



UNIVERSITY OF  
Global Health  
EQUITY

**HEALTH-SEEKING BEHAVIORS OF SNAKEBITE ENVENOMATION VICTIMS IN  
BUGESERA DISTRICT OF RWANDA, IN 2020.**

By

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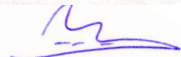
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**DECLARATION**

We, Happy Tahirih Kampire and Leandre Ishema hereby declare that the practicum capstone thesis has been written by us without any external unauthorized help, that it has been neither presented to any institution for evaluation nor previously published in its entirety or in parts. Any parts, words, or ideas, of the thesis, however limited, which are quoted from or based on other sources, have been acknowledged as such without exception.

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## **DEDICATION**

I dedicate this to my mother, who has always been there for me. She has loved and supported me throughout my education process and encouraged me when I was losing hope.

To my son Ishema Ninziza Eran, this is for you. You have been the greatest source of motivation throughout this journey.

To Rugwiro Landry, Dascha Lydia Sahabo, and Igihozo Gloria, thank you for pushing me beyond my limits and showing me the important things in life.

I also dedicate this to healthcare professionals all over the world that aspire for change and equity, and all the supportive lecturers and faculty that have inspired me to strive for making a lasting impact in healthcare.

Finally, to the MGHG class of 2021, thank you for enriching my journey in the MGHG program.

### **Leandre Ishema**

I dedicate this study to the vibrant community of Bugesera District. Going through a pandemic and experiencing snakebite must've been devastating, so thank you for sharing your experiences to generate change for your community.

### **Happy Tahirih Kampire**

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Lastly, special thanks to the practicum faculty team: Dr. Zahirah McNatt, Diana Rujema, and Gloria Igihozo. Your support and wisdom during the entire practicum experience have been invaluable.

## ABSTRACT

**Background:** Snakebite Envenomation (SBE) is a neglected tropical disease affecting over 2 million people globally. It presents a public health threat to the Rwandan community, both for humans and animals. Between 2017 and 2018, the Eastern province of Rwanda recorded the highest cases of snakebites among human victims (39%) compared to other provinces. Proper and timely management of SBE can be lifesaving but depends on victims' health-seeking behavior. Therefore, this study was conducted to assess the health-seeking behaviors of SBE human victims and livestock owners whose animals were bitten in Bugesera District of Rwanda in 2020.

**Methods:** A retrospective cross-sectional study was conducted between June and July 2021, among 395 snakebite victims from three sectors in Bugesera District, in the Eastern Province of Rwanda. A quantitative questionnaire was used to assess forms of care sought by snakebite victims in the study location.

**Results:** Seeking care through informal sources was the most common source of care for snakebite victims, both human and livestock owners (96.1%), followed by seeking care from formal sources such as health facilities and veterinarians (5.4%). Nearly half (44.6%) of human victims considered trust in the service provider to be the most important factor affecting their choice of where to seek care. This was followed by proximity, affordability, and other factors such as recommendations from neighbors. Having health insurance in 2020 and past snakebite experience were significantly ( $p=0.017$  and  $p=0.021$  respectively) associated with the type of care sought.

**Conclusion:** This study highlights care seeking behavior gaps impacting the effective management of SBE in Rwanda. The health-seeking behaviors not only affect access to timely treatment but presents a challenge to Rwanda's 2024 roadmap to eliminate NTDs and reduce the national burden of SBE by 50%. Therefore, community education on recommended first-aid practices and appropriate health-seeking channels and collaborations with traditional healers, present important avenues through which Rwanda can disseminate formal care for snakebite victims.

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## **CHAPTER ONE: INTRODUCTION**

### **1.1 Introduction**

Snakebite Envenomation (SBE) is a Neglected Tropical Disease (NTD) affecting over 5 million people globally (WHO, 2021). It is a public health threat that accounts for 1.03 million disability-adjusted life years in sub-Saharan Africa and leads to envenoming, amputations, permanent disabilities, and death (Joshi et al., 2018; Halilu et al., 2019; WHO, 2021). In 2017, the World Health Organization (WHO) redeclared it a neglected tropical disease and added it to its portfolio of 20 priority NTDs to increase its awareness and promote research, so that efforts to control its burden could be strengthened (Babo Martins et al., 2019). Although its exact global burden is unknown, the highest burden and risk of envenomation lies in low and middle-income countries of Africa, Latin America, and Asia where access to proper and timely care is limited (WHO, 2021). Additionally, SBE in sub-Saharan Africa affects poor communities, especially agricultural communities that work in fields and farms barefoot or without protective shoes which makes them more vulnerable to snake bites (WHO, 2021).

Rwanda, a low-income country in East Africa is one of the nations where SBE is endemic, affecting both humans and animals (RBC, 2019). The Eastern province of Rwanda has been identified to account for over a third of the SBE cases, particularly since this region is home to Akagera National Park (one of the largest parks in the country), which is home to many venomous snakes and is surrounded by an agricultural community whose main economic activities are farming and animal rearing (Nduwayezu et al., 2020; NISR, 2011). Studies on SBE and snake bites in Rwanda have estimated that the country has more than 4100 cases of SBE reported annually, that snake bites are the second leading cause of individuals seeking care from animal bites, and that more than a half of SBE cases occur among rural farming communities (Halilu et al., 2019; Nduwayezu et al., 2019). In 2019 alone, the country's health management information system (HMIS) noted that cases of snakebites reported in the system exceeded 1000 (RBC, 2019).

Treatment and prevention for SBE are prioritized in Rwanda's NTD Strategic Plan, 2019-2024. This plan targets a 50% reduction in SBE morbidity and mortality by 2024 and outlines control strategies to achieve this goal (RBC, 2019). The plan aims to increase community awareness of SBE preventive measures and appropriate first aid interventions. Moreover, this plan also aims to improve delivery and access to antivenom for communities most at risk. However, successful control and management of SBE depend on timely access to care for victims, which is intertwined with their health-seeking behaviors (Olenja, 2003).

In many countries in sub-Saharan Africa, the majority of snakebite victims opt to use home remedies or seek care from traditional healers, which hinders timely access to antivenom (Alcoba et al., 2020). In Rwanda, however, this information is still unknown. To our knowledge, no studies have been conducted to assess the health-seeking behaviors of human SBE victims and of livestock owners whose livestock have been bitten by snakes. This information is crucial in strengthening Rwanda's plan to eliminate SBE as a public health threat by 2024, as understanding the health-seeking behaviors of SBE victims could help the country improve the existing treatment cascade for SBE victims. Thus, this study aimed to address this knowledge gap by assessing the health-seeking behaviors of SBE human victims and livestock owners whose livestock were bitten by snakes in Bugesera District of the Eastern Province of Rwanda, in the year 2020.

## **1.2 Problem statement**

The health-seeking behaviors of SBE victims, both human victims and livestock owners whose livestock were bitten by snakes in Bugesera District of the Eastern province of Rwanda in the year 2020 are unknown.

## **1.3 Research Question**

What are the health-seeking behaviors of SBE victims in Bugesera District of Rwanda in 2020?

## **1.4 Study Objectives**

1. To assess the health-seeking behaviors of humans bitten by snakes in Bugesera District from January 1<sup>st</sup> to December 31<sup>st</sup>, 2020.
2. To assess the health-seeking behaviors of livestock owners whose livestock were bitten by snakes in Bugesera District from January 1<sup>st</sup> to December 31<sup>st</sup>, 2020.
3. To propose recommendations for community sensitization programs that promote SBE care-seeking behaviors in line with WHO guidelines to Rwanda Biomedical Center's NTD department, by August 2021.

## **1.5 Organization of the Report**

This report is organized into six chapters.

The first chapter gives an overview of the study topic and contextualizes the importance of this research project. It also introduces the research question and the objectives that this study aimed to explore.

