DETERMINANTS AND BARRIERS TO RABIES PREVENTION AND CONTROL IN MANYINGA AND MWANSABOMBWE DISTRICTS OF ZAMBIA

By:

Muma Chipo Misapa

A thesis submitted to the University of Zambia in Fulfilment of the requirements for the award of the degree of Master of Science in Epidemiology by Research.

THE UNIVERSITY OF ZAMBIA

LUSAKA

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This thesis of Muma Chipo Misapa has been approved as fulfilling the requirements for the award of the degree of the Masters of Science in Epidemiology by the University of Zambia.

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ABSTRACT

Rabies persists as a long-standing issue in Zambia, despite being preventable. The current control measures, including dog vaccination, population control, and movement restriction, guided by Zambia's Dog Control Act, have not yielded the desired impact in Manyinga and Mwansabombwe districts. These areas continue to report low dog vaccination percentages, unrestricted dog movements, and escalating cases of animal and human rabies, along with dog bites. Aligned with global aspirations to achieve zero human rabies cases from dog-mediated rabies by 2030, this study scrutinizes the determinants and obstacles hampering the execution of rabies prevention and control initiatives in Manyinga and Mwansabombwe. Spanning approximately 11 months, this cross-sectional study targeted a population of 48,181 in Manyinga and 35,546 in Mwansabombwe were pre- and post-vaccination data from 301 households in Manyinga and 100 households in Mwansabombwe was collected. Using pretested structured questionnaire, including closed and open-ended questions we probed knowledge, attitudes and practices related to rabies prevention and control.The questionnaire comprised 10 questions on rabies knowledge, 3 questions on practices, 2 questions on attitudes, and general follow-up questions. A transect survey, key informant interviews, and assessment of rabies vaccination and dog bite records complemented the data collection. IBM SPSS Statistics version 26.0 was used for a comprehensive thematic analysis were cross tabulations and Pearson's Chi Square were performed. Findings revealed that 68% of respondents in Manyinga and 84% in Mwansabombwe possessed knowledge about rabies, confirming affected species and transmission. Moreover, 76.8% in Manyinga and 88.6% in Mwansabombwe were acquainted with rabies prevention and control methods. Concerning dog owners, 89% were aware of rabies, 66% understood its prevention and control, and the majority identified bites as the primary mode of transmission. Vaccination coverage stood at 64% in Manyinga and 21% in Mwansabombwe. Notably, education and occupation exhibited significant associations with rabies knowledge. On the attitudes and practices on rabies vaccination 51.82% in Manyinga and 72.09% in Mwansabombwe of the dog owning respondents had valid rabies vaccination. And only 55% in Mwansabombwe and 70% in Manyinga washed the wound, visited the veterinary office and went to the hospital after a dog bite. Manyinga recorded low numbers on vaccinated dogs with valid vaccinations which is a risk to the community because majority of the dogs were not protected against rabies. Also, the two districts had beliefs which hindered the community from having their dogs vaccinated. The key informants were well vested with rabies and their role in rabies

prevention, however, they faced a lot of challenges due to understaffing, lack of resources and community practices.

The study underscores critical knowledge gaps which affected the practices and attitudes towards rabies prevention and control and emphasizes the need for enhanced education, awareness programs, improved rabies surveillance, free mass vaccination campaigns, and community engagement to augment vaccination coverage and knowledge about rabies.

Key words: Rabies, Prevention, control, vaccination, barriers, determinants

DEDICATION

This work is dedicated to my Husband Michael Elias Mulenga Bweupe, My Father Maynard Julius Chanda Misapa and My Mother Theresa Kabwe Misapa for the incredible support they have rendered during this study at the University of Zambia. I thank them for their spiritual and moral support and the undying belief they have in my abilities to achieve greater heights in all my endeavors.

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ABBREVIATIONS

PEP Post exposure prophylaxis

WHO World Heath Organization

OIE World Organization for Animal Health

FAO Food Agriculture Organization

MFL Ministry of Fisheries and Livestock

MOH Ministry of Health

CVRI Central Veterinary Research Institute

NALEIC National Livestock Epidemiology and Information Centre

CHAPTER 1

1.1 INTRODUCTION

1.1.1 Background

Rabies is a zoonotic viral disease that causes fatal encephalitis in humans and other mammals (Ayu Ria Widiani *et al* 2022; Lodha et al 2023; Soler-Rangel et al. 2020) Annually, it claims approximately 59,000 human lives globally, with a prevalence of 56% in Asia and 44% in Africa (World Health Organization (WHO) 2014).The preponderance of these fatalities transpires in rural locales (WHO 2018a; Nadal et al. 2022). Canines persist as the principal reservoir in developing nations, while wildlife assumes this role in developed regions (Rupprecht 2004). In the context of developing nations, optimal eradication of human rabies hinges on the strategic management of canine rabies (CLEAVELAND 2003) .

In view of the above, World Health Organization (WHO) proffers recommendations for integral components such as mass canine immunization campaigns, population control measures, restricted breeding practices and curtailed mobility of stray canines. These interventions save as pivotal elements in the elimination of rabies from endemic areas and the prophylaxis of dog-mediated human rabies cases (World Health Organization 2004). Rabies has been a persistent challenge in Zambia since the 20th century(Munang'andu et al. 2011a). It is an endemic notifiable disease in both humans and animals, with a relative prevalence hypothesized to be 39.7% and postulated to be 48% according to Central Veterinary Research Institute (CVRI) and (Mulipukwa et al 2017a). Consequently, this country has instituted measures for rabies control, encompassing canine immunization, population control, and movement restrictions, as articulated in the Control of Dogs Act within the Laws of Zambia (Mulipukwa et al. 2017a).

Despite extant legislation mandating canine vaccination, the districts of Manyinga and Mwansabombwe persistently report suboptimal figures regarding vaccinated canines, unrestricted canine movements, and an escalating incidence of animal and human rabies cases, in addition to canine bites, National Livestock Epidemiology and Information Centre (NALEIC) reports. The aforementioned prompted the selection of these two rural districts and also because no such surveys have been conducted in these rural parts of the country. The dog population in Zambia is estimated to be 934,171, as reported by (NALEIC), but this is not conclusive as the precise canine population in Zambia remains elusive, with a purportedly

minute fraction undergoing vaccination (Mulipukwa et al. 2017a). Estimated canine populations in Manyinga and Mwansabombwe hover around 2300 and 1500, respectively, with presumed low vaccination rates and a paucity of rabies awareness in rural populations.

Despite concerted efforts in mass vaccination endeavors, the scope of coverage remains wanting, in the country,with the number of notified dog bite cases rising. The Zambian report on rabies was presented at the Southern and East African Rabies Group (SEARG) meeting of 2013; the number of notified dog bite cases in Zambia rose from 620 in 2010 to 732 in 2011 (Mulipukwa et al. 2017a). According to veterinary records, between 2018 and July 31, 2020, only 752 canines in Manyinga and 75 in Mwansabombwe received vaccinations . Primarily concentrated in urban enclaves, these vaccinations neglect the substantial rural canine populace, commonly deployed for illicit hunting and thereby posing substantial health risks to both imperiled wildlife and local denizens. The two districts record dog bite cases every year, but the extent of canine rabies cases in Manyinga and Mwansabombwe remains indeterminate, as ostensibly rabid canines are expeditiously euthanized without postmortem and confirmation by CVRI and the University of Zambia School of Veterinary Medicine laboratory, which is the only laboratory that conducts rabies confirmation in the country. The aforementioned has contributed to the poor rabies surveillance in Zambia, together with the lack of collaboration between human and animal health sectors .

The rabies suspected cases analysis recorded in Zambia between 1985 to 2004 found 1,088 rabies-positive samples from various species, of which 747 were from dogs and 98 were from humans (Munang'andu et al. 2011b; Mulipukwa et al. 2017b). Another analysis conducted on brain samples collected from suspected rabid dogs between January 2005 and December 2013 found 153 rabies-positive cases (Babaniyi et al. 2016). The aforementioned indicates that the dog-mediated human rabies and dog rabies burdens in the country are still a challenge.

This study's main objective was to identify barriers to rabies prevention and control in the Manyinga and Mwansabombwe districts. Methodologically, the research interrogated the knowledge, attitudes, and practices concerning rabies within the general populace and pet owners. Additionally, it analysed demographic charecteristics of the canine populace, estimated the number of vaccinated dogs to gauge mass vaccination coverage, and discerned factors influencing the viability of rabies control programs in the Manyinga and Mwansabombwe districts. By elucidating these impediments, the study aspires to augment canine rabies vaccination coverage to align with the 70% benchmark proposed by the World Health

Organization (World Health Organization 2004), thereby ameliorating attitudes and knowledge among the rural population regarding rabies.

1.1.2 Statement of the problem

In Zambia, the actual dog population is not well known, and it is assumed that only a small percentage of these dogs are vaccinated (Mulipukwa et al. 2017). In Manyinga and Mwansabombwe, the dog population is approximated to be about 2,300 and 1,500 respectively, according to the 2018 livestock census (MFL, Livestock and aquaculture census report 2018) . Of this estimated dog population, the percentage of vaccinated dogs is assumed to be very low, and knowledge about rabies is poor among people in rural parts of the district.

Despite several organized mass vaccinations, coverage has been inadequate. Between 2018 and July 31, 2020, only 752 dogs were vaccinated in Manyinga, and only 75 dogs in Mwansabombwe between 2020 and May 2022 (Ministry of Fisheries and Livestock report). These efforts primarily targeted urban areas, neglecting substantial rural canine populations. These rural dogs are often involved in illegal hunting, posing significant health risks to both endangered wildlife and humans.

This low vaccination coverage indicates poor outreach of the mass vaccination programs and minimal protection against rabies in the districts. Consequently, both Manyinga and Mwansabombwe continue to record cases of dog and human rabies.

1.1.3 Rationale of the Study

The extent of canine rabies cases in Manyinga and Mwansabombwe remains indeterminate,as dogs suspected of being rabid are immediately killed without follow-up confirmatory diagnosis.To establish well-organized rabies control and prevention programs in both districts, it is imperative to identify the impediments to rabies prevention and control. By pinpointing these obstacles, the study seeks to enhance rabies knowledge and attitudes among rural citizens, leading to improved vaccination coverage and better rabies disease surveillance. Ultimately, this study has the potential to provide crucial information necessary for the effective control of rabies in Manyinga and Mwansabombwe districts.

1.1.4 Research Question

What are the major barriers to implementation of rabies control strategies in Manyinga and Mwansabombwe District?

1.1.5 Objectives

General objective

The aim of this study is to identify determinants and barriers to rabies prevention and control in Manyinga and Mwansabombwe districts using surveys and mass vaccination campaigns

Specific Objectives

1. Determine the knowledge, attitudes and practices on Rabies in Manyinga and Mwansabombwe Districts
2. Determine the dog population demography in Manyinga and Mwansabombwe Districts
3. Estimate both the number of vaccinated dogs and stray dogs in order to determine the coverage of mass vaccinations
4. Determine the factors that affect the sustainability of rabies control programs in Manyinga and Mwansabombwe Districts

CHAPTER 2

2.1 LITERATURE REVIEW

Rabies is a neglected tropical zoonotic disease (Khalafalla 2021; Sivagurunathan et al. 2021) which is said to be one of the oldest recorded infectious diseases (Blanton et al. 2015). This disease has been known since 3500 B.C. The first written record of rabies is in the Codex of *Eshnunna* (1930 BC), ancient Mesopotamia now known as Iraq (Baer et al. 1996) . The first confirmed rabies case in Africa was in 1892 after the importation of an infected dog from England into the Eastern Cape of South Africa. It's a disease that has been known to affect humans and animals for a long period of time. Rabies is a neglected disease because it has remained an ignored zoonotic disease in many developing countries including Asia and Africa where there is lack of definite diagnostic and investigation techniques (Bilal 2021). It is more prevalent in developing countries where management and control measures are poor (Knobel et al. 2005). The disease causes more deaths in the world than any other infectious disease (Banyard et al. 2013a;WHO 2017).

Aetiology

Rabies is caused by rabies virus of the genus *lyssavirus*, family *Rhabdoviridae* and it causes acute encephalomyelitis (WHO 2018b; Mshelbwala et al. 2021). The virus is bullet-shaped and composed of two functional units: the internal nucleocapsid core and external unit which is represented by a lipid bi-layer lipid. Its genome is a non-segmented linear, negative-sense, single stranded RNA comprising of approximately 12kb long (WHO 2018).

