | No  |

If Yes

.....  
.....  
.....  
.....

b. Where did you hear it from?

|   |              |
|---|--------------|
| A | Community    |
| B | Dog show     |
| C | Radio/TV     |
| D | Social Media |
| E | Clinic       |
| F | Others       |

c. If No why

d. How many dogs do you have?

|   |                 |
|---|-----------------|
| A | One             |
| B | Two             |
| C | Three           |
| D | More than three |

e. How long have you been with your dogs?

|   |                    |
|---|--------------------|
| A | Less than 6 months |
| B | More than 6 month  |
| C | More than 1 year   |
| D | Others             |

f. Do you usually acquire old dogs or young ones?

|   |            |
|---|------------|
| A | Young      |
| B | Puppy      |
| C | Medium age |
| D | Old age    |

g. Have you ever taken them for immunisation of parvo and other diseases?

|   |     |
|---|-----|
| A | Yes |
| B | No  |

If Yes, Where did you take them?.....

|   |                           |
|---|---------------------------|
| A | Animal clinic             |
| B | Dog handlers and trainers |
| C | Field vets                |
| D | Self-treat                |

h. What diseases where they vaccinated against

|   |                      |
|---|----------------------|
| A | Rabies               |
| B | Parvovirus           |
| C | Hepatitis            |
| D | Cocktail of diseases |
| E | Others               |