The second chapter is a highlight of existing literature on this topic. It describes the burden of snakebite envenomation on humans and animals globally, in sub-Saharan Africa, and in Rwanda, as well as factors contributing to this burden. The chapter provides information on the prevention, treatment, and management of SBE cases, and challenges that currently impact its

successful control. Lastly, it explores gaps in the literature and delves into the need to conduct this study in Rwanda.

The third chapter explains the methodology of this research study including the setting where the study took place, study participants and the sampling approach, the data collection process, the data collection tools used, measures of the study, and how the data collected was analyzed. It also details ethical considerations.

The fourth chapter presents the results of this study in form of tables and a description of general findings.

The fifth chapter discusses the results and connects them to findings from other studies. It points out similarities and differences that our study has compared to other literature on the topic and analyzes the meaning of the results in the context of Rwanda's fight against neglected tropical diseases. This chapter also describes the challenges and limitations of the study.

The sixth chapter summarizes the entire research study and provides recommendations on how the results of this study could inform Rwanda's approach to managing and controlling SBE.

## **CHAPTER TWO: LITERATURE REVIEW**

### **2.1 Overview of Snakebite Envenomation**

Snakebite envenomation (SBE) is a neglected tropical disease that results from venom injection to kill or paralyze a threat for their protection and to catch prey (Wüster & Arbuckle, 2020). It was removed from the list of neglected tropical diseases in 2013 and re-added in 2017 by WHO, after stakeholders realized its high incidence and negative impact on people and livestock (WHO, 2017). SBE causes massive distress, disability, and early death worldwide (WHO, 2017; Chippaux et al., 2019). There is no known global prevalence of SBE. However, WHO estimates that 4.5-5.4 million people are bitten by snakes annually and about 2.7 million of these people are bitten by venomous snakes, leading to 81,000 to 131,000 deaths and morbidity of 400,000 people every year (Chippaux, 1998; Kasturiratne et al., 2008). Snakes mainly bite people in tropical and developing regions, especially in Sub-Saharan Africa, South, and Southeast Asia, (Minghui et al., 2019). Additionally, SBE mostly affects rural communities, and the incidence is high among farmers (Babo Martins et al., 2019). SBE affects its victims mentally, physically, and economically, and its impact is even higher when you consider its outcome in livestock farming (Onoviran et al 1976; Lawal et al 1992). Factors contributing to SBE in humans and livestock include human habitat and occupation, (Babo Martins et al., 2019; Odio et al., 2005).

Snake venom is a combination of toxins made of proteins and enzymes that vary in size, lipids, carbohydrates, amines, and nucleosides that are discharged from the oral gland (Minghui et al., 2019; Wüster & Arbuckle, 2020). Venom is transmitted by fangs through a bite or spit (Minghui et al., 2019; Wüster & Arbuckle, 2020). Venom has long-term and short-term effects on humans and animals (Minghui et al., 2019; Powell, 2005). Neurotoxins affect the nervous system and alter the transmission of signals and information from nerve cells which results in paralysis or death. Haemotoxins impinge on the circulatory system and affect red blood cells resulting in

blood clots and sometimes hypotension. Myotoxins affect the muscles preventing them from contracting which may cause the death of body cells and tissues. Snakebite venom also causes coagulopathy which is a decrease in factors that cause coagulation and results in the inability of blood to clot. (Bailey, 2019; Paterson, 2019; Maduwage K et al., 2015).

## **2.2 Snakebite in Sub Saharan Africa (SSA)**

In Sub-Saharan Africa, it is estimated that up to one million people are bitten every year, with 100,000 to 500,000 bites from venomous snakes, resulting in 10,000- 30,000 deaths (Chippaux, 1998; Kasturiratne et al., 2008). In West Africa alone, 3557-5450 people die annually. (WHO, 2017). In Rwanda, a study looking at district and provincial hospital records from 2017-2018, demonstrated 363 cases of snakebite envenomation (Nduwayezu et al., 2019). Another study looking at estimates in 41 SSA countries estimated that 4,171 cases of SBE occur in Rwanda annually (Halilu et al., 2019). However, these studies are not true representations of what is happening in the community as these cases are from hospital records.

Care-seeking pathways of snakebite victims and livestock owners can be classified into three categories, hospital/veterinary care, traditional healers, and home remedies. All three pathways are available in SSA countries, however, due to factors such as affordability, accessibility, and preference some are sought more than others. According to a study done in Cameroon, 59 victims used home remedies, 25 went to traditional healers, and 31 consulted healthcare professionals. (Alcoba et al., 2020; Tagwireyi, 2011)

### *Types of Snakes found in Rwanda*

Snakes can be categorized into two categories according to WHO: Category 1: snakes of highest medical importance, highly venomous, and very common. Category 2: snakes of secondary medical importance are highly venomous. However, Category 2 lacks precise epidemiological data because of the snake's habitat choice, life cycle, and behavior. Both categories result in high numbers of morbidity, disability, and death (WHO, 2010). Rwanda has both categories of snakes (Table 1).

*Figure 1: Types of venomous snakes in Rwanda (Warel, 2010)*

Category	Name	Species
Highest medical importance	Black-necked spitting cobras	<i>Naja nigricollis</i>
	Jameson's mambas	<i>Dendroaspis jamesoni</i>
	Puff adders	<i>Bitis arietans</i>
Secondary medical importance	Bibron's burrowing asp	<i>Atractaspis bibronii</i>
	Variable burrowing asp	<i>Atractaspis irregularis</i>
	East African Gaboon viper	<i>Bitis gabonica</i>
	Rhinoceros viper	<i>Bitis nasicornis</i>
	Black mamba	<i>Dendroaspis polylepis</i>
	Forest vine snake	<i>Thelotornis kirtlandii</i>
	Boomslang	<i>Dispholidus typus</i>
	Banded water cobra	<i>Naja annulata</i>
	Forest cobra	<i>Naja melanoleuca</i>
	Gold's tree cobra	<i>Pseudohaje goldii</i>

### 2.3 Burden of SBE in humans and livestock in SSA

The burden of SBE, like other neglected tropical diseases, is difficult to estimate due to the limited availability of data. SBE in low- and middle-income countries mostly affects poor agricultural communities (Alcoba et al., 2020; Bolon et al., 2019; Snow et al., 1994). SSA was identified as one of the hotspots for SBE (Joshua L, et al., 2018). Short and long-term effects of SBE can be physical, mental, and socioeconomic (Halilu et al., 2019). Deaths observed from SBE were due to progressive swelling and intense vomiting which led to systematic shock and organ failure (Halilu et al., 2019). The risk of mortality is mostly found in children equal to or less than 5 years of age (Alcoba et al., 2020; Halilu et al., 2019).

A study conducted in 41 SSA countries estimated that SBE's burden was 1.03 million disability-adjusted life years (DALYs) yearly, which resulted in 12,290 deaths, 14766 (7.9%) amputations, and 55,332 people diagnosed with PTSD (14.9%) (Halilu et al., 2019). The countries with the highest burden were Nigeria (15.7%), Ethiopia (13.58%), and the Democratic Republic of Congo (DRC) (9.03%) which altogether accounted for 38.32% of the burden. However, due to the study

limitations of using estimates rather than actual records, and the use of PTSD and amputation as disabilities caused by SBE from Asia may have resulted in a lack of representation of the extent of the impact.

Poverty acts both as a predisposing factor and outcome of SBE because it threatens the economic stability of communities (Harrison et al., 2009). For example, a study of 109 snakebite victims in Nigeria, showed that delay in seeking care (>24 hours) and staying in the hospital for more than two days, is 5.8 and 19.5 times more likely to incur high-cost care (Habib, 2013a; Iliyasu et al., 2015). This does not only affect the victim, but their families also suffer from the cost of treatment. Some families sell their livestock or use part of their harvest earnings to pay for treatment. (Harrison et al., 2009, Dalhat, 2015). Poverty is also a predisposing factor because protective measures such as wearing shoes, walking with a torch and proper housing might be costly for some households, thus increasing their risk to snakebite (Tagwireyi et al., 2011; WHO, 2016). In Nigeria, the most affected communities in the region are agricultural workers, and each snakebite whether venomous or not leads to fewer working days (Salako, 1994). These workers are the most economically active population in Nigeria as 70% of Nigerian households practice crop farming and account for 20% of their GDP (Varrella, 2020), thus long- or short-term impediments in the most productive agricultural season can lead to a decrease in agricultural production and negatively affect their economic performance (Salako, 1994). This inevitably also contributes to poverty in these communities.