Epidemiology and disease burden

Rabies causes approximately 59,000 human deaths annually worldwide (Nelwan 2018; Singh et al. 2023) with over 95% of the cases occurring in Asian and African countries (Kaneko et al. 2021a). Considering the aforementioned, about 21,476 human deaths take place in Africa (WHO 2023). Due to wide spread underreporting and uncertain estimates, it is possible that the disease burden is underestimated (https://www.who.int/teams/control-of-neglected-tropical-diseases/rabies/epidemiology-and-burden#, Accessed: 20 August 2024) .

According to the World Health Organization report of 2013, owned dogs account for the majority of the hundreds of millions of people that are bitten by dogs in the world (World Health Organization 2013). The disease is most prevalent in low and middle income countries with poor or lack of management and control strategies (Knobel et al. 2005). Children under

15 years of age are at highest risk of being exposed to rabid animals, leading to a disease burden of 3.7 million disability-adjusted life years (WHO 2018a)

Dog mediated rabies has been eliminated from western Europe, Canada, the United States of America, Japan and some Latin American countries while Australia and many pacific island nations have always been free from dog mediated rabies (WHO 2024).

The economic burden of rabies in the world takes a large toll. The total estimated global annual expenditure due to rabies control and prevention is more than US$500 million and the high costs of post-exposure prophylaxis (PEP) are a burden for governments and individuals especially in developing countries (Knobel et al. 2005) . Africa is estimated to spend the least on PEP but records the highest human mortality. Dog bite victims from poor rural areas are likely to be unable to meet the expensive costs of PEP. And livestock losses due to rabies can be substantial for subsistence communities (Coleman et al.2004) .

Transmission

Rabies virus is readily transmitted among mammals. It is particularly present in the saliva of infected animals hence the transmission through saliva when they bite or scratch other animals (Ntampaka et al. 2019; Khalafalla 2021; Ayu Ria Widiani et al 2022). The virus has also been reported to be transmitted less often through contact with infectious saliva or neurological tissues via breaks in the skin or mucous membranes. There are also rare reports of transmission after organ transplant of particularly the corneas but also the pancreas, kidneys and liver (OIE 2009). Aerosol transmission has been documented in laboratories and they are speculations of transmission through ingestion of rabies infected animals among wild animals.

Experimental and historic evidence documents that dogs, cats, and ferrets shed the virus for a few days prior to the onset of clinical signs and during illness (NASPHV Rabies Compendium. 2016). The domestic dog has been found to be responsible for the transmission of up to 90% of human rabies cases in developing countries (Lembo et al. 2010; Hampson et al. 2015).

Diagnosis

Clinical diagnosis of rabies in both human and animals is difficult without a reliable history of contact with rabid animal or presence of specific symptoms e.g hydrophobia or aerophobia (WHO 2018a). However postmortem confirmation of rabies infection is done using various diagnostic techniques that detect viruses, viral antigen or nucleic acid in infected tissue (brain, skin or saliva). The recommended diagnostic techniques by WOAH are florescent antibody test

(FAT); direct rapid immunohistochemical test and enzyme-linked immunosorbent assay (ELISA); virus detection using cell culture technique and mouse inoculation test and molecular tests like reverse transcription-polymerase chain react (RT-PCR) and real time RT-PCR (WOAH 2021; Niti et al. 2023).

Clinical signs and symptoms

The first specific clinical symptom of rabies is neuropathic pain at the bite site which is as a result of virus replication in the dorsal root ganglia and inflammation induced by cellular immunity (WHO 2018a). Other symptoms of rabies may be non-specific at first but within days they can progress to cerebral dysfunction, ataxia, weakness and paralysis, breathing and swallowing difficulties, excessive salivation, abnormal behavior, aggressivity or self-mutilation (WOAH). The disease is 100% fatal once clinical signs appear (Dacheux et al.2012; Nejash et al. 2017)

Surveillance and control Control

Control of rabies in dogs coupled with provision of post-exposure prophylaxis (PEP) is the best elimination strategy of rabies in humans in developing countries (CLEAVELAND 2003; Kaneko et al. 2021a). Canine rabies has been effectively controlled and even eliminated in several countries through coordinated surveillance and canine vaccination campaigns (Lembo et al. 2010). The World Health Organization (WHO), the World Organization for Animal Health (OIE) and the Food and Agriculture Organization (FAO) have set a goal to eliminate dog-mediated human rabies deaths by 2030 (WHO 2019). However, many countries with endemic canine rabies are in the early stages of planning control efforts and face barriers including limited understanding of rabies prevalence, logistical challenges, and competition for limited resources (Mcbride et al. 2017). The number of rabid dogs and human rabies deaths is likely underreported in many canine rabies endemic countries (Banyard et al. 2013a). The absence of reliable surveillance data makes it challenging to estimate the rabies burden, procure funding and plan control strategies (Townsend et al. 2013) and lack of data has been a major factor in the low prioritization of rabies in endemic countries (Rupprecht et al. 2008) . With funds to procure vaccines being a major challenge in many countries the World Animal Organization has encouraged research industry to develop vaccines that will confer long term immunity, thereby eliminating the need for booster vaccinations (OIE 2011).

WHO has recommended rabies control measures that target dogs such as mass dog vaccination campaigns, dog population control, restricted breeding, and restricted movements

of stray dogs and vaccination of wildlife via oral baits as the key components of eliminating rabies from endemic areas and preventing dog-mediated human rabies cases (World Health Organization 2004). Since dog vaccination has demonstrated how it contributes to rabies control in both public health and animal health (M Kaare et al. 2009), it is well recognized that dog vaccination is the key measure for the control of rabies in dogs and humans (CLEAVELAND 2003; WHO 2018a). In order to prevent rabies outbreak in the dog population, 20-45% of the dog population must always be immune because this threshold is recognized as the critical vaccination coverage of rabies (Kaneko et al. 2021a). The threshold is calculated from the basic reproduction number of rabies, which is estimated to be between 1 and 2 around the world (Kaneko et al. 2021a). To maintain herd immunity beyond the above mentioned critical threshold coverage in intervals between the vaccination campaigns, a high dog vaccination coverage must be achieved (Hampson et al. 2009) to counteract the rapid decline in herd immunity due to the death of immunized dogs, the birth and immigration of dogs that are susceptible and loss of individual immunity (Kaneko et al. 2021a). Hence at least 70% of the dog population must be vaccinated over consecutive years in order to interrupt rabies transmission among dogs (World Health Organization 2004). Control of rabies through vaccinations appears straight forward to the outside world. However, considering the differing socio-culture and environmental conditions across rabies endemic regions in the world, it remains a challenge to achieve herd immunity in the population to stop transmission (Molini et al. 2021) . Studies have also shown that only a few developed countries are currently rabies free, despite the control measures having been in place for several years (Mulipukwa et al. 2017). This is attributed to the low public rabies awareness, difficulty in execution of registration of owned dogs, insufficient management of stray dogs, deficiency of high-quality vaccines, unknown dog population, lack of resources needed to implement rabies control programs and mingling of dogs with wildlife (Banyard et al. 2013b). Asia and Africa in which rabies is endemic have a huge number of free roaming dogs that are often inaccessible for parenteral vaccinations when mass vaccinations are being conducted. To increase the vaccination coverage and attain herd immunity in the dog population, the concept of oral rabies vaccinations as a complimentary to parenteral vaccinations has to be proposed in these free roaming dogs (Molini et al. 2021) . And the effects of environmental changes on rabies are still poorly understood, although climate change is likely to impact the geographical distribution of animal hosts (LHM van de Burgwal et al.2017).

The eradication of rabies also warrants a One Health approach in which human and veterinary disciplines collaborate to eradicate diseases, as has been instituted before with smallpox by human medicine and rinderpest by veterinary medicine. Importantly, these successes show how diseases can be controlled in resource-poor settings and how they rely on social as well as technical innovation (LHM van de Burgwal et al.2017). Elimination of canine rabies is epidemiologically and operationally feasible through mass vaccination of domestic dogs and enforcement of responsible dog ownership (Lembo et al. 2010; Hampson et al. 2009; Kaare et al. 2009) . Even though these tools are available, a number of obstacles prevent a coordinated approach to the global elimination of canine rabies, which includes: a lack of awareness and education of the public health and veterinary sectors; the absence of diagnostic facilities; inadequate surveillance and reporting systems; limited access to modern vaccines; and failures of responsible dog ownership (Banyard et al. 2013b) The lack of effective control of canine rabies in developing countries is often attributed to low prioritization, epidemiological and operational constraints and insufficient financial resources. Because effective rabies control and prevention programs require reliable information on disease occurrence, they should be guided by modern epidemiological insights and driven by laboratory-based surveillance (Rupprecht et al. 2006; Banyard et al. 2013b) . Improved local diagnostic capacity is essential to achieve adequate canine vaccination coverage and to assess the impact of control and elimination efforts (Lembo et al. 2010). An integrated One Health approach applied in rabies programs fills the responsibility gap between health sectors (Léchenne et al. 2020; Gibson et al. 2022; Tidman et al. 2022). Since these factors are interlinked, the implementation of one will positively enhance the others.

The analysis of reported rabies data from African countries identifies major discrepancies that are indicators of poor surveillance (Nel et al. 2011). Data management is still a challenge, especially in African countries (Nel et al. 2011).

Rabies in Zambia

In Zambia, rabies has been present in both humans and animals since the early 1900s. But it is believed that rabies was apparently present in Zambia during the 19th century (Edmond 1922: Snyman 1940; Shone 1962). The first case was recorded in 1913 when diagnostic facilities were available (Zyambo et al. 1985; Tuchili 1988; Sinyangwe 1992). Rabies is

endemic and is a notifiable disease in Zambia, with a monthly occurrence of 2.9 (95% CI= 2.6 -3.3) (Munang'andu et al. 2011a). Although confirmed cases in humans through fluorescent antibody testing are rare, the total number of people bitten by dogs is increasing (Olusegun et al., 2016). In 2018, Zambia recorded 16,000 dog bite cases and 23 human rabies deaths, however, due to inconsistent reporting of rabies in Zambia (Kaneko et al. 2021a), these figures are likely to be an underestimate. Studies have further shown that rabies deaths can be as much as 10-100 times more than the reported cases by health facilities (Cleaveland et al. 2002) in developing countries due to the lack of surveillance and laboratory infrastructure and insufficient communication (Banyard et al. 2013b; Kaneko et al. 2021a). Of the 2018 recorded dog bite cases, 65 were from Manyinga District (MOFL, 2018), with Manyinga Loloma mission hospital reporting 2 cases of human rabies deaths (MOH, 2018).

In Zambia rabies control is driven according to the Control of Dogs Act of the Laws of Zambia and the Rabies Control Protocol outlined by the veterinary public health sub-unit,veterinary services unit, department of veterinary services, Ministry of Fisheries and Livestock (Mulipukwa et al.2017). Zambia regards dog vaccination against rabies as the most effective rabies control strategy combined with secondary roles of population control, movement regulations and promotion of responsible dog ownership (Mulipukwa et al. 2017).

In Zambia, Rabisin® (Boehringer Ingelheim Animal Health France. SCS, Laboratoire, Porte des Alpes- Saint Priest, France) is the most widely used vaccine. According to The Control of Dogs Act (Chapter 247), it is mandatory that all dogs and cats are injected with an annual booster following the first vaccination and booster at 3 and 9 months of age. The annual booster vaccination is injected in the last month of expiry of the precious vaccination. Routine vaccinations are carried out at a fee throughout the year. Mass vaccination campaigns are conducted district-wide twice a year (1 in March/April and the other in September/October) when dogs begin to mate. Free of charge mass vaccinations in areas were poverty levels are high more especially in rural areas are considered and when the area is experiencing a rabies outbreak (Kabeta,M.N., 2012). Dog/cat population control is done by the local authority through restriction of dogs per household. Stray dogs are normally eliminated by shooting with firearm (Kabeta, M.N., 2012).

Although rabies control measures are available in the country, Control in the districts has been hampered by a number of challenges such as the general lack of funds by rural households to pay for vaccinations during routine preventive programs. As a result, the country records low

vaccination rates, while cases of rabies continue to rise (Mulipukwa. et al., 2017). Veterinary records from Manyinga and Mwansabombwe districts show high dog bite cases with Manyinga reporting 91 in 2018 and 95 in 2021 and Mwansabombwe reporting 58 in 2021 and 46 between January and June 2022. The rise in dog bites has led to an increased demand for post-exposure prophylaxis (PEP), as most bites are from unvaccinated dogs, highlighting the urgent need for PEP. The WHO estimated the global annual cost of PEP to be around $1.6 billion (WHO, 2013), making dog vaccination a more cost-effective option compared to PEP. Despite several mass vaccination campaigns in the two districts, coverage has been poor, leaving both human and dog populations at risk of rabies infection. Manyinga and Mwansabombwe still report cases of rabies each year. An analysis of brain samples collected from suspected rabid dogs between January 2005 and December 2013 found 153 rabies-positive cases (Babaniyi et al., 2016).

Thus, this study was aimed at determining barriers to rabies prevention and control in the afore-mentioned districts using surveys and mass vaccinations. By identifying the barriers, the study will improve rabies vaccination coverage in the dog and cat population and knowledge on rabies which in turn will improve the implementation of rabies prevention and control in the two districts.

CHAPTER 3

3.1 MATERIALS AND METHODS

3.1.1 Study area

This study was carried out in Manyinga District of North Western Province and Mwansabombwe District of Luapula Province of Zambia. Manyinga is approximately 331 km from the provincial capital Solwezi and 950 km from national capital Lusaka and it is a new Rural District that is only eight years old. The District covers a total area of about 21,851 square kilometers and 90 percent of which is covered by woodlands and streams.

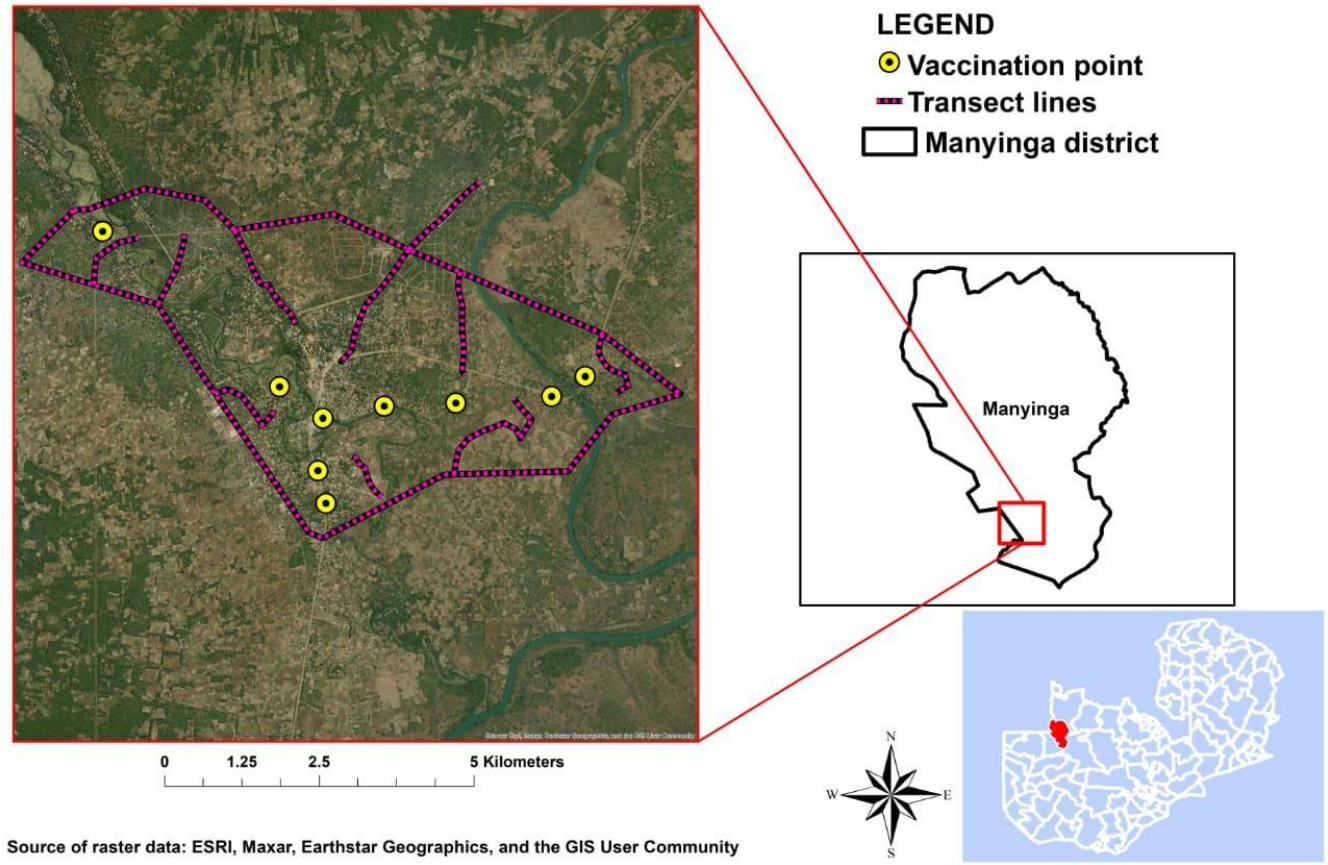


Figure 3.1: Manyinga District study area

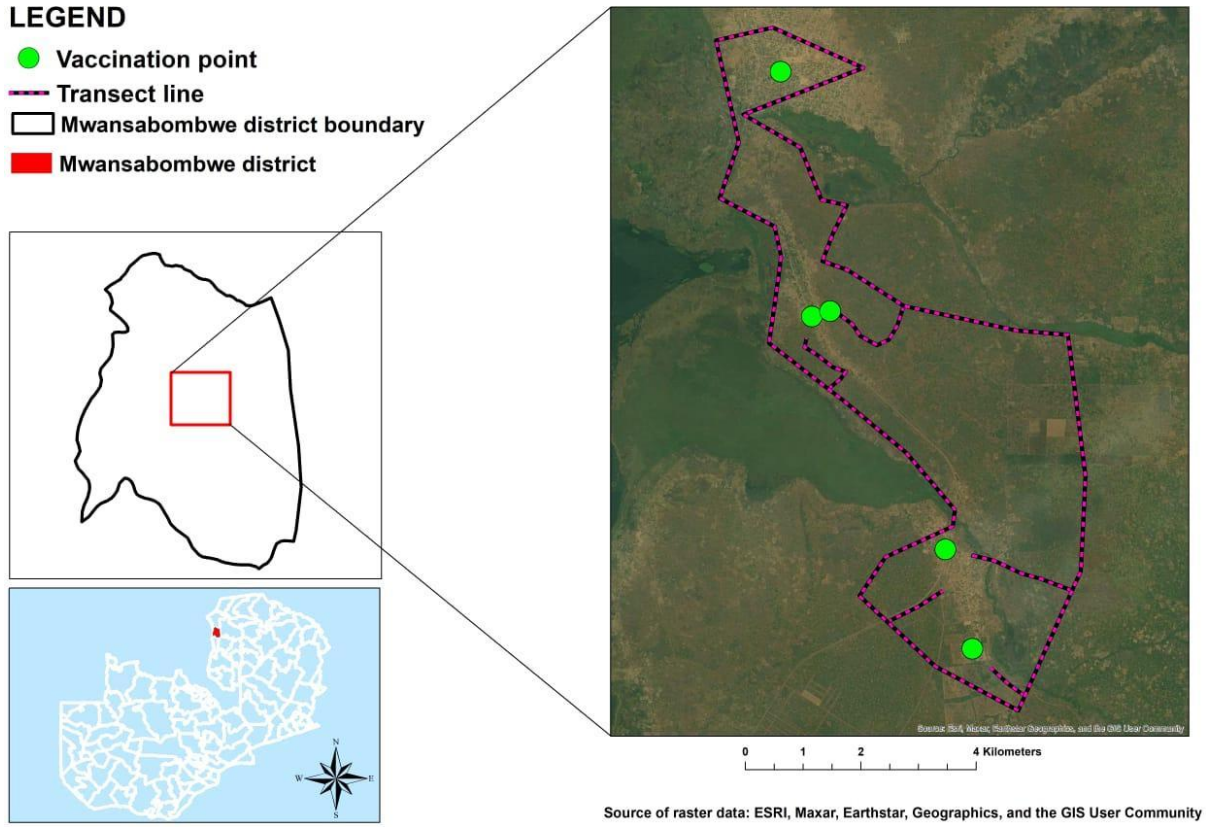


Figure 3.2:Mwansabombwe study area

Mwansabombwe is approximately 939.5km from national capital Lusaka it is equally a new District which was separated from Kawambwa District in 2012. The District covers a total area of 5,252 square kilometers.

The two study districts are rural dwelling Districts thus the household number is difficult to estimate however, according to the 2010 census it was estimated that there are 10,000 households with a human population of 48,141 in Manyinga and 35,546 in Mwansabombwe with a dog/cat population of 1140 in Mwansabombwe and 2734 in Manyinga according to 2018 livestock census . Manyinga District has four ethnic groups namely Luvale, Lunda, Kalunda and Chokwe, however the Luvale are the indigenous ethnic group while the ethnic group found in Mwansabombwe District is Lunda. Agriculture in terms of livestock and crop farming is the main source of livelihood in Manyinga while fishing and crop farming are the main sources of livelihood in Mwansabombwe.

The two districts were chosen because they record positive rabies cases in animals every year, they are rural dwelling and they have game management areas which poses a risk to wildlife.

. The household sample was calculated using Yamane formula as below;

$$\mathbf{n= N/ (1+Ne^2)}$$

- **n** is the sample size
- **N is** number of households
- **e** is the margin of error

95% confidence level was used and 0.05 margin of error.

Manyinga	Mwansabombwe
n= 10000/(1+10000*0.05²)	n=8000/(1+8000*0.05²)
n=384.6	n=380.9

3.1.2 sampling technique

The cluster design was employed in this study due to the wide dispersion of households in the Manyinga and Mwansabombwe districts. Households were divided into clusters, and random selection was conducted from these clusters. Households within the randomly selected clusters participated in the questionnaire survey, regardless of dog or cat ownership. In each selected household, the head of the household was interviewed; if the head was absent, a suitable substitute aged 15 years or older was interviewed

3.2 Ethical Aspects

The study was approved by the board of graduate studies (School of Veterinary Medicine, University of Zambia) and ethical clearance was granted by ERES CONVERGE IRB (Ref.No.2021-Jun-023). Participants in the questionnaire survey were told the purpose of the study and consent for participation was obtained. The ethical aspects sought for; confidentiality, informed consent, culture sensitivity, minimizing harm and transparency.

3.3 Study design

A cross-sectional study was used that included household questionnaires, interviewing key informants, and evaluation of rabies vaccination and dog bite case records. A structured questionnaire, including closed and open-ended questions was designed to collect data through a face-to-face interview with respondents. The study was conducted by 10 intervievers from the Department of Veterinary and local authority. Prior to the survey, interviewers participated in a day-long orientation workshop to familiarise themselves with the use of the questionnaire,

data collection procedures and the consent form held by the trained chief investigator and supervisor. Each of the questionnaires considered the socio-demographic profile of the respondents. The questionnaire comprised 15 rabies-related questions regarding rabies knowledge, practices, attitudes towards animal bites, and healthcare-seeking behaviour. The respondents were allowed to provide multiple responses (when applicable). The questionnaire was reviewed by the working group members and pretested by a few randomly selected community members to avoid any personal, social or cultural conflict before the actual survey. To be eligible to participate in this survey, an inclusion criterion was set: either the head of the household or an adult member (≥15 years of age) willing and able to provide informed consent. Before the interview, the respondents were briefed about the purpose of the study, and a written or verbal informed consent was obtained. The names of the respondents or other directly identifiable information was not collected as a part of this study.

3.3.1 Data Collection

Household Surveys

- Pre-sensitization and Vaccination Household Survey

This initial phase of the study involved administering a face-to-face household questionnaire to randomly selected households. The questionnaire consisted of three sections: Section A gathered personal information, while Sections B and C covered 10 questions on rabies knowledge, 3 questions on practices, 2 questions on attitudes, and additional general and follow-up questions. The surveys were administered by trained veterinary assistants, who also assisted respondents with completing the questionnaire. Data collected included information on rabies knowledge, attitudes, practices, socio-demographics, the number of dogs in the household, and previous vaccination history. Owners of unvaccinated dogs were asked to explain why their dogs had not been vaccinated. All participants were informed about the study's purpose, and their consent to participate was obtained.

- Post-sensitization and Vaccination Household Survey

Five months after the mass vaccination campaign, a follow-up questionnaire survey was conducted to assess the effectiveness of the sensitization efforts and rabies awareness.The same questionnaire used in the pre-sensitization survey was administered. Because the study was focused on the whole community and also considering the make-up of the study areas, the study did not insist on using the same participants for both pre and post sensitization survey.This was because, rabies awareness was not only administered to a

selected few individuals but it was done on a wide scale using tools like radio and print media in both districts. These tools ensured a wider capture and distribution of information.