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The burden of SBE is even higher when you consider its impact on livestock, it causes a fatality rate of 47% and even though this number is high, little is known about the degree of burden for livestock owners (Bolon et al., 2019). Studies in Nigeria and Zimbabwe reported envenomation among cattle, goats, pigs, and poultry which resulted in death (Onoviran et al 1976, Lawal et al 1992). In these rural communities, livestock is an important part of their livelihood, it provides a stable source of food and income for these family's loss of livestock may result in emotional distress (Onoviran et al 1976, Lawal et al 1992, Stewart et al 1974, Martins et al., 2019). Loss of livestock, therefore, represents an important socioeconomic impact on communities.

In Rwanda, a study estimated that 195 deaths, 229 amputations, and 859 PTSD were related to 4,171 cases of SBE and a total of 12,597 years of life are lost to SBE yearly in humans (Halilu et al., 2019). There is no literature on the burden of envenomation in livestock.

## **2.4 Factors contributing to the incidence of SBE**

### *Factors contributing to SBE in humans and livestock*

### *Climate and environmental factors*

In SSA, snakebites cases are attributed to an increased exposure to different snakebite habitats and increased vulnerability due to type of occupation such as working in farmlands (Kasturiratne et al., 2008; Longbottom et al., 2018). Snakes adapt to areas modified by human activity such as agriculture and deforestation (Hauptfleisch et al., 2021). When humans invade natural snake habitats through these activities, they are likely to encounter snakes. This interaction has been seen in a study done in Windhoek Namibia, a city surrounded by natural forests and farms. The number of snakebites increased with ecosystem changes that caused conflicts between humans and snakes (Hauptfleisch et al., 2021). Notably, factors like climate change and global warming have been associated with increased interactions between humans and snakes, as they affect the distribution of snakes among different geographic areas with different climatic conditions. In Kenya, season change caused an increase in snakebites as snakes go around searching for water and food due to scarcity caused by dry seasons (Ochola et al., 2018). Snakebite incidence was also associated with certain climatic events such as flooding in coastal Ecuador and Asia, as a result of the monsoon (Gutiérrez, 2020).

Snakebite in livestock is mainly influenced by grazing environments and the weather (Yahaya et al., 2019). A study conducted in Ghana found a correlation between the rainy season and snakebites. In the rainy season, it was 71.2% and in the dry season, it was 28.8% (Yahaya et al., 2019; Bolon, 2019). Another study in Nigeria showed that most bitten livestock were in areas with vast canopies of trees and bushes. They also had large gorges of water behind residential areas which contributed to the presence of snakes (Lawal et al., 1992).

### *socio-economic factors*

Poverty, poor housing, and type of occupation also increase exposure to snakebite envenomation (Musah et al., 2019). People who live in rural areas and engage in agriculture such as farmers and herdsman are at significant risk of getting bitten by snakes. Paddy fields which are mostly used in growing crops such as rice are known to act as snake habitats, therefore farmers who work in these fields are likely to be bitten. Another contributing factor is lack of protective equipment, for example, people also get bitten as they walk barefooted around houses or in agricultural lands due to a lack of shoes (Babo Martins et al., 2019; Odio et al., 2005). It was found that most of the people that were bitten by snakes in Niakhar, Senegal were poor and relied on agriculture for a living (Chippaux et al., 2005). Culturally, due to the different gender roles assigned to men and women, males (61%) were more affected compared to women (39%), because they participate more in pastoral activities, which puts them at risk of snakebites (Igawe et al., 2020).

Currently, there is no study on contributing factors of snakebite envenomation in humans and livestock in Rwanda.

## **2.5 Prevention of SBE**

Snakebite envenomation is preventable. The prevention of bites aims to reduce the number of reported bites and mortality due to envenomation (Chippaux, 2000). The WHO recommends

educating the community about effective preventive measures to improve their knowledge on how to reduce risks of being envenomed or having their livestock envenomed. This set of knowledge should cover information on local snakes, their favorite habitat, and the times of the season and day which they are most likely to be active (WHO, 2016). Snakebite prevention measures include wearing shoes, sleeping under bed nets, and wearing clothing that protects their ankles and lower legs (Bawaskar & Bawaskar, 2019). These measures can also be used to prevent other diseases. For example, sleeping under bed nets protects you from certain vector-borne diseases and reduces risks of SBE, and wearing shoes/avoiding walking barefoot can protect them from podoconiosis (Chappuis, 2007). Additional, prevention measures for the environment in which people live are clearing bushes around their homes and avoiding any kind of behavior that can attract rodents such as poor waste management (WHO, 2016). Adherence to some of these recommendations has been reported in Cameroon and Nigeria, where people cover their ankles when outdoors, wear long pants, two pairs of socks, and boots (Alcoba et al., 2020; Ibrahim, 2020). However, other perceived prevention measures have been reported Kenya and Cameroon, such as: using plants that repulse snakes, using traditional concoctions walking around with a black stone in your pocket, having a domestic animal (Alcoba et al., 2020; Omara et al., 2021)

## **2.6 Management of SBE**

### *Clinical management of SBE*

#### *First aid*

In the case of a snakebite, several steps can be taken to protect victims from future disabilities. Take note of the bite time, move away from the bite location, call for emergency help, and take note of the snake's appearance to describe it to healthcare providers (Warell, 2010). To protect the person, make them lie down with the wounded part below the heart, keep them calm and avoid movements to prevent the venom from circulating. Cover the wound with a loose and clean cloth or bandage, remove clothing, jewelry, and shoes around the bitten area, and transport the victim to a health facility as soon as possible. People should avoid cutting or playing with the wound, trying to suck venom from the wound, using ice, tourniquet, or water on the wound, or giving the victim alcohol, caffeinated drinks, or medicine (Warell, 2010).

#### *Clinical Treatment*

Treatment of snakebites depends on whether or not the snake is venomous, the severity of the bite, age, and the health of the victim (Alcoba et al., 2020). If the snake is not venomous or when venom is not released, this is referred to as dry bites, whereas a snake bite can be described as wet when a snake releases venom in the body of a human or animal (Pucca et al., 2020). Once at the health center history should be taken with an attempt to determine: if the snake was venomous or not, the bite severity, time elapsed after the bite, as well as a brief medical history (Ahmed et al., 2008).

An airway, breathing, circulation, and disability (ABCD) assessment should be done as soon as the victim arrives at the hospital (Ahmed et al., 2008). If the patient is in shock due to

cardiovascular toxicity, cardiac arrest caused by lack of oxygen in body tissues, or respiratory failure caused by neurotoxins, emergency resuscitation should be performed (Ahmed et al., 2008).

Diagnosis of snakebite only has one commercial test that can confirm the venom type in the body, this uses antibodies to identify the type of venom in the victim's body. Most times diagnosis depends on symptoms which also depend on the type of venom (WHO, 2019). General symptoms include two wound punctures, pain at the bite site that spreads to the limbs, swollen lymph nodes, swelling and redness of the wound and its surroundings, difficulty breathing, sweating, nausea, salivation, vomiting, numbness in face and limbs, muscle weakness, blurred vision, and diarrhea (Mehta & Sashindran, 2002; Warell, 2010). There are also rare symptoms that are caused by an alteration in body systems, these include hypotension, coagulopathy, necrosis, paralysis, respiratory failure caused by difficulty breathing, renal failure, and shock (Mehta & Sashindran, 2002).