As a result, the follow-up survey was conducted independently of the first survey participants and was limited to Manyinga due to financial constraints. The goal was to evaluate the impact of the initial mass vaccination on enhancing rabies knowledge among Manyinga residents. During the five-month period between the two surveys, monthly rabies awareness initiatives were implemented through the local radio station and community leaders.

Interviewing Key Informants

The second phase of the survey focused on interviewing key informants. This involved conducting in-depth interviews with local rabies experts, including representatives from the District Veterinary Department, Rabies Control Officers from the district council, and public health officers from the Ministry of Health. The interviews explored the informants' understanding of rabies, including its transmission, prevention, and control. Additionally, the discussions examined the roles these officers played in rabies prevention and control and the challenges they encountered in implementing these measures.

Assessment of Dog and Jackal Bite Cases

An evaluation of rabies vaccination and dog bite case records was conducted at both veterinary offices and district hospitals. This assessment aimed to determine the frequency of dog bites and the vaccination status of dogs involved in reported bite incidents.

3.3.2 Rabies Sensitization and Awareness

Rabies sensitization and awareness campaigns were conducted across the districts for 3 months following the initial questionnaire survey. The sensitization campaigns covered what rabies was, its transmission, animals affected, signs of rabies in animals, steps to take when bitten by a dog, rabies prevention/control, dog registration, and responsible dog ownership. These campaigns utilized local radio stations and disseminated posters translated into the local language to promote better acceptance and facilitate a clearer understanding of the presented message. The posters were strategically displayed in various locations, including schools, clinics, markets, churches, residences of village headmen, and all communal gathering points.

This comprehensive approach aimed to maximize outreach and engage diverse segments of the community in fostering awareness and understanding of rabies prevention.

3.3.3 Mass Vaccination Campaign

- Transect survey to Estimate Dog and Cat Population

The transect survey was executed by two groups, each comprising three individuals, traversing through the community on foot. The survey areas were demarcated into 2 km by 2 km polygons. To prevent the inclusion of migrating dogs, a 50 m buffer was established around the boundaries within each transect area. The survey involved counting all encountered dogs along the transect line, following the methodology outlined by (Kaneko et al. 2021b). Visual identification was employed to estimate the populations of both dogs and cats. Throughout the transect survey, GPS tracking devices were utilized to log movement data. Subsequently, the length of the transect lines was measured using Google Earth Pro software, utilizing the records from the GPS log.

- Mass Vaccination Campaign

A rabies mass vaccination campaign was orchestrated through radio announcements and the dissemination of multilingual posters (English, Luvale, Lunda, and Bemba) in various community settings, including schools, markets, churches, clinics, village headmen houses, and other communal meeting places. The campaign featured multiple central vaccination points, notably in Manyinga at the central veterinary camp and in Mwansabombwe at the veterinary camps.

During the 21-day mass vaccination campaign in both districts, dogs and cats underwent vaccination with 1ml of Rabies Vet (Bio-Med Private Limited, Ghaziabad-201009, U.P. INDIA) intramuscularly. Each dog or cat was administered the vaccine using a new needle and syringe to ensure hygiene and prevent contamination. Following vaccination, all dogs and cats were distinctly marked with red-colored spray on their bodies to prevent re-vaccination and save as an identification feature for vaccinated dogs and cats. Additional details such as sex, age, color markings, owner information, and previous vaccination records were collected, followed by the issuance of a new vaccination certificate. This method facilitated the easy identification of vaccinated dogs and cats, distinguishing them from those that remained unvaccinated.

- Transect survey (re-capture)

Two days following the mass vaccination, a transect survey (re-capture) was undertaken in the Manyinga and Mwansabombwe districts to assess the uptake of rabies vaccines. Two groups conducted the transect survey, utilizing motorbikes. During the survey, the teams systematically counted all encountered dogs along the transect lines, distinguishing between those that had been sprayed (marked) and those that had not, in accordance with the methodology outlined by Kaneko et al. (Kaneko et al. 2021b). Through visual identification of vaccinated dogs, an estimate of the coverage of rabies mass vaccinations was then determined.

3.3.4 Data Analysis

The collected data were entered into a Microsoft Excel spreadsheet and subsequently exported to IBM SPSS Statistics version 26.0 for a comprehensive thematic analysis. Descriptive statistics were generated, and cross tabulations calculating Pearson's Chi Square were performed in comparing demographic variables of Manyinga pre- and post-sensitization and testing of association on demographic knowledge and rabies knowledge. KAP analysis chart is in appendices as appendix 1

CHAPTER 4

4.1 RESULTS

4.1.1 Demographic Characteristics of Respondents from Mwansabombwe and Manyinga

A total of 301 and 100 representing a response rate of 78.0% and 26.2% in Manyinga and Mwansabombwe were interviewed, respectively. The poor response was observed in Mwansabombwe due to refusals. From the surveys conducted in the two districts, there was a higher participation of females (52.8%) and (58.0%) in Manyinga and Mwansabombwe respectively. In both districts, the majority of respondents had attained some form of formal education. Specifically, in Mwansabombwe, most respondents were farmers (43.0%), while in Manyinga (75.4%), respondents were predominantly students. Moreover, Mwansabombwe had fewer respondents from households owning pets compared to Manyinga (Table 4.1).

Table 4. 1: Demographic data of respondents from Mwansabombwe and Manyinga (pre-sensitization).

	MANYINGA		**MWANSABOMBWE**	
Variables	**n = 301**	**%**	**n = 100**	**%**
AGE				
15–25 Years	194	64.5%	20	20.0%
26–35 Years	72	23.9%	23	23.0%
36–45 Years	13	4.3%	27	27.0%
46–55 Years	12	4.0%	19	19.0%
56 Years and above	10	3.3%	11	11.0%
GENDER				
Male	142	47.2%	42	42.0%
Female	159	52.8%	58	58.0%
EDUCATION LEVEL				
Primary	4	1.3%	34	34.0%
Secondary	254	84.4%	28	28.0%
Tertiary	37	12.3%	27	27.0%
Others	6	2.0%	11	11.0%
SETTLEMENT				
Urban	22	7.3%	4	4.0%
Semi-urban	79	26.2%	42	42.0%
Rural	200	66.4%	54	54.0%
OWN PET (dog/cat)				
Yes	220	73.1%	43	43.0%
No	81	26.9%	57	57.0%
OCCUPATION				
Government employee	15	5.0%	16	16.0%
Student	227	75.4%	15	15.0%
Farmer	31	10.3%	43	43.0%
Others	28	9.3%	26	26.0%

4.1.2 Rabies Awareness and Knowledge in Manyinga and Mwansabombwe

In terms of rabies knowledge, 88.0% of respondents from both districts had prior awareness of rabies. Notably, Mwansabombwe respondents exhibited a higher level of information regarding prevention (82.0%), signs of rabies in animals (77.0%), and signs of rabies in humans (69.0%). Concerning the mode of transmission, Mwansabombwe respondents displayed greater knowledge, with 97.7% identifying bites as the primary mode, compared to 95.6% in Manyinga.

Regarding the source of rabies information, respondents from both districts predominantly cited veterinarians. Mwansabombwe's veterinarians and health workers were particularly effective in rabies sensitization, being more exposed to television and radio compared to Manyinga. However, they were less exposed to social media and other information sources (Table 4.2).

Table 4.2: Rabies awareness and knowledge in Manyinga and Mwansabombwe.

Questions	MANYINGA		MWANSABOMBWE	
	N	%	N	%
Have you heard of Rabies?				
YES	265	88.0%	88	88.0%
NO	36	12.0%	12	12.0%
Do You know signs of Rabies in Animals?				
YES	90	29.9%	77	77.0%
NO	211	70.1%	23	23.0%
Do you know how rabies is prevented/controlled?				
YES	183	60.8%	82	82.0%
NO	118	39.2%	18	18.0%
Do you know signs of rabies in humans?				
YES	162	53.8%	69	69.0%
NO	139	46.2%	31	31.0%
Do you know animals that get infected with rabies?				
COW	65	24.0%	14	15.9%
DOG	239	90.2%	86	97.7%
CAT	108	40.8%	58	65.9%
GOAT	47	17.7%	11	12.5%
SHEEP	30	11.3%	11	12.5%
PIG	71	26.8%	11	12.5%
FOX	73	27.5%	51	58.0%
What was your source of Rabies information?				
Veterinary	82	31.3%	51	58.0%
Health workers	67	25.6%	34	38.6%
Television	47	17.9%	28	31.8%
Radio	18	6.90%	25	28.4%
Social media	37	14.1%	5	5.7%
Others	63	24.0%	7	8.0%
How is Rabies transmitted?				
Bites	208	83.2%	86	97.7%
Scratch	15	6.0%	13	14.8%
Contact saliva	17	6.8%	31	35.2%
Cuts	14	5.6%	19	21.6%
Uncooked Meat	6	2.4%	4	4.5%
Urine	2	0.8%	2	2.3%

4.1.3 Demographics, Knowledge, and Attitude of Dog Owners Toward Rabies Prevention and Control Manying and Mwansabombwe

Among respondents who owned dogs, the majority fell within the age range of 15–25 years in Manyinga; in Mwansabombwe, they were predominantly between 36–45 years old, female, and residing in rural areas (65.9% and 48.8% in Manyinga and Mwansabombwe, respectively). Additionally, a significant proportion in both districts had at least attained a primary level of education. Regarding occupation, the majority were students in Manyinga, whereas farmers were predominant in Mwansabombwe.

With regards to respondents who owned dogs, the majority demonstrated awareness of rabies, knowledge about signs of rabies in animals, prevention and control measures, the mode of transmission, signs of rabies in humans, and adherence to pet vaccination. Mwansabombwe had a higher number of well-informed participants compared to Manyinga. Overall, dog owners in Mwansabombwe exhibited a robust knowledge of rabies, and their attitude towards prevention and control was commendable (Table 4.3).

Table 3.3: Demographics,knowledge and attitudes of dog owners towards rabies prevention and control in Manyinga vs Mwansabombwe

VARIABLES	MANYINGA PRE-SENSITIZATION		MWANSABOMBWE	
	Frequency	**Percent %**	**Frequency**	**Percent %**
OWN DOGS				
AGE				
15–25 YRS	149	67.7%	7	16.3%
26–35 YRS	45	20.5%	10	23.3%
36–45 YRS	7	3.2%	13	30.2%
46–55 YRS	12	5.5%	9	20.9%
56 YRS AND ABOVE	7	3.2%	4	9.3%
GENDER				
MALE	103	46.8%	19	44.2%
FEMALE	117	53.2%	24	55.8%
SETTLEMENT				
URBAN	19	8.6%	1	2.3%
SEMI-URBAN	56	25.5%	21	48.8%
RURAL	145	65.9%	21	48.8%
EDUCATION LEVEL				
PRIMARY	1	0.5%	16	37.2%
SECONDARY	188	85.5%	12	27.9%
TERTIARY	25	11.4%	10	23.3%
OTHERS	6	2.7%	5	11.6%
OCCUPATION				
GOVERNMENT EMPLOYEE	8	3.6%	5	11.6%
STUDENT	176	80.0%	6	14.0%
FARMER	21	9.5%	19	44.2%
OTHERS	15	6.8%	13	30.2%
Have you heard of Rabies?				
YES	196	89.1%	40	93.0%
NO	24	10.9%	3	7.0%
Do you know signs of Rabies in Animals?				
YES	75	34.1%	35	81.4%
NO	145	65.9%	8	18.6%
Do you know signs of Rabies in Humans?				
YES	135	61.4%	34	79.1%
NO	85	38.6%	9	20.1%
Is your pet vaccinated?				
YES	131	59.5%	35	81.4%
NO	88	40.0%	8	18.6%
How is Rabies transmitted?				
BITE	178	96.7%	39	97.5%
CUTS	5	2.7%	9	22.5%
SCRATCH	7	3.8%	4	10.0%
CONTACT WITH SALIVA	9	4.9%	16	40.0%
UNCOOKED MEAT	2	1.1%	2	5.0%
URINE	0	0.0%	2	2.5%
Do you know how Rabies is prevented and controlled?				
YES	146	66.4%	41	95.3%
NO	74	33.6%	2	4.7%

4.1.4 Differences in Demographic Characteristics and Rabies Knowledge among Respondents in Mwansabombwe and Manyinga

Regarding age, respondents aged 31–45 years in Mwansabombwe and respondents aged 26–35 years in Manyinga demonstrated higher awareness of rabies. Additionally, respondents aged 46 years and above were more likely to be aware of rabies in both dis-tricts. In terms of gender, males exhibited greater awareness of rabies in Mwansabombwe, while in Manyinga, both males and females were equally aware. According to settlement, respondents from semi-urban and urban areas displayed higher awareness compared to those from rural areas in both districts. Concerning education, respondents who had attained tertiary education showed greater awareness of rabies in both Mwansabombwe and Manyinga.

In Mwansabombwe, a significant relationship between settlement ($p = 0.007$) and age ($p = 0.001$) with rabies knowledge was observed in terms of rabies awareness. However, gender ($p = 0.203$), occupation ($p = 1.97$), and education ($p = 0.071$) exhibited no significant relationship with rabies knowledge. On the other hand, in Manyinga, there was a signifi-cant relationship between education ($p = 0.011$) and occupation ($p = 0.044$) with rabies knowledge, while gender ($p = 0.995$), age ($p = 0.516$), and settlement ($p = 0.133$) had no significant relationship with rabies knowledge.

4.1.5 Demographic Characteristics of Respondents in Manyinga Pre-Sensitization vs Post-Sensitization

A total of 301 individuals participated in both the pre-sensitization and post-vaccination surveys in the Manyinga district. In both surveys, the majority of respondents were female, had acquired some level of formal education, resided in rural areas, and were pet owners (Table 4.3).

A comparison of the demographic variables between the two groups pre-sensitization and post-sensitization revealed that there was no significant relationship in terms of age ($p = 0.970$),gender ($p = 0.633$),settlement ($p = 0.503$),education ($p = 0.961$), and occupation ($p = 0.514$) in both surveys, as shown in Table 4.4.

Table 4.4: Demographic characteristics of respondents pre- and post-sensitization in Manyinga.

Variable		Pre-Sensitization (%)	Post-Sensitization (%)	*p*-Value
Age	15-25 years	194 (64.5%)	191 (63.5%)	0.970
	26-35 years	72 (23.9%)	56 (18.6%)	
	36-45 years	13 (4.3%)	20 (6.6%)	
	46-55 years	12 (4.0%)	27 (9.0%)	
	56 years and above	10 (3.3%)	7 (2.3%)	
Gender	Male	142 (47.2%)	144 (47.8%)	0.633
	Female	159 (52.8%)	157 (52.2%)	
Settlement	Urban	63 (20.9%)	24 (8.0%)	0.503
	Semi-urban	79 (26.2%)	84 (27.9%)	
	Rural	159 (52.8%)	193 (64.1%)	
Education	Primary	41 (13.6%)	53 (17.6%)	0.961
	Secondary	182 (60.5%)	197 (65.4%)	
	Tertiary	48 (15.9%)	43 (14.3%)	
	Others	30 (10.0%)	8 (2.7%)	
Occupation	Government	50 (16.6%)	19 (6.3%)	0.514
	Student	165 (54.8%)	78 (25.9%)	
	Farmer	39 (13.0%)	132 (43.9%)	
	Others	47 (15.6%)	72 (23.9%)	

Note: * $p < 0.05$ is taken as the level of statistical significance.

4.1.6 Rabies Awareness and Knowledge Pre and Post-sensitization in Manyinga

In relation to pre-sensitization knowledge, the majority (88.0%) of respondents in Manyinga were already familiar with rabies. They demonstrated awareness of prevention methods, the mode of transmission, could identify at least one animal affected by rabies, and were acquainted with signs of rabies in humans. However, there was a gap in recognizing signs of

rabies in animals. The primary source of rabies information for the majority of respondents was veterinarians.

Post-sensitization, there was a notable improvement in knowledge. The majority (90.4%) of respondents were now informed about rabies, including prevention methods, the mode of transmission, identification of animals affected by rabies, and recognition of signs of rabies in animals, although a reduction in knowledge about human rabies was observed which was attributed to the unavailability of public health officers, who were unable to provide further elaboration due to understaffing. Veterinarians remained a predominant source of information, cited by 82.2% of respondents (Table 4.5).

Overall, a positive shift in respondents' knowledge was observed after sensitization and mass vaccinations, particularly in terms of having heard about rabies, and preventing and recognizing signs of rabies in animals (Table 4.5).

Table 4.5: Rabies awareness of study population pre- and post-sensitization in Manyinga

Questions	Pre-Sensitization		Post-Sensitization	
	N	%	N	%
Have you heard of rabies?				
YES	265	88.0%	272	90.4%
NO	36	12.0%	29	9.6%
Do you know signs of rabies in animals?				
YES	90	29.9%	165	54.5%
NO	211	70.1%	138	45.5%
Do you know how rabies is prevented/controlled?				
YES	183	60.8%	207	68.5%
NO	118	39.2%	95	31.5%
Do you know signs of rabies in humans?				
YES	162	53.8%	117	38.7%
NO	139	46.2%	185	61.3%
Do you know animals that get infected with rabies?				
COW	65	24.0%	85	34.4%
DOG	239	90.2%	245	100.0%
CAT	108	40.8%	150	60.7%
GOAT	47	17.7%	75	30.4%
SHEEP	30	11.3%	75	30.4%
PIG	71	26.8%	80	32.4%
FOX	73	27.5%	160	64.8%
What was your source of rabies information?				
Veterinary	82	31.3%	222	82.2%
Health workers	67	25.6%	9	3.3%
Television	47	17.9%	13	4.8%
Radio	18	6.9%	116	43.0%
Social media	37	14.1%	29	10.7%
Others	63	24.0%	9	3.3%
How is rabies transmitted?				
Bites	208	83.2%	236	87.7%
Scratch	15	6.0%	0	0%
Contact saliva	17	6.8%	33	12.3%
Cuts	14	5.6%	0	0%
Uncooked Meat	6	2.4%	0	0%
Urine	2	0.8%	0	0%

4.1.7 Dog Demographics, Knowledge, and Attitude of Dog Owners Toward Rabies Prevention and Control Pre- and Post-Sensitization in Manyinga

Among respondents who owned dogs, the majority were between the age range of 15–25 years, female, rural based, 65.9% and 60.7% pre- and post-sensitization, respectively, and had

at least attained a secondary level of education in both surveys. With regards to occupation during the pre-sensitization survey, the majority were students, while the majority were farmers in post-sensitization.

In the pre-sensitization survey, the majority (89.1%) were already aware of rabies, possessed knowledge about prevention and control measures, identified modes of transmission, and were familiar with the signs of rabies in humans. Moreover, they were informed about the importance of pet vaccination (Table 4.6).

Post-sensitization, the knowledge and attitude of dog owners toward rabies prevention and control remained consistent. The majority (94.2%) continued to demonstrate awareness of rabies, knowledge about prevention and control, identification of modes of transmission, recognition of clinical signs in animals, and adherence to pet vaccination practices. The overall knowledge and attitude of dog owners regarding rabies and its pre-vention and control remained largely unchanged in both surveys (Table 4.6).

Table 4.6: Demographics, knowledge, and attitudes of dog owners towards rabies prevention and control pre- and post-sensitization in Manyinga

VARIABLES	OWN DOGS			
	PRE-SENSITIZATION		POST-SENSITIZATION	
	Frequency	Percent %	Frequency	Percent %
AGE				
15–25 YRS	149	67.7%	110	63.6%
26–35 YRS	45	20.5%	30	17.3%
36–45 YRS	7	3.2%	11	6.4%
46–55 YRS	12	5.5%	17	9.8%
56 YRS AND ABOVE	7	3.2%	5	2.9%
GENDER				
MALE	103	46.8%	84	48.6%
FEMALE	117	53.2%	89	51.4%
SETTLEMENT				
URBAN	19	8.6%	14	8.1%
SEMI-URBAN	56	25.5%	54	31.2%
RURAL	145	65.9%	105	60.7%
EDUCATION LEVEL				
PRIMARY	1	0.5%	36	20.8%
SECONDARY	188	85.5%	104	60.1%
TERTIARY	25	11.4%	26	15.0%
OTHERS	6	2.7%	7	4.0%
OCCUPATION				
GOVERNMENT EMPLOYEE	8	3.6%	13	7.5%
STUDENT	176	80.0%	43	24.9%
FARMER	21	9.5%	78	45.1%
OTHERS	15	6.8%	39	22.5%
Have you heard of Rabies?				
YES	196	89.1%	163	94.2%
NO	24	10.9%	10	5.8%
Do you know signs of Rabies in Animals?				
YES	75	34.1%	113	65.3%
NO	145	65.9%	60	34.7%
Do you know signs of Rabies in Humans?				
YES	135	61.4%	98	56.6%
NO	85	38.6%	75	43.4%
Is your pet vaccinated?				
YES	131	59.5%	152	87.9%
NO	88	40.0%	21	12.1%
How is Rabies transmitted?				
BITE	178	96.7%	152	100%
CUTS	5	2.7%	0	0%
SCRATCH	7	3.8%	0	0%
CONTACT WITH SALIVA	9	4.9%	23	15.1%
UNCOOKED MEAT	2	1.1%	0	0%
URINE	0	0.0%	0	0%
Do you know how Rabies is prevented and controlled?				
YES	146	66.4%	155	89.6%
NO	74	33.6%	18	10.4%

4.1.8 Differences in Demographic Characteristics and Rabies Knowledge among Respondents Pre- and Post-Sensitization in Manyinga

In both surveys, it was observed that respondents aged between 26 and 35 years ex-hibited greater awareness of rabies compared to those between 15 and 25 years of age. Ad-ditionally, respondents aged 46 and above were more likely to be aware of rabies. Among the gender demographic, the majority of males demonstrated a higher level of awareness of rabies. Urban-based respondents were found to be more aware, and individuals with ter-tiary education showed a higher level of awareness regarding rabies (Table 4).

In the pre-vaccination survey, a noteworthy association between education ($p = 0.011$) and occupation ($p = 0.044$) with rabies knowledge was identified. However, gender ($p = 0.995$), age ($p = 0.516$), and settlement ($p = 0.133$) exhibited no significant relationship with rabies knowledge.

In the post-sensitization rabies awareness survey, a significant relationship was ob-served between education ($p = 0.005$) and occupation ($p = 0.006$) with rabies knowledge. Conversely, no significant relationship was found with gender ($p = 0.062$), age ($p = 0.148$), and settlement ($p = 0.999$). Throughout both surveys in the Manyinga district, education and occupation consistently demonstrated a significant relationship with rabies knowledge (Table 4.7).

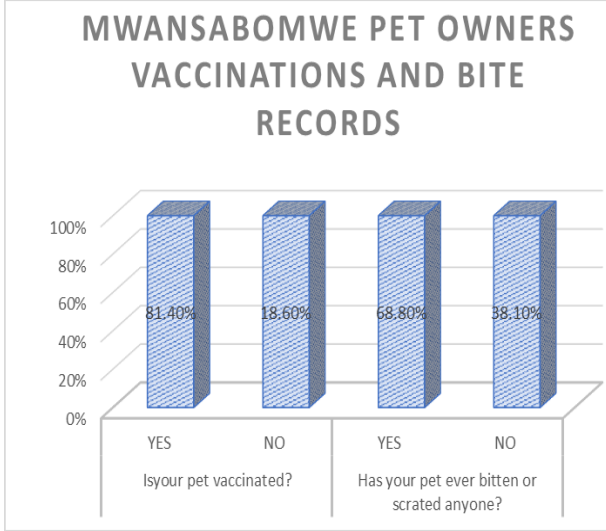
Table 4.7: Differences in demographic characteristics and rabies knowledge among respondents pre- and post-sensitization in Manyinga.

VARIABLES	HEARD OF RABIES					
	PRE-SENSITIZATION			POST-SENSITIZATION		
	Count	Percent (%)	*p*-Value	Count	Percent (%)	*p*-Value
AGE						
15–25 Years	166	85.0%		141	73.0%	
26–35 Years	67	93.0%	0.516	49	87.5%	0.148
36–45 Years	12	92.0%		16	80.0%	
46–55 Years	11	91.6%		24	88.9%	
56 Years and Above	9	90.0%		7	100.0%	
GENDER						
Male	125	88.0%	0.995	121	83.4%	0.062
Female	140	88.0%		181	74.7%	
EDUCATION LEVEL						
Primary	2	50.0%	0.011	50	94.3%	
Secondary	223	87.8%		146	73.7%	0.006
Tertiary	36	97.0%		35	79.5%	
Others	4	66.6%		8	100.0%	
OCCUPATION						
Government employee	15	100.0%	0.044	19	100.0%	
Student	193	85.0%		53	67.0%	0.006
Farmer	30	96.7%		109	81.9%	
Others	27	96.4%		58	80.5%	
SETTLEMENT						
Urban	22	100.0%	0.133	19	79.1%	
Semi-urban	71	89.8%		67	78.8%	0.999
Rural	172	86.0%		153	78.8%	

4.1.9 Attitudes and practices of Manyinga and Mwansabombwe towards rabies

In this study 220 (73.1%) and 43 (43%) of the respondents in Manyinga and Mwansabombwe respectively, reported they had either a dog or a cat in their homes. 61.40% in Manyinga and 81.40% in Mwansabombwe reported they had their dogs vaccinated (Figure 3), on examination of the records only 84.40% in Manyinga and 88.60% vaccination records were valid (Figure 4). The above indicate that 51.82% in Manyinga and 72.09% in Mwansabombwe

of the dog owning respondents had valid rabies vaccination. Manyinga recorded low numbers which is a risk to the community because majority of the dogs were not protected against rabies.