Every patient with suspected or known envenomation should be treated with oxygen and normal saline administered intravenously or Ringer's lactate. Physical examinations to rule out symptoms should be done and if necessary antivenom should be administered if available either by intravenous injection or infusion to stop further damage of body tissues and effects on the nervous system (Ahmed et al., 2008). To treat dry bites the wound should be kept dry and clean, and a tetanus vaccine should be given (Pucca et al., 2020; Alcoba et al., 2020).

Spontaneous hemorrhage caused by envenomation of some snake species is an essential clinical sign for antivenom use. A test known as the 20 Minutes whole Blood Clotting Test is done for diagnosis. 1-2 milliliters of venomous blood are collected in a dry glass bottle and allowed to stand for 20 minutes at room temperature. It is turned upside down to check the presence or absence of a clot. If the blood clots, the result is negative. If the blood does not clot, the result is positive which indicates the presence of coagulopathy, and antivenom is needed for treatment (WHO, 2019).

Antivenom can only neutralize venom but cannot treat harm to the other organs. Physical examination should follow to facilitate treatment of other symptoms. Symptoms and other side effects should be treated using support therapy drugs like antibiotics to prevent or treat infections, as well as pain killers, vitamin k, tetanus toxoid, and symptom-related medication. Snakebite victims should also be hospitalized for some time to observe their progress (Ahmed et al., 2008; Mehta & Sashindran, 2002).

After a snakebite on an animal, the owner needs to recognize signs and symptoms caused by the snakebite. After that, they need to rush the animal to a veterinarian. Signs and symptoms should be checked (Rajesh Singh, 2020). Symptoms depend on the snake type and amount of venom injected, and include agitation, salivation, shivering, vomiting, general weakness, involuntary release by the bladder or bowel, unstable walking, dilation of pupils with reduced light reflex, difficulty in coagulation, swelling of the limb, discolored urine, panting, paralysis and the animal may collapse (Rajesh Singh, 2020; Sharon M, 2013).

The animal that was bitten is treated with polyvalent antivenom along with intravenous normal saline followed by dexamethasone and dextrose depending on the animal's weight and the severity of the symptoms (Rajesh Singh, 2020). A dose of tetanus toxoid should be injected. Afterward, the animal should be given an intramuscular injection of ceftiofur sodium 2 times a day for 3 days and be kept under observation (Rajesh Singh, 2020).

### *Traditional treatment and home remedies for SBE*

Traditional treatment is the combination of knowledge, practices, and skills founded on cultural beliefs, assumptions, and experiences used in providing care, diagnosis, prevention, and treatment of different diseases (WHO, 2019). In the treatment of snakebites, this has also been used on both animals and people in sub-Saharan Africa. Omara et al. (2020) in Uganda shows that the treatment of snakebites varies from culture and religion. An example is the Pentecostal Assemblies of God who believe that victims of snakebite can be cured by prayers. Other methods are also used like tying the tourniquet over the bite wound five minutes after being bitten to prevent the venom from reaching other body organs (Omara et al., 2020). Other treatment methods include the use of black stones. This treatment is done by putting a black stone on an incision that has been made on the bite wound. This stone is placed for a period of 20 to 30 minutes to draw out the venom (Omara et al., 2020). In South Africa, a remedy named isibiba is used, which is prepared using different parts of a cremated snake minced in powder form and taken as a drink. The gallbladder is the most used part of the snake for this treatment (Newman et al., 1998). In Nigeria, a combination of plants with sour milk called nono is used for snakebite treatment in humans and animals. They mostly use plants like Tunfafiya (*Calotropis procera*), Bagaruwa (*Acacia nilotica*), Kanya (*Diospyros mispiliiformis*), and many more which are given orally, topically, or by smoke/steam inhalation (Ismaila, 2012). Some countries use urine, plant leaves, a mixture of different herbs, massages, detergents, ingestion of snake bile, and oil. (Newman et al., 1998; Alcoba et al., 2020). There are many traditional treatments and home remedies for snake bites, and they vary from different countries and cultures.

## **2.7 Health-seeking behaviors in humans and livestock owners**

### *Health-seeking behaviors among humans affected by SBE.*

Health-seeking behaviors (HSB) are actions or inactions undertaken by an individual to respond to a health problem to find a suitable remedy. This decision can be taken by an individual or a household member (Olenja, 2003). Factors that influence the individual or household members decision can be cognitive (i.e: the nature of disease, symptoms), or contextual (i.e social norms and economic factors) (Olenja, 2003). Individual factors that affect the type of care sought by victims were age, education level, occupation, and socioeconomic status (Alcoba et al., 2020). The desired HSB in the case of SBE is seeking care from a trained physician for human victims and a trained veterinary for livestock (WHO, 2010). HSB that have been identified among human and animal victims are home remedies (self or family-administered traditional medicine), traditional healers, and hospital-based care. WHO estimates that 60-80% of SBE victims seek care from traditional and spiritual healers in vulnerable communities (Bawaskar & Bawaskar, 2019).

In 2020, Akolinga health district in Cameroon reported that community members used home remedies (89%), traditional healers (38%), and hospitals (47%). In this study seeking care from traditional healers was associated with increased severity in envenoming and acute complications as outcomes, while home remedies were associated with reduced severity and reduced complications (Alcoba et al., 2020). Factors associated with seeking care from traditional healers were distance to health facilities, traditional beliefs, financial reasons, and preference to use traditional healers (Alcoba et al., 2020).

Care-seeking behaviors of rural communities in Kilifi district showed that 78% sought care from traditional healers, 29% from the hospital, and 17% from a dispensary or a private clinic. The most used first aids were incisions on the bite site (48%), use of tourniquet (40%), and limb immobilization (36%) (Snow et al., 1994). Another study in Kenya discusses how the cultural beliefs of the victims influence which type of care was sought. Seventy-five percent of clinicians believed that victims sought care from traditional healers, one participant believed it was because they were easily accessible in the community, and 25% believed it was because of culture (Ochola et al., 2018). The practice of the use of traditional healers is very common in Kenya, which may explain their low antivenom uptake in other studies (Owuor & Kisangau, 2006). In Southern Africa, 243 SBE patients were admitted to Ngwelezana hospital in Kwazulu-natal, no record showed victims seeking care from traditional healers or using home remedies. (Wood et al., 2009). In a retrospective study in Zimbabwe, 273 victims were recorded. The use of first aid and other prehospital treatments were observed in 14% of the patients and 4.77 % consulted traditional healers before seeking care from the hospital (Tagwireyi, 2011).

From the literature, we acknowledge that victims prefer to consult traditional healers and rely on home remedies. The choice of seeking care from a health facility or a traditional healer or using home remedies was influenced by the distance between where they were bitten and the health facility, as well as affordability (Alcoba et al., 2020; Njoku et al., 2008). Seeking timely care from a formal sources increases chances of survival and can reduce morbidity for its victims (Habib et al., 2020).

Currently, there is no study on the health-seeking behaviors of snakebite victims in Rwanda. However, a study on Health-seeking behaviors among livestock owners affected by SBE showed that similar to humans, livestock owners may also seek care from a trained veterinarian, traditional healers, and use home remedies. In a study conducted in northwest Nigeria 90% of farmers directly or indirectly used traditional healers (M. S. Ismaila, 2012). Another study in Botswana found that (33.33%) of farmers in Kweneng district did not use any medicine or treatment when their cattle were bitten, 30.77% used modern medicine, 28.21% used traditional medicine and 7.79% used both modern and traditional medicine. The lack of use of any medication was due to the lack of knowledge or lack of money to buy medication (Setlalekgomo, 2015).

The type of care sought by the livestock owner can also be influenced by socio-economic and cultural factors, where many victims choose to seek traditional care rather than veterinary care (WHO, 2019). Additionally, the practice of zootherapeutic practices has also been observed in

some studies (Setlalekgomo, 2015). Veterinary services are unaffordable by most African farmers thus is the least used care path (M. S. Ismaila, 2012; Setlalekgomo, 2015). In Rwanda, there is no literature on the health-seeking behaviors of livestock owners affected by SBE.