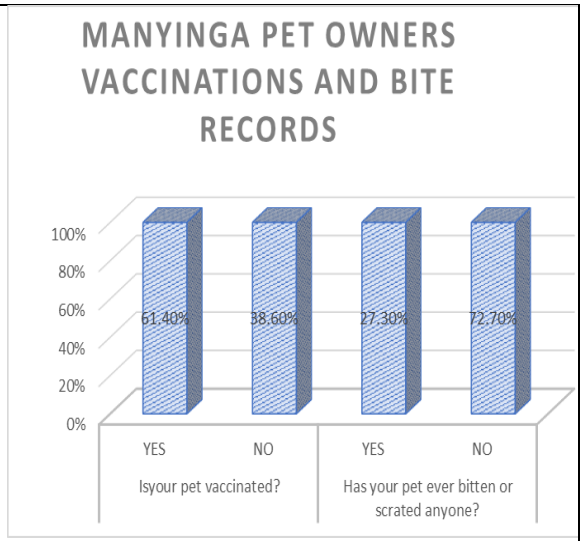


Figure 4.3: shows respondents who own pets and reported they were vaccinated and also those that had bitten or scratched someone in Manyinga and Mwansabombwe Districts

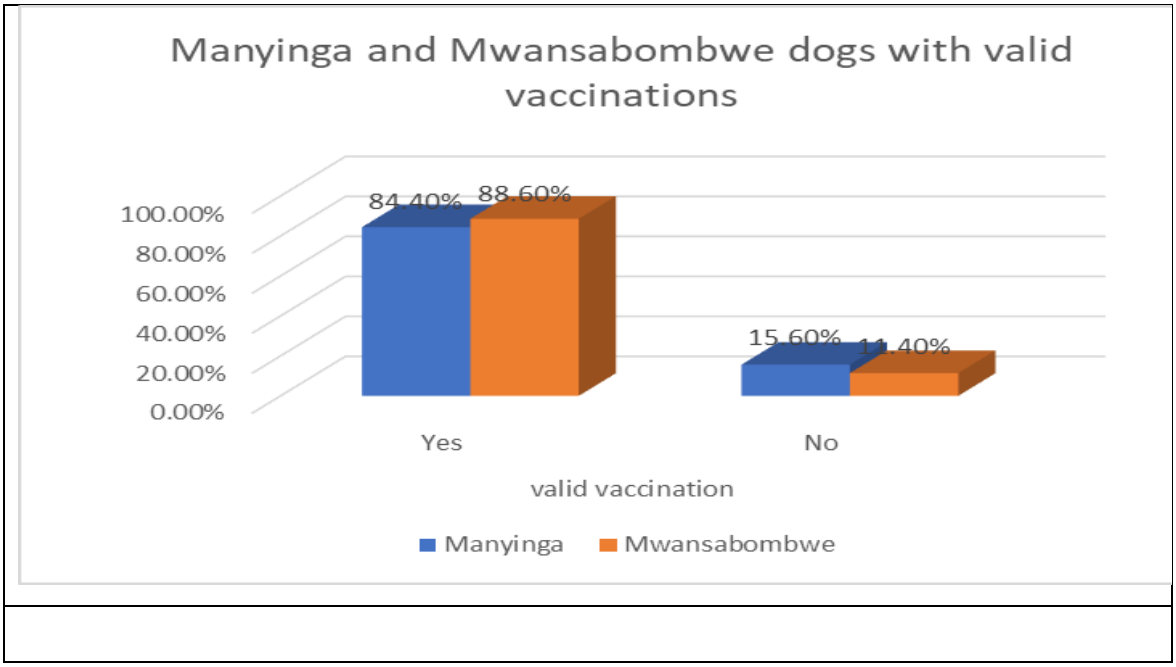


Figure 4.4: shows respondents who reported to have vaccinated dogs with valid vaccinations

Of the dog/cat owning respondents 68.80% in Mwansabombwe and 27.30% in Manyinga reported that their pet had either bitten or scratched someone. When asked on what actions were taken when the pet had bitten them or someone else, only 55% in Mwansabombwe and 70% in Manyinga washed the wound, visited the veterinary office and went to the hospital (Figure 5).

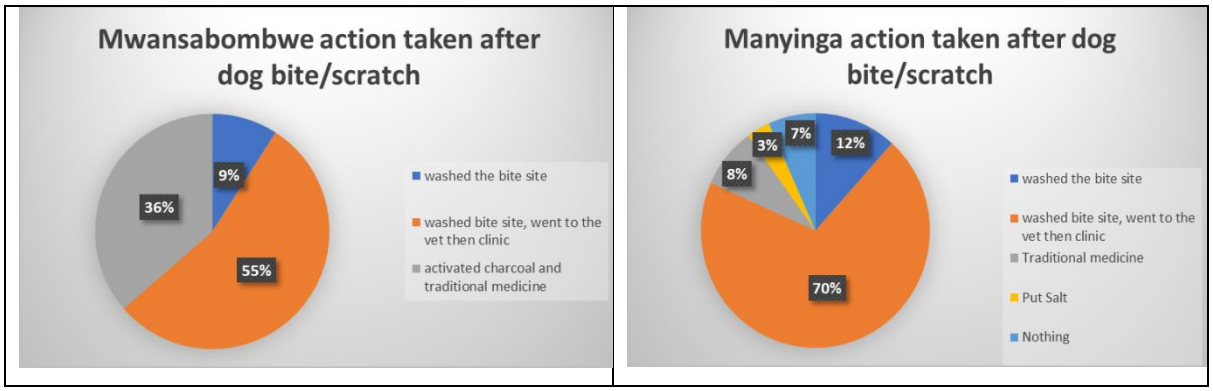


Figure 4. 5: showing action taken after dog/cat bite or scratch in Manyinga and Mwansabombwe

When asked if they were beliefs about rabies vaccine, 46% in Mwansabombwe and 23.3% in Maniynga of the respondents reported they had beliefs. Of these 28% in Mwansabombwe and 13% in Manyinga, said dogs become less vicious when vaccinated, while 51% in Manyinga and 13% in Mwansabombwe reported that dogs go mad when they are vaccinated (Figure 6).These beliefs put the people in both districts at a high risk of getting rabies because they do not vaccinate their dogs due to the beliefs in their communities.

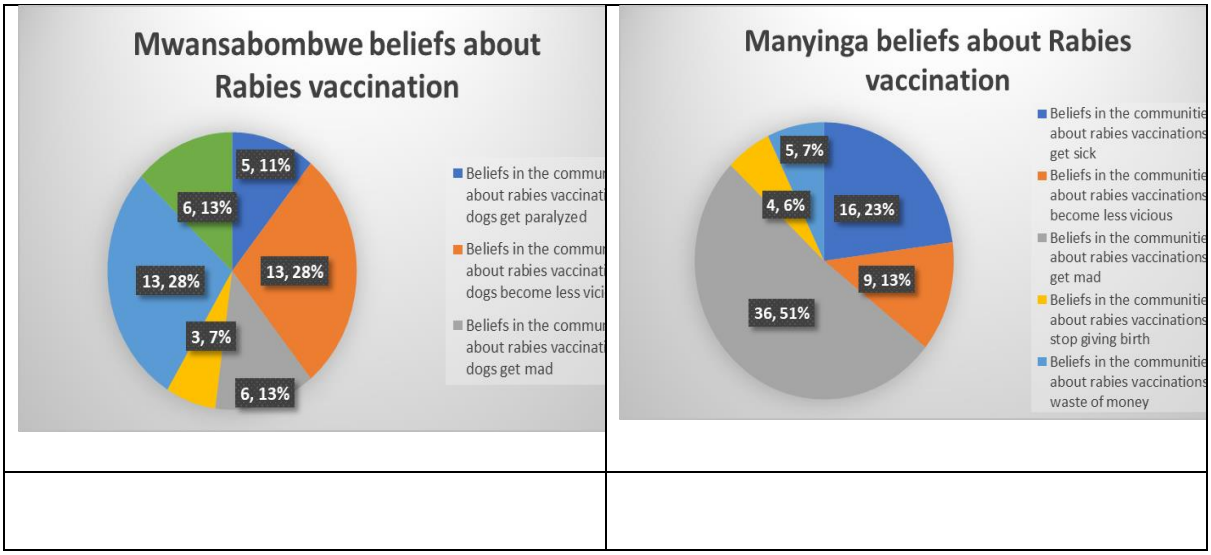


Figure 4.6: shows beliefs about rabies vaccinations in Mwansabombwe and Manyinga Districts

4.1.10 Key Informants View on Rabies

The interviews with key informants included 10 participants, 2 of whom were female. Veterinary staff were asked about their knowledge of rabies, its prevention and control, community perspectives on rabies, and the challenges faced in its prevention and control. Council public health officers were asked about the difficulties in enforcing the law and the specific challenges in preventing human rabies.

Informants from both districts demonstrated a thorough understanding of rabies, revealing that a significant portion of the population was aware of rabies and the primary preventive measures. However, there was a strong demand for free vaccinations. The departments highlighted several obstacles to the sustainability of rabies control, including inadequate staffing and insufficient resources. Additionally, challenges in dog handling and control resulted in a limited number of dogs being presented for vaccination during campaigns. The local authorities faced difficulties in enforcing dog control laws, particularly with dog registration due to the associated costs and the economic challenges faced by poor communities in the two districts. Controlling dog movement was also problematic, as few homes were enclosed by fences, and many dog owners were unable to restrain their dogs. This led to dogs scavenging at dump sites near residential areas, making it difficult to distinguish owned dogs from strays. The reviews indicated that responsible dog ownership and movement restrictions were not effectively implemented, as owned dogs were often indistinguishable from unowned ones.

The public health department identified the unavailability of post-exposure prophylaxis (PEP) in hospitals as a major challenge, along with insufficient staff to conduct community sensitizations on the appropriate actions to take in case of a dog bite. The lack of PEP in government hospitals made it costly for dog bite victims, who had to procure it themselves or travel to neighboring districts, incurring both transport and procurement expenses—a significant burden for poor victims.

Following up on suspected rabies cases was also challenging due to community practices, such as killing and disposing of suspected rabid dogs in rivers after biting incidents. The absence of laboratories in district and provincial head offices capable of testing for rabies further complicated the management and confirmation of rabies cases.

4.1.11 Evaluation of 2017 to 2022 Dog Bite Cases

The assessment of dog bite cases from the veterinary offices and Loloma Mission Hospitals revealed a total of 538 recorded cases spanning from January 2017 to June 2022 in Manyinga and. The ages of the victims varied between 3 and 56 years. Notably, in Manyinga, 75.0% of the rec-orded cases involved victims below the age of 15 years. Unfortunately, in Mwansabomb-we, the age range of victims could not be determined due to a lack of available records.

In Manyinga district, 55.0% of the bite cases, and in Mwansabombwe, all cases, were attributed to dogs whose owners were unknown, making it impossible to ascertain the vaccination status of these dogs. Of these cases, 43.0% were linked to owned but unvac-cinated dogs, while a mere 2.0% resulted from bites by vaccinated dogs with valid vac-cination certificates (Figures 3 and 4). This aligns with the veterinary records in the Manyinga district, where the validity of vaccination certificates was determined based on the occurrence of the bite preceding the next scheduled dog vaccination.

Victims of bites from unvaccinated dogs were advised by the district veterinary officer to undergo wound management, tetanus treatment, and post-exposure prophylaxis. All recorded victims of bites from unvaccinated dogs, except for two individuals, received the recommended treatment and post-exposure vaccines. Regrettably, the two individuals who did not receive post-exposure vaccines succumbed to the disease in 2018 at Loloma Mission Hospital.