## **2.8 Strategies recommended for SBE management in Sub-Saharan Africa**

In 2015, WHO published a list of recommendations for SBE management specific to Sub-Saharan Africa. The recommendations encompassed community sensitization especially for the most at risk to ensure access to treatment, support, and strengthen health systems using an integrated care approach. Additionally, a multidisciplinary approach can be adopted to ensure effective reinforcement. These strategies touch on the prevention and treatment of SBE (Chippaux et al., 2019).

The management of SBE has two important components, firstly adjuvant treatments are administered to stop the progress of venom in the body and lessen pain in the victim. Secondly, administration of antivenom in case there are no perceived side effects that would worsen the victim's state. Availability and accessibility of a safe, effective, and affordable antivenom play an important role in the management of SBE. Due to the absence of a manufacturer in sub-Saharan Africa, Antivenom is scarce, and when available it can be very expensive. WHO recommends establishing a local Antivenom manufacturer (Chippaux et al., 2019).

Integrated health services delivery is an approach to strengthening human-centered health systems through the promotion of comprehensive delivery of quality services across the life course. The design of these services is aligned with the multidimensional needs of the individual and populations, they are delivered and coordinated by a multidisciplinary team of skilled providers (WHO, 2016). Integrating care to strengthen health systems is another recommendation from WHO. This approach is cost-effective and has proven to be effective in African communities. However, this does not address other infrastructure challenges like poor roads and distance to the health facility. Thus, a reasonable alternative is to target communities that are at risk and provide treatment at the nearest health facility. This will reduce the time in seeking care, as well as decrease mortality and complications (Chippaux et al., 2019).

Coordination of resources and partnership will be necessary to sustain SBE management in SSA. Currently, some African governments are funding experiments and supporting the cost (50-90%), however appropriate measures need to be taken as the burden is too big. International organizations like the African Union can support and invest in the equipment and the manufacturing of antivenom, research, and training of health professionals. Other collaborators can be local governments, private institutions, and NGOs, especially those that employ or work with high-risk populations. This will greatly contribute to the availability and accessibility of SBE care (Chippaux et al., 2019).

## **2.9 Significance of the study**

SBE in Sub-Saharan Africa impacts human victims and owners of livestock, mentally, physically, and economically. Various studies in Cameroon, Ghana, Nigeria, and other locations,

note a high incidence of snakebite. However, the health-seeking behaviors of victims in sub-Saharan Africa are poorly understood. Available studies from Kenya, Cameroon, and Southern Africa note that most of these studies used home remedies and traditional healers as their first choice of care (Alcoba et al., 2020; Omara, 2020; Sloan et al., 2007). In Rwanda, there is only one published study on snakebite, and it explores the demographic distribution of SBE cases according to district and hospital records, the care provided to the patients, and the availability of antivenom. Studying health-seeking behaviors helps us understand how communities engage with available health systems in regard to their socio, cultural, economic, and demographic conditions. Thus, we have partnered with the University of Global Health Equity (UGHE) to assess the health-seeking behaviors of SBE from a one health perspective in the Eastern Province of Rwanda.

## **CHAPTER THREE: METHODS**

### **3.1 Setting**

This research study was conducted in Bugesera district, in the Eastern province of Rwanda. The Eastern province, the largest and most densely populated province in Rwanda, was found to have treated more SBE patients (37%) compared to other provinces i.e., Kigali City (21%), Western (18%), Southern (14%), and Northern (9%) between 2017 and 2018 (Nduwayezu et al., 2020). Bugesera district is among the least densely populated regions in Rwanda (280 inhabitants/km<sup>2</sup>). Its total population in 2020 was 437,195; 49% men and 51% women (NISR, 2012). The main economic activity in Bugesera is agriculture and it provides approximately 79% of employment in the district (Bugesera District, 2019). The majority of households in the district practice subsistence farming and 77.8% of the population depend on it (Bugesera District, 2019). Although the number of livestock in Bugesera District is unknown, 2.7% of the land is used for livestock production (NISR, 2018). Bugesera has one district hospital (Nyamata hospital), 15 health centers, and 48 health posts (Bugesera District, 2019).

### **3.2 Design**

This was a retrospective cross-sectional study assessing the health-seeking behaviors of human victims and livestock owners affected by SBE in Bugesera District in 2020, from a One Health perspective.

### **3.3 Sample**

Our sampling frame was 841 human victims bitten by snakes and livestock owners whose livestock was bitten by snakes in 2020 in Bugesera District, identified by CHWs in the main incidence study. Our goal was to include everyone who fulfilled the inclusion criteria. Through convenient sampling, participants meeting the inclusion criteria were selected from the sampling frame to participate in the study (Figure 1).

1. Inclusion criteria:

- a. Victims who reported snakebite in 2020 who consented to participate in the study.

2. Exclusion criteria:

- a. Victims with diminished mental capacity that were unable to consent and those with a disability such as hearing or/and speaking impairment who did not have an interpreter.
- b. Victims who were minors that did not have parental consent to participate.

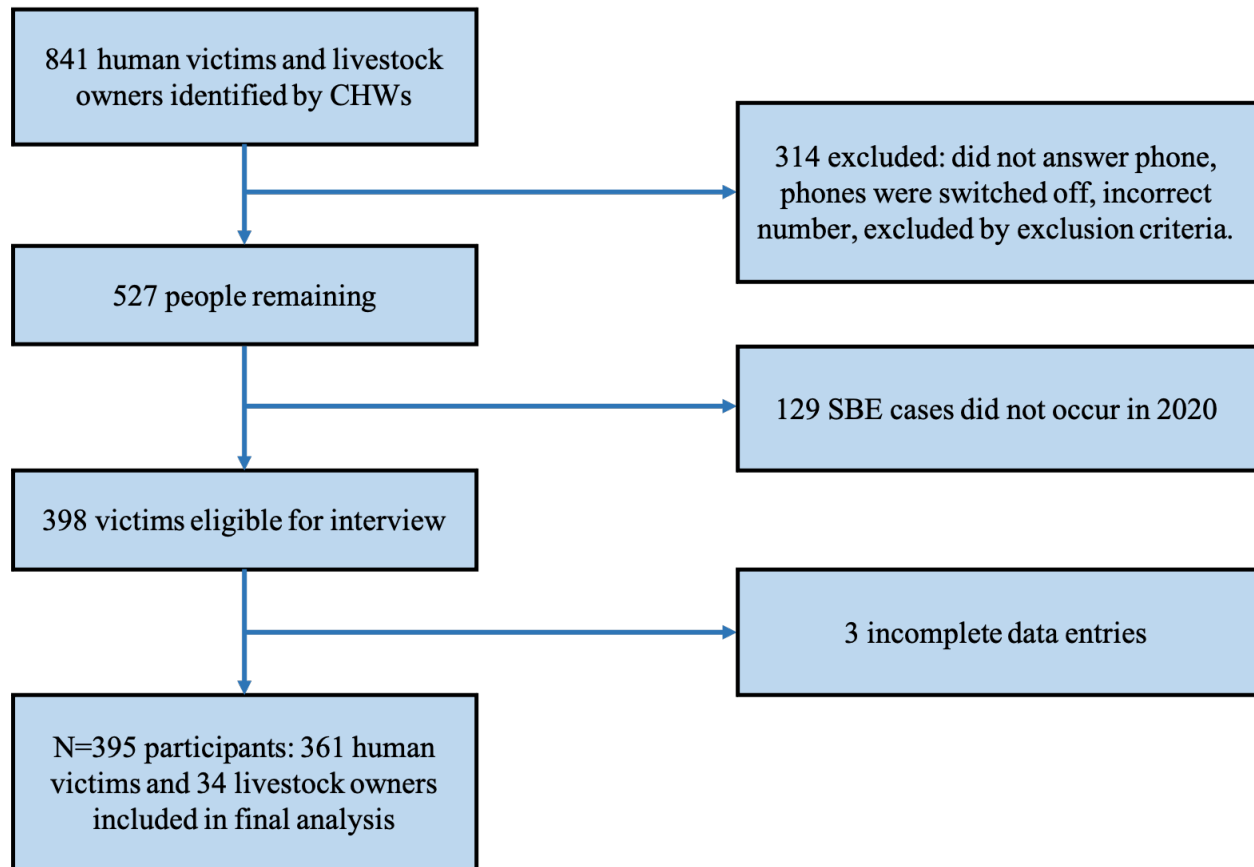


Figure 2: Flowchart depicting screening process for people who were bitten by snakes or whose livestock was bitten in 2020 in Bugesera District, Rwanda.