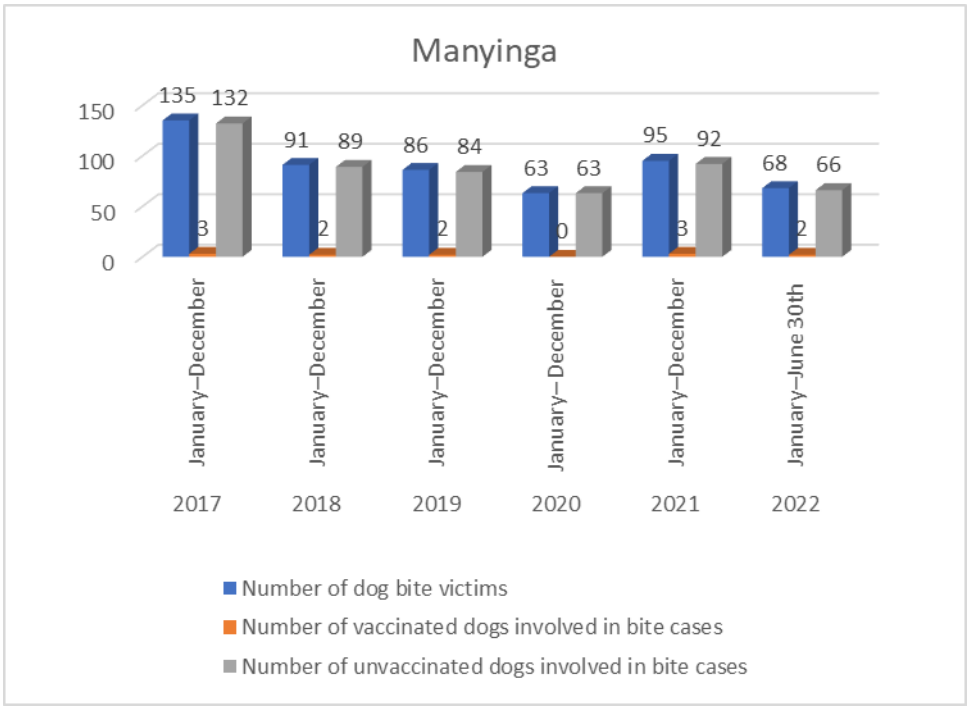


Figure 4.7: . Manyinga dog bite records from January 2017–30th June 2022.

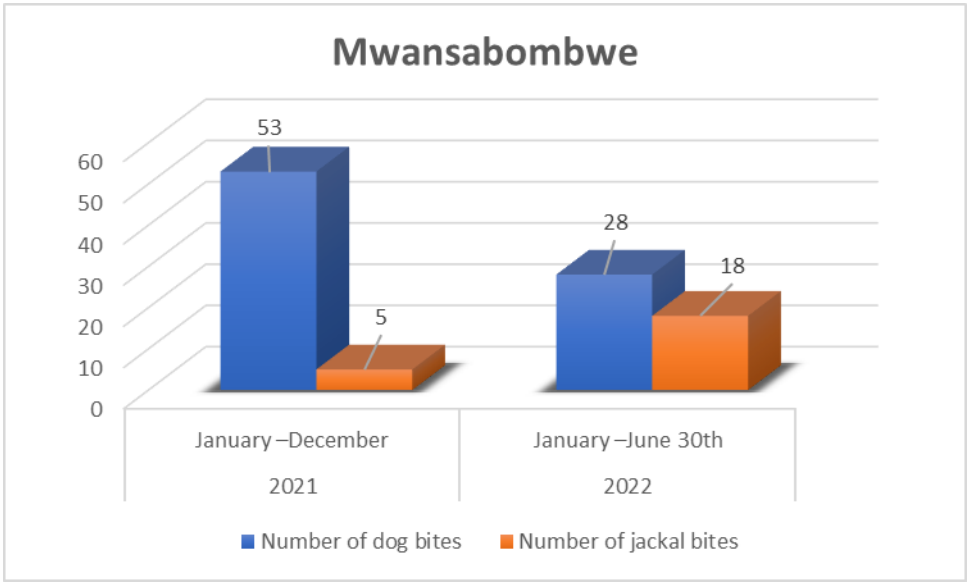


Figure 4.8:Mwansabombwe dog and jackal bites record from January 2021–30th June 2022.

4.1.12 Dog Vaccination Coverage

A total of 481 dogs received vaccinations at nine designated points within the Many-inga central veterinary camp from 27 May 2022 to 2 June 2022. In Mwansabombwe, 326 dogs were vaccinated at five designated points across the three veterinary camps. The vac-cination coverage in the study area reached 481 out of an estimated 750 dogs, representing 64% of the dog population in Manyinga. In Mwansabombwe, the coverage was 326 out of an estimated 1500 dogs, representing 21.0% of the dog population. Notably, in both study areas, the targeted 70.0% vaccination rate, as recommended by WHO, was not achieved.

CHAPTER 5

5.1 Discussion

This study represents a pioneering effort in both Manyinga and Mwansabombwe districts of Zambia with regards to rabies control. This study is the first of its kind in both Manyinga and Mwansabombwe districts and aimed to comprehensively assess the knowledge, attitudes, and practices related to rabies, with a specific focus on the prevention and control of this zoonotic disease. The primary objectives encompassed exploring the general understanding of rabies among the residents, evaluating the demographics and vaccination status of the dog population, and identifying barriers to the successful implementation of rabies control programs in these districts

The collected data reveals that 88% of respondents from both districts had heard about rabies. Prior to sensitization majority knew that rabies transmission was through bites, though only 29.9% knew the signs of rabies in animals, but after sensitization and vaccination, this percentage increased to 54.5%. In Mwansabombwe, 77% of respondents knew about rabies signs and majority knew it was transmitted through bites.It was also discovered that 60.8% in Manyinga and 82% in Mwansabombwe knew the prevention and control of rabies. However, the majority remained unaware of the signs of rabies in dogs and humans. The above indicates lack of comprehensive knowledge about rabies. Poor awareness on signs of rabies in dogs indicates that transimission is most likely and human deaths due to lack of knowledge.This discovery is similar to the findings by Milton in Mozambique (Mapatse et al. 2022) but it contrasts the study conducted in Lilongwe, Malawi, by Jonasson (Jonasson A, 2014) reported that 98% of respondents had heard of rabies, with 71% aware of its transmission from dogs to humans. The difference between the findings in this study and the findings in lilongwe might have been because of the difference in the study areas, with Lilongwe been a town while Manyinga and Mwansabombwe been in the rural parts of Zambia.

The factors that influenced better knowledge in this study were occupation and education indicating the highest risk of developing rabies is likely to fall on the uneducated, the finding is similar to the study that was conducted in Tanzania (Sambo et al. 2014). Rabies awareness interventions aimed at addressing the gaps in rabies knowledge must be inclusive and target all populations, that's including the most marginalized population. A study by Lapiz et al (Lapiz et al. 2012) and Chapman et al (Chapman et al. 2000) advocate for school based interventions to increase rabies awareness but this study suggests that traditional entertainment gatherings, markets and churches must be considered as strategic places for

implementations of community based rabies awareness and education. Sambo (Sambo et al. 2014) also pointed community based programmes involving all community members to be considered as strategic places for the implementation of community based awareness and rabies education campaign.

This study recorded a higher proportion of female respondents, possibly due to cultural practices where females remain at home and males dominate educational gatherings. The study also showed that rural areas had more dogs than the urban which is similar to the study conducted in Nyimba (Mulipukwa et al. 2017c) and South Africa KwaZulu-Natal (Hergert et al. 2018). And similar findings were recorded in Mutendere urban Zambia were only 11% of households owned dogs while rular palabana 45% kept dogs (De Balogh et al. 1993). This could be as a result of way dogs are acquired in rural areas and kept. In rural areas dogs are usually not bought but just given by neighbors and they are not fed by owners instead they are left to fend for food on their own. Dog owners demonstrated good knowledge of rabies in Manyinga and Mwansabombwe,however, additional sensitization efforts from the veterinary department, medical health, and council public health workers are crucial for imparting accurate knowledge. This enhanced awareness can lead to responsible dog ownership and emphasize the importance of rabies vaccination and importance of post exposure prophylaxis (PEP) after dog bites from unknown and unvaccinated dogs. Official education by experts may improve dog handling skills and subsequently increase vaccination coverage to effectively control rabies outbreaks (Munangándu et al. 2011) .

Research findings underscore the common occurrence of dog and jackal bite cases in both study areas. Although unreported cases were not determined, studies from Nyimba and Tanzania suggest that for every reported case, at least 10 cases go unreported (WHO 2004; Mulipukwa et al. 2017). Notably, 55% of dog bite cases in this study involved unknown dogs, highlighting the challenge of absent dog registration and restricted movements, making proper identification difficult. This situation complicates the differentiation between owned and stray dogs. In contrast, a study in South Africa's KwaZulu-Natal found 87.9% of dog bite cases caused by owned dogs (Sivagurunathan et al. 2021). This difference can be associated to the absence of registration and fenced yards in the two districts which has made differentiating owned dog from un-owned difficult.

In our study, 70% of dog bites were attributed to unknown dogs, and 75% of victims were below 15 years old, aligning with global trends identified by the World Health Organization

and a study conducted in Nyimba district Zambia (Mulipukwa et al. 2017). The above finding is not suprising because children in these two districts tend to play in the open damp sites that are in close proximity with the residential areas. And dogs in these unfenced households scavenge the dump sites for food. As children play around dumpsite areas they tend to taunt dogs as a way of playing and in the process they get bitten by the dogs. This is similar to the study conducted Mulipukwa in Nyimba (Mulipukwa et al. 2017c).

For victims of dog bites by unvaccinated dogs, post-exposure prophylaxis (PEP) was recommended. However, PEP availability varied between Manyinga and Mwansabombwe, impacting accessibility and incurring additional costs for transportation. Vaccinating dogs could reduce such costs, as studies indicate that dog vaccination is more cost-effective than PEP for rabies control (WHO 2004). However, PEP is not readily available in government hospitals which makes dog bite victims to buy on their own. This cost could be avoided if PEP is stocked in all health facilities. In cases were the victim is coming from a poor home that cannot afford to buy PEP the victims don't get PEP which perpetuates human rabies incidences .

Irresponsible dog ownership, absence of fenced yards and inadquete dog vaccination is prevalent in the two districts and the councils have failed to enforce Part II: the Registration of Dogs Regulations of Chapter 247: The Control of Dogs Act of the Laws of Zambia in Manyinga and Mwansabombwe districts due to the associated costs and the poverty within these communities.This has hinded the differentiation between owned and stray dogs as all dogs rome about.The roaming of dogs and absence of fences is similar to Madagascar (Mapatse et al. 2022).Confining and vaccinating of dogs in these two districts can minimize the contracting and spread of rabies.The lack of fencing in the majority of households allows for uncontrolled dog movement and breeding, resulting in more stray dogs which complicates rabies control efforts, which requires community compliance through responsible dog ownership and law enforcement by the council. Challenges include the absence of dog registration due to attached fees and various obstacles hindering a coordinated global approach to canine rabies elimination.

Inadequate staff in Veterinary Camps to routinely vaccinate dogs and cats,lack of operational funds by department to procure: Vaccines, Ammunition to destroy stray dogs and cats;Transport to go round in villages to vaccinate dogs and cats; and, Establish cold chain facilities at Veterinary Camp level for Veterinary Assistants to store rabies vaccines and routinely vaccinate dogs and cats in villages has also hindered rabies prevention and control

in these two districts which is similar to the finding in the study conducted in Nyimba Zambia by Mulipukwa (Mulipikwa et al.2017c).

Destruction or killing of the rabies suspected dogs after a dog bite and disposing them before samples are collected has lead to under-reporting of rabies cases in Manyinga and Mwansabombwe Districts and this in not only unique to the two Districts but it is similar to the findings in the studies conducted in Mozambique, Kenya, Tanzania and Democratic Republic of Congo ((Mapatse et al. 2022; Mucheru et al. 2014; Mbilo et al. 2019; CLEAVELAND 2003)). The above entales the need to ensure better allocation of passive and active surveillance teams and logistical conditions for samples to be collected and packaged for rabies diagnosis. The absence of laboratories in districts and provincial head offices capable of testing for rabies added to the complexities in managing and confirming rabies cases hence there is need for construction of diagnostic laboratories in every District.