### 3.4 Data collection procedures

All identified victims were informed by CHWs about the study. A list of names and phone numbers of victims who agreed to participate in the study was collected from CHWs. Principal Investigators (PI) and data collectors contacted participants via mobile phone calls, and all conversations were done in Kinyarwanda. Participants were given a description of the study, assurance of respect of confidentiality, and were requested verbal consent via mobile phone. An appointment to administer the questionnaire to participants was set at a mutually agreed time. Prior to beginning data collection, participants were recommended to go into a private room to ensure privacy. Once verbal consent was given, the PI and data collectors read the questions and

answer options for the participant, and they recorded the answers on the questionnaire directly into an ArcGis survey 123. Phone calls took approximately 30-40 minutes. For participants whose phones were off or unavailable, the research team tried to reach them two-three times before excluding them from the study. For participants without mobile phones, the researchers coordinated with CHWs to use their phones to administer the survey.

### 3.5 Data collection tools

The survey tools used in this study were an adaptation of two studies from Cameroon and Sri Lanka (Alcoba et al., 2020, Ediriweera et al., 2017), conducted to assess the health-seeking behaviors of SBE victims. In our study, modifications were made to meet the context of Rwanda’s factors influencing health-seeking behaviors based on previous literature (Csete, 1993; Kagabo et al., 2018).

The questionnaire for human victims had two sections. The first section had seven demographic questions such as age, gender, and occupation. The second section had eight multiple-choice questions related to snakebite experience and the health-seeking behaviors of victims.

The questionnaire for livestock owners had two sections. The first section had six demographic questions such as the livestock owner’s age, gender, and occupation. The second section had six multiple-choice questions related to exploring snakebite experience and health-seeking behaviors of livestock owners.

The questionnaires were developed in English (Appendix 1) and translated to Kinyarwanda (Appendix 2) by the principal investigators and translated back to English to ensure content consistency and validity. The questionnaires were pretested with 10 UGHE students. Further modifications to the questionnaire were made according to the feedback from the pretest.

### 3.6 Data collectors

The data collection team consisted of two principal investigators and five data collectors, who were all fluent in Kinyarwanda. Data collectors received a 2-hour training covering the study aim, inclusion and exclusion criteria, protocol to contact participants, and data collection tools. Quality of work was ensured by reviewing their entries at the end of the day to make sure the data is coherent, and feedback was provided to them when necessary; this was done by the principal investigators.

### 3.7 Measures

#### Dependent Variables

Dependent variables that were studied:

Variable	Type	Explanation
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Health seeking behavior	Categorical – binary	This variable accounted for whether the victim sought informal or formal care as their first point of care. Formal care included seeking care from a community health worker, a health post, a health center, or a hospital. Informal care included any other type of care such as home remedies and traditional healers.
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Variable	Type	Explanation
Health seeking behavior	Categorical – binary	This variable accounted for whether the livestock owner sought informal or formal care as their first point of care. Formal care included seeking care from a veterinarian. Informal care included any other type of care such as home remedies and traditional healers.

**Independent Variables**

Independent variables that were collected in this study included:

1. For human victims, variables included:
  - a. Socio-demographic characteristics including age in 2020, sex, ubudehe category, education level, occupation, the sector where the bite occurred, and being insured. Sex and insured in 2020 were categorized as a binomial variable, while age, ubudehe, education level were ordinal variables, and occupation & sector where the bite occurred were nominal variables.
  - b. SBE experience such as the time of day that the victim was bitten, type of care chosen, reason of care chosen, bitten before 2020, the body part that was bitten, symptoms reported, first aid applied, and treatment received. Care chosen and bitten before were categorized as binary variables, while the rest of the variables were categorized as nominal variables.
  - c.
2. For livestock owners, variables included:
  - a. Social demographic characteristics including age in 2020, sex, education level, Ubudehe category, occupation, and the sector where the bite occurred. Sex was categorized as a binomial variable, while age, ubudehe, education level were ordinal variables, and occupation & sector where the bite occurred were nominal variables.

- b. SBE experience such as the time of the day that the livestock was bitten, type of care chosen, if there is livestock that was bitten before 2020, the body part that was bitten, symptoms reported, and treatment received. Care chosen and bitten before were categorized as binary variables, while the rest of the variables were categorized as nominal variables.

### **3.8 Data management**

All data were collected through ArcGIS survey 123, transferred into a Google Sheet, and uploaded into SPSS for cleaning and analysis. Data was stored in two password-protected computers of the principal investigators and was only accessible to them.

### **3.9 Data analysis**

Descriptive statistics such as measures of frequency and central tendencies were done separately for human victims and livestock owners, and summary tables were used to report findings. The fisher-Exact test was used to analyze the association between independent variables (age, gender, occupation, first aid applied, etc.) of human victims and dependent variables (Seeking care from formal or informal sources). Bivariate analysis was not done for livestock owners because variables had many empty cells (cells with 0). All statistical analyses were conducted using SPSS (version 26.0), with a statistical significance level set at 0.05.

### **3.10 Ethical considerations**

Ethical approval was obtained from UGHE IRB (Protocol number 0126) on May 8th, 2021.

#### *Vulnerable populations*

Minors, pregnant women, orphans, and people with disabilities that could provide full consent or whose parent or legal guardian could provide consent on their behalf participated in the study. Throughout the study, the research team did not witness or encounter any emotional harm from those that participated.

#### *Assessment of risks to participants*

There was a risk of distress caused by questions asked and the recollection of a traumatic event. The study team re-emphasized that participation is voluntary, and participants could drop-out of the study at any time in case of distress. The research team did not encounter any distress from participants.

#### *Medical or psychosocial support*

There was no need for medical or psychosocial support for participants in this study.

#### *Information and consent process:*

First consent to participate in this study was obtained by CHWs in the first study conducted by UGHE. The second consent was obtained by those collecting data via mobile phone. The data

collectors explained to the participants the purpose of the study, the benefits the study could bring to the community once it is accomplished, as well as confidentiality measures taken to protect study participants. The data collectors also explained to the participants that there was no risk of harm associated with participating in this study and that they could withdraw at any time. Participants were then asked if they were willing to participate in the study verbally, and then the interview would start. The study consisted of a survey that was administered by the data collectors, which was in Kinyarwanda to help study participants who did not speak English.

#### *Protection of privacy and confidentiality*

Data was collected anonymously and filled questionnaires were in ArcGIS survey 123 that only the primary investigators had access to, to avoid the disclosure of any information. The data collection tool did not bear any identification of the participants. Data was kept on a personal computer in an Excel file, locked by a password, and will be destroyed after ten years per UGHE IRB regulations. The filled data collection tool will also be kept in a password-protected Excel file for ten years.

#### *De-identification of data*

Participant names were replaced by IDs and were not used during the analysis and final report. Results were analyzed and disseminated as aggregates to prevent the identification of individual victims.

#### *Safekeeping of data*

Data collected was stored on two password-protected laptops that can only be accessed by researchers. Data will be kept at UGHE and will be destroyed after 10 years as required by IRB regulations.

## CHAPTER FOUR: RESULTS

### Study participants

A total of 841 SBE victims were identified in Bugesera District. Of these, 398 (47.3%) SBE victims were invited to participate, and they all consented (100% participation rate). However, 3 participants were excluded from data analysis due to the provision of incomplete data. Participants were predominantly female (68.9%; Table 2) and mostly aged above 20 years (68.7%). Most participants were farmers (61.9%), belonged in Ubudehe category 2 (44.8%), and had only completed primary school education (57.7%). Ngeruka and Ruhuha cells recorded the most snake bites both for human victims (51.1%) and livestock (26.6%). Additionally, 78.1% of human victims were not insured in 2020. Livestock owners were not asked about having livestock insurance. Six livestock owners reported that their livestock died after being bitten, and one human victim was also reported dead after being bitten.

*Table 1: Demographic summary of study participants who were bitten or had livestock bitten by a snake in 2020 in Bugesera District of Rwanda (N=395)*

Variables	Number (%)		
	Human victims (n=361)	Livestock owners (n=34)	Total (N=395)
<b>Age<sup>1</sup></b>			
Children	62 (17.2)	0(0)	<b>62 (15.7)</b>
Adolescents	63 (17.5)	0 (0)	<b>63 (15.9)</b>
Adults	234 (64.8)	34 (100)	<b>268 (67.8)</b>
Missing	2 (0.6)	0 (0)	<b>2 (0.5)</b>
<b>Gender</b>			
Male	148 (41)	20 (58.8)	<b>189 (47.8)</b>
Female	213 (59)	14 (41.2)	<b>272 (68.9)</b>
<b>Education Level</b>			
None	128 (35.5)	10(29.4)	<b>138 (34.9)</b>
Primary	207 (57.3)	20 (58.8)	<b>227 (57.5)</b>
Secondary or University	25 (6.9)	4 (11.8)	<b>29 (7.3)</b>
Missing	1 (0.3)	0 (0)	<b>1 (0.3)</b>

<b>Occupation</b>			
Unemployed	136 (37.7)	2(5.9)	<b>138 (34.9)</b>
Farmer/cultivator	216 (59.8)	28 (82.4)	<b>244 (61.8)</b>
Other <sup>2</sup>	8 (2.2)	4 (11.8)	<b>12 (3.0)</b>
Missing	1 (0.3)	0 (0)	<b>1 (0.3)</b>
<b>Ubudehe</b>			
Category 1	72 (19.9)	2 (5.9)	<b>74 (18.7)</b>
Category 2	157 (43.5)	20 (58.8)	<b>177 (44.8)</b>
Category 3	132 (36.6)	12 (35.3)	<b>144 (36.5)</b>
<b>Sector</b>			
Gihembe	1 (0.3)	0 (0)	<b>1 (0.3)</b>
Kamabuye	66 (18.2)	9 (26.4)	<b>75 (19.0)</b>
Mareba	1 (0.3)	0 (0)	<b>1 (0.3)</b>
Ngeruka	186 (51.5)	16(47.1)	<b>202 (51.1)</b>
Ruhuha	105 (29.1)	9 (26.5)	<b>105 (26.6)</b>
Missing	2 (0.6)	0 (0)	<b>2 (0.5)</b>
<b>Human health insurance in 2020</b>			
Yes	308 (85.3)	NA <sup>3</sup>	<b>308 (85.3)</b>
No	53 (14.7)	NA	<b>53 (14.6)</b>

<sup>1</sup>Children: less or equal to 12 years of age, Adolescent: age between 13 - 19 years, and adults: older than 19 years

<sup>2</sup> Nightguards, a tailor, and a teacher

<sup>3</sup> NA: Not applicable

Snakebites in both humans and livestock predominantly occurred between 6 pm and 6 am (73.6%; Table 2). Ninety-four percent of victims (human and livestock owners) reported seeking care from informal providers, such as traditional healers. The type of care sought by human victims was influenced by family members' trust in the provider (44.6%) and the distance to be covered (27.7%).

Human victims were mostly bitten on the foot (48.5%) while livestock on the leg (67.6%). No mild symptoms were reported by livestock owners, while 8.5% of human reported experienced swelling at the bite site, pain, and bleeding at the same time. while there were none reported by livestock owners. Only human victims reported simultaneously experiencing severe symptoms (severe pain, swelling of the entire limb, difficulty breathing, and severe bleeding) (7.4%). The median number of reported signs/symptoms for human victims is 6 (10), while for livestock owners the median is 2 in a range of 5 symptoms/signs. Commonly used first aid methods in human victims were consuming herbal traditional drinks (49.9%) and tying a tourniquet around the bite site (48.2%) before seeking care. Livestock owners were not asked about first-aid practices.

**Table 2: Summary of snakebite experience and the type of care sought by snakebite victims in 2020 in Bugesera District of Rwanda**

Variables	Number %		
	Human victims (n=361)	Livestock owners (n=34)	Total (N= 395)
<b>Time of the day the bite occurred<sup>1</sup></b>			
Day	93 (25.8)	10 (29.4)	<b>103 (26.1)</b>
Night	266 (73.7)	24 (70.6)	<b>290 (73.4)</b>
I do not know	1 (0.3)	0 (0)	<b>1 (0.3)</b>
Missing	1 (0.3)	0 (0)	<b>1 (0.3)</b>
<b>Care chosen<sup>2</sup></b>			
Formal Care	20 (5.5)	1 (3.6)	<b>21 (5.4)</b>
Informal Care	341 (94.5)	27 (96.4)	<b>368 (96.1)</b>
<b>Reason of care chosen</b>			
Proximity	60 (16.6)	NA	<b>60 (16.6)</b>
Trust	161 (44.6)	NA	<b>161 (44.6)</b>
Cost	40 (11.1)	NA	<b>40 (11.1)</b>
Others <sup>3</sup>	100 (27.7)	NA	<b>100 (27.7)</b>
<b>Bitten before 2020</b>			
Yes	31 (8.6)	6 (17.6)	<b>37 (9.4)</b>
No	330 (91.4)	27 (79.4)	<b>357 (90.4)</b>

<b>Body part that was bitten</b>			
Hand/Arm	61 (16.9)	NA	<b>61 (15.4)</b>
Torso	0 (0)	4 (11.8)	<b>4 (1.0)</b>
Foot/Hoof	175 (48.5)	2 (5.9)	<b>177 (44.8)</b>
Leg	116 (32.1)	23 (67.6)	<b>139 (35.2)</b>
Head/Neck/Face	7 (1.9)	6 (17.6)	<b>13 (3.3)</b>
Other areas <sup>4</sup>	10 (2.8)	2 (5.9)	<b>12 (3.0)</b>
<b>Symptoms/Signs reported by victims/livestock owners</b>			
No symptoms/signs	1 (0.3)	0 (0)	<b>1 (0.3)</b>
Pain	258 (71.5)	0 (0)	<b>258 (65.3)</b>
Swelling	316 (87.5)	20 (58.8)	<b>336 (85.1)</b>
Bleeding where bitten	43 (11.9)	5 (14.7)	<b>48 (12.2)</b>
Difficulty breathing	217 (60.1)	6 (17.6)	<b>223 (56.5)</b>
Sweating	154 (42.7)	1 (2.9)	<b>155 (39.2)</b>
Lethargy	252 (69.8)	13 (38.2)	<b>265 (67.1)</b>
Staggering/trembling	NA	9 (26.5)	<b>9 (26.5)</b>
Unable to stand	NA	14 (41.2)	<b>14 (41.2)</b>
Nausea or vomiting	265 (73.4)	0 (0)	<b>265 (67.1)</b>
Loss of appetite	NA	9 (26.5)	<b>9 (26.5)</b>
Dizziness	155 (42.9)	0 (0)	<b>155 (39.2)</b>
Numbness	138 (38.2)	0 (0)	<b>138 (34.9)</b>
Paralysis	51 (14.1)	2 (5.9)	<b>53 (13.4)</b>
Loss of consciousness	61 (16.9)	2 (5.9)	<b>63 (15.9)</b>
Blindness	9 (2.5)	0 (0)	<b>9 (2.3)</b>
Reduced milk production	NA	1 (2.9)	<b>1 (2.9)</b>
Other	15 (4.2)	12 (35.3)	<b>27 (6.8)</b>