Vaccination coverage in both study areas fell short of the WHO-recommended 70%, with 64% in Manyinga and 21% in Mwansabombwe. This is lower than re-ported coverage in rural Mazabuka (Munangándu et al.2011), rural areas of Tanzania Mara and Serengeti (WHO. 2018; Mshelbwala et al.2021). The findings suggest that ordinary vaccination coverage in rural Zambia does not reach the critical threshold of 20-45% needed to interrupt dog rabies transmission (Munangándu et al.2011), but in this study the critical threshold in the study areas was reached after the vaccination campaign indicating that it is attainable

Dog owners identified financial constraints, distance to veterinary offices, vaccine unavailability, and certain beliefs as reasons for not vaccinating their dogs. Overcoming these barriers requires addressing inadequate veterinary staffing, securing funding for vaccine procurement, and dispelling misconceptions within the community. A study by Nejash A.et al,(Nejash et al. 2017) emphasizes that rabies cases predominantly occur in poor communities characterized by poor dog ownership and an unwillingness or inability to pay for vaccinations which similar to the findings in this study.

5.2 Limitations

This study faced several limitations, including insufficient resources to conduct a second post-sensitization questionnaire survey in Mwansabombwe, which hindered our ability to assess the impact of sensitization and vaccination on rabies knowledge. Additionally, there was reluctance among Mwansabombwe residents to participate in the survey. Achieving the WHO-recommended 70% vaccination coverage was impeded by various challenges, such as owners'

reluctance to handle their dogs, prevailing community beliefs such as the misconception that vaccinating a dog hinders its hunting abilities and insufficient resources to sustain the vaccination campaign over an extended period

CHAPTER 6

6.1 Conclusions and recommendation

In conclusion the prevention and control of rabies in the two districts remains a challenge, primarily due to a lack of sufficient and accurate knowledge about the disease, which affects attitudes and practices. The study has shown compliance to dog vaccinations against rabies was low and there were a number of significant social and economic barriers identified. It has also demonstrated the impact of accurate rabies information has on mindset change in the two districts.

Identifying these barriers lays the groundwork for targeted interventions aimed at the global objective of rabies elimination. Potential solutions include knowledge dissemination and free mass vaccination campaigns for owned dogs and dog registration. Despite efforts,both districts fell short of the WHO's 70% coverage recommendation. Essential interventions are required to overcome these challenges.

Community education on rabies can foster responsible dog ownership, reducing stray dogs and improving vaccination coverage. This aligns with the tripartite goal of the WHO, World Organization for Animal Health, and Food and Agriculture Organization to achieve zero dog-mediated human rabies cases by 2030. Key steps include improving the estimation of the dog population to ensure minimum vaccination coverage, enhancing accessibility of PEP for high-risk animal bites, controlling the dog population through mass sterilization, and using oral bait rabies vaccinations for dogs that are difficult to handle and stray dogs. Thorough investigation of human dog bite cases by veterinary authorities to assess human exposure risk, addressing staffing issues at veterinary offices, and ensuring accessibility of rabies vaccinations are also crucial measures.

CHAPTER 7

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No date, 'Rabiesprotocol2'.

APPENDICES

Appendix: 1 KAP calculation

Questions	KAP calculations of the community people	
	Satisfactory	**Unsatisfactory**
1. Which animals can be infected with rabies?	When one of these are selected Dog cat Cattle Goat Sheep Pig Fox	Did not answer any of these
2. How is it transmitted?	When one of these are selected -through bites -through scratches -through contact with saliva	-through consumption of uncooked meat -through cuts -through contact with urine
3. Do you know clinical signs/symptoms of rabies in animals?	-Biting objects and people -Sudden behavior change -Increased aggression/viciousness -Hyper salivation/drooling -Fear to drink water/eat -Photophobia -Paralysis that worsens overtime -Nervousness -Unfriendly animal becomes friendly -hyperexcitability	Did not answer any of these
4. . Do you know how rabies can be prevented and controlled?	When any of these were selected -through dog/cat vaccinations - through population control -through post exposure vaccination	When only these were selected -through killing animals -through beating animals - through deworming
5. Has your pet/s bitten or scratched any one or have you ever been bitten or scratched by a dog or cat?	Wash wound with soap and water then visit the veterinary office then Consult with physicians and receive vaccine	Wash with water Use traditional medicine Wash and put salt Consult with local doctors Nothing to do
6. Do you know the signs of rabies in humans?	-Salivation - die -barking like a dog -fighting -hydrophobia - restless -Photophobia -moving about -crying - mental diorder -Getting mad - biting -behavior change - hyperactive	Did not answer any of these

Appendix 2: Oral Consent Form

THE UNIVERSITY OF ZAMBIA

SAMORA MICHEAL SCHOOL OF VETERINARY MEDICINE

DEPARTMENT OF BIOMEDICAL SCIENCES

DETEMINANTS AND BARRIERS TO RABIES PREVENTION AND CONTROL IN MANYINGA AND MWANSABOMBE DISTRICT

ORAL CONSENT FORM FOR PARTICIPANTS AND KEY INFOMANT

Hello, my name is Dr Misapa Chipo Muma. I am doing a research and I wondered if you would be interested in being involved. I am a Masters student at the University of Zambia studying Epidemiology. My research is about Determinants and Barriers to Rabies Prevention and control in Manyinga and Mwansabombwe Districts.

In this study, I want to investigate the knowledge, attitudes and practices on rabies in Manyinga and Mwansabombwe Districts and determine the dog population demograph. The aforementioned will help identify the barriers to rabies prevention and control in Manyinga and Mwansabombwe districts. By identifying these barriers, the study aims to improve rabies vaccination coverage in the dog population to at least 70% as recommended by World Health Organization (WHO).

You are invited to participate because you are a resident of Manyinga and Mwansabombwe Districts. If you choose to be part of this research, here is what will happen.

I will have a conversation/ questionnaire interview with you where we will talk about rabies knowledge, attitudes and practices.

I may, with your permission, take some photographs during the interview.

The data which includes questionnaires and interviews will be de-identified, which means any publication will not use yours name. if there are photographs where you are identifiable, I will obtain your permission before using them in any public way.

I will store your information safely and confidentially in a password protected and encrypted laptop. I would like to be able to use your de-identified information/data in future studies, and to share this information data with other researchers.

The following are risks involved in taking part in this study: you will find this aspect of the interview boring and at times personal as we will talk about your knowledge on rabies. You are free to take a break or stop participating in the interview at any time. You can also let me know if you do not want to have any photographs taken of you.

You do not have to agree to take part; you can ask me any questions you want before or throughout; you can also withdraw at any stage without giving a reason. If you choose to withdraw, I will take out what you have said in the transcript.

The project will be published in my master's thesis and scientific journals.

If you have any concerns or complaints please contact me on mobile number +260978692928, and email; mumamisapa1@gmail com.

Do you give your permission for me to interview you?.....

Do you give your permission for me to take photos during the course of the interview?.....

Are you happy to take part?.....

Participants signature….....

Appendix 3: Questionnaire for Household Survey

THE UNIVERSITY OF ZAMBIA

SAMORA MICHEAL SCHOOL OF VETERINARY MEDICINE

DEPARTMENT OF DISEASE CONTROL

TOPIC: DETERMINANTS AND BARRIERS TO RABIES PREVENTION AND CONTROL IN MANYINGA AND MWANSABOMBWE DISTRICTS.

The purpose of this survey is to determine the knowledge, perceptions and practices of the people in Manyinga and Mwansabombwe Districts with respect to rabies prevention and control measures and identify the barriers to Rabies control measures. The results of the survey will improve information dissemination and implementation of measures towards rabies control in an effort to attain zero rabies cases in humans by 2030.

QUESTIONNAIRE

Part A: Personal Information (instructions: tick the answers)

1. Age ……..
2. Gender

   ☐ Male ☐ Female

3. Type of settlement

   ☐ Urban ☐ Semi-urban ☐ Rural

4. Education qualification

Primary Secondary Tertiar Others

5. Occupation

Government employee Student Farmer Others

Part B: General Information on Rabies (Tick all suitable answers in this section)

6. Have you ever heard of Rabies?

Yes No

7. If yes what are the sources of your knowledge?

Veterinarian Health worker Television Radio Social media Others

8. What animals can be infected by rabies?

Animal	Yes	No
Cows		
Dogs		
Cats		
Goats		
Sheep		
Pigs		
Foxes		

9. How is rabies transmitted?

-through bites

-through cuts

-through scratches

-through contact with saliva

-through consumption of uncooked

-through contact with urine

11. Do you know clinical signs/symptoms of rabies in animals?

Yes No

12. If answer to 11 is Yes, what are they?.....

12. Do you know how serious rabies is?

Yes No

13. Do you know how rabies can be prevented and controlled?

Yes No

14. If the answer is Yes to question 13, how can it be prevented/controlled?

- through dog/cat vaccinations -through killing animals

- through population control -through beating animals

- through deworming

-through post exposure vaccination

Part C:

15. Do you have any pet (e.g dog/cat)

Yes No

16. How many dogs/cats do you have?.....

17. what is the sex of your pet?

Female Male

18. How old is your pet?.....

19. Are the pets vaccinated against rabies?

Yes No

20. If the answer to 19 is Yes, is the vaccination still valid?

Yes No

21. If the answer is Yes to 20, when is the next time it is going to be vaccinated?.....
.....

22. If the answer to 19 is No, why is the dog/ cat not vaccinated?.....
.....

23. Are there any beliefs attached to vaccinating dogs in your community?

Yes No

24. if answer to 23 is Yes, what are those beliefs?.....
.....
.....
.....

25. what is the reason for keeping the dog/cat?.....
.....
.....

26 Has your pet/s bitten or scratched any one or have you ever been bitten or scratched by a dog or cat?

Yes No

27. what was done after the scratch or bite by the dog/cat?.....
.....
.....

28. Do you know the signs of rabies in humans?

Yes No

29. if answer to 28 is Yes what are the signs of Rabies in human?

Salivation
barking like a dog
hydrophobia
Photophobia
crying
crying
Getting mad
behavior change
die
Fighting
restlessness
moving about

Mental disorder  biting  hyperactive 

Failure to eat  others 

Appendix 4: Ethical clearance

Plot No. 272, Cnr Olive Tree Westwood Road,
Westwood Ibex
Lusaka - Zambia
Tel: +260 955 155 633
+260 955 155 634
Cell: +260 977 493 220
Email: eresconverge@yahoo.co.uk

I.R.B. No. 00005948
F.W.A. No. 00001697

23rd September, 2021.

Ref. No. 2021-Jun- 023

The Principal Investigator
Dr. Misapa Chipo Muma
School of veterinary Medicine
Biomedical Science Department
Lusaka, Zambia

Dear Dr. Muma

REF: DETERMINANTS AND BARRIES TO RABIES PREVENTION AND CONTROL IN MANINGA DISTRICT.

Reference is made to your protocol resubmission. The IRB resolved to approve this study and your participation as Principal Investigator for a period of one year.

Review Type	**Fast Track**	Approval No. **2021-Jun-023**
Approval and Expiry Date	Approval Date: 23rd September, 2021	Expiry Date: 22nd September, 2022
Protocol Version and Date	Version - Nil.	22nd September, 2022
Information Sheet, Consent Forms and Dates	• English.	22nd September, 2022
Consent form ID and Date	Version - Nil	22nd September, 2022
Recruitment Materials	Nil	22nd September,2022
Other Study Documents	Questionnaire.	22nd September, 2022
Number of participants approved for study	-	22nd September, 2022

Where Research Ethics and Science Converge

Specific conditions will apply to this approval. As Principal Investigator it is your responsibility to ensure that the contents of this letter are adhered to. If these are not adhered to, the approval may be suspended. Should the study be suspended, study sponsors and other regulatory authorities will be informed.

Conditions of Approval

- No participant may be involved in any study procedure prior to the study approval or after the expiration date.
- All unanticipated or Serious Adverse Events (SAEs) must be reported to the IRB within 5 days.
- All protocol modifications must be IRB approved prior to implementation unless they are intended to reduce risk (but must still be reported for approval). Modifications will include any change of investigator's or site address.
- All protocol deviations must be reported to the IRB within 5 working days.
- All recruitment materials must be approved by the IRB prior to being used.
- Principal investigators are responsible for initiating Continuing Review proceedings. Documents must be received by the IRB at least 30 days before the expiry date. This is for the purpose of facilitating the review process. Any documents received less than 30 days before expiry will be labelled "late submissions" and will incur a penalty.
- Every 6 (six) months a progress report form supplied by ERES IRB must be filled in and submitted to us.
- A reprint of this letter shall be done at a fee.

Should you have any questions regarding anything indicated in this letter, please do not hesitate to get in touch with us at the above indicated address.

On behalf of ERES Converge IRB, we would like to wish you all the success as you carry out your study.

Yours faithfully,
ERES CONVERGE IRB

Dr. Jason Mwanza
Dip. Clin. Med. Sc., BA., M.Sc., PhD
CHAIRPERSON