<b>First Aid applied</b>			
Tourniquet	174 (48.2)	NA	<b>174 (48.2)</b>
Burning	42 (11.6)	NA	<b>42 (11.6)</b>
Cutting	10 (2.8)	NA	<b>10 (2.8)</b>
Sucking out venom	8 (2.2)	NA	<b>8 (2.2)</b>
Herbal drinks	180 (49.9)	NA	<b>180 (49.9)</b>
Herbal ointments/salves	69 (19.1)	NA	<b>69 (19.1)</b>
Black stone	13 (3.6)	NA	<b>13 (3.6)</b>
Other <sup>5</sup>	20 (5.5)	NA	<b>20 (5.5)</b>

<sup>1</sup>Day (6 PM-6 AM) and Night (6 AM – 6 PM)

<sup>2</sup>Formal care includes any level of the health system in Rwanda such as CHW, a health post, a health center, or a hospital, and Informal care includes any type of care including traditional healers, self-treatment, and others

<sup>3</sup>Victims who were unconscious when taken to the provider or those that were referred by neighbors

<sup>4</sup>Victims that reported being bitten in the back or genitals

<sup>5</sup>Victims that reported using cow dung, snakes body parts, or urine

### **Association between care-seeking behavior and social demographic factors and snakebite experience**

There was a statistically significant association between health insurance status and the type of care sought ( $p=0.017$ ; Table 4). Being bitten before 2020 was also significantly associated with the type of care sought ( $p=0.021$ ).

***Table 3: Bivariate comparison of care-seeking behavior versus demographic factors and snakebite experience among SBE human victims in Bugesera District in 2020***

Variables	Number (%)			Fisher exact test P-value
	Formal care (n=20)	Informal care (n=341)	Total (N=361)	

<b>Age</b>				
Children	3 (15)	59 (17.4)	62 (17.3)	
Adolescents	7 (35)	56 (16.5)	63 (17.5)	<b>0.13</b>
Adults	10 (50)	224 (66.1)	234 (65.2)	
<b>Gender</b>				
Male	8 (40.0)	140 (41.1)	148 (41.0)	<b>&gt;0.99</b>
Female	12 (60.0)	201 (58.9)	213 (59.0)	
<b>Education Level</b>				
None	7 (35.0)	121 (35.5)	128 (35.5)	<b>0.80</b>
Primary	11 (55.0)	196 (57.5)	207 (57.3)	
Secondary or University	2 (10.0)	23 (6.7)	25 (6.9)	
<b>Ubudehe</b>				
Category 1	5 (25)	67 (19.6)	72 (19.9)	<b>0.07</b>
Category 2	4 (20)	153 (44.9)	157 (43.5)	
Category 3	11 (55)	121 (35.5)	132 (36.6)	
<b>Health insurance in 2020</b>				
Yes	13 (65.0)	295 (86.5)	308 (85.3)	<b>0.017*</b>
No	7 (35.0)	46 (13.5)	53 (14.7)	
<b>Time of the day when the bite occurred</b>				
Day	6 (30.0)	87 (25.5)	93 (25.9)	
Night	14 (70.0)	252 (74.3)	266 (74.1)	<b>0.61</b>
<b>Reason for care chosen</b>				
Proximity	6 (30)	54 (15.8)	60 (16.6)	
Trust	8 (40.0)	153 (44.9)	161 (44.6)	<b>0.24</b>
Cost	3 (15)	37 (10.9)	40 (11.1)	
Other	3 (15.0)	97 (28.4)	100 (27.7)	

<b>Bitten before 2020</b>				
Yes	5 (25.0)	26 (7.6)	31 (8.6)	<b>0.02*</b>
No	15 (75.0)	315 (92.4)	330 (91.4)	
<b>Symptoms reported by victims after snakebite</b>				
<b>Pain</b>				
Yes	15 (75.0)	243 (71.3)	258 (71.5)	<b>0.80</b>
No	5 (25.0)	98 (28.7)	103 (28.5)	
<b>Swelling</b>				
Yes	18 (90.0)	298 (87.4)	316 (87.5)	<b>&gt;0.99</b>
No	2 (10.0)	43 (12.6)	45 (12.5)	
<b>Paralysis</b>				
Yes	3 (15.0)	48 (14.1)	51 (14.1)	<b>&gt;0.99</b>
No	17 (85.0)	293 (85.9)	310 (85.9)	
<b>Nausea or/and vomiting</b>				
Yes	15 (75.0)	250 (73.3)	265 (73.4)	<b>&gt;0.99</b>
No	5 (25.0)	91 (26.7)	96 (26.6)	
<b>Loss of consciousness</b>				
Yes	6 (30.0)	55 (16.1)	61 (16.9)	<b>0.12</b>
No	14 (70.0)	286 (83.9)	300 (83.1)	
<b>Blindness</b>				
Yes	0 (0)	9 (2.6)	9 (2.5)	<b>&gt;0.99</b>
No	20 (100)	332 (97.4)	352 (97.5)	

All livestock owners were adults (Table 5). Only one livestock owner sought formal care. He finished primary school and works as a farmer. He is in Ubudehe 2 and resides in Ngeruka sector. His livestock was bitten between 6 pm-6 am, and the purpose of the livestock was to generate him income. Additionally, he reported having livestock bitten in previous years.

Most men (94%) and all women sought informal care. The majority of respondents reported having completed primary school (57.1%) and 28.5% reported having no education. Most of our respondents were farmers and/or cultivators (75%). Many of the respondents belonged to Ubudehe 2 (60.7%) and Ubudehe 3 (32.1%). Their livestock were mostly bitten during the night (60.7%), in Ngeruka (42.8%) and Ruhuha (28.5%). The majority also reported no history of livestock being bitten before 2020 (71.4%). Most owners reported owning livestock for income generation (82.1%).

**Table 4: Summary of the distribution of care-seeking behavior versus social demographic factors, snakebite experience, and factors influencing the type of care sought among livestock owners whose livestock was bitten in Bugesera District in 2020**

Variables	Number %		Total (N=28)
	Formal care (n=1)	Informal care <sup>1</sup> (n=27)	
<b>Age</b>			
Adults	1 (100)	27 (100)	28 (100)
<b>Gender</b>			
Male	1 (100)	17 (63)	18 (64.3)
Female	0 (0)	10 (37)	10 (35.7)
<b>Education Level</b>			
None	0 (0)	8 (29.6)	8 (28.6)
Primary	1 (100)	16 (59.3)	17 (60.7)
Secondary and University	0 (0)	3 (11.1)	3 (10.7)
<b>Occupation</b>			
Unemployed	0 (0)	2 (7.4)	2 (7.1)
Farmer/cultivator	1 (100)	21 (77.8)	22 (78.6)
Other	0 (0)	4 (14.8)	4 (14.3)

<b>Ubudehe</b>			
Category 1	0 (0)	1 (3.7)	1 (3.6)
Category 2	0 (0)	17 (63)	17 (60.7)
Category 3	1 (100)	9 (33.3)	10 (35.7)
<b>Sector</b>			
Kamabuye	0 (0)	7 (25.9)	7 (25)
Ngeruka	1 (100)	12 (44.4)	13(46.4)
Ruhuha	0 (0)	8 (29.6)	8 (28.6)
<b>Time of the day when the bite occurred</b>			
Day	0 (0)	10 (37)	10 (35.7)
Night	1 (100)	17 (63)	18 (64.3)
<b>Livestock bitten before 2020</b>			
Yes	0 (0)	6 (22.2)	6 (21.4)
No	1 (100)	20 (74.1)	20 (74.1)
<b>Purpose of livestock</b>			
Money	1 (100)	23 (85.2)	24 (85.7)
Other	0 (0)	4 (14.8)	4 (14.3)

<sup>1</sup>This number excludes 5 livestock owners whose livestock died before they sought care.

Among those that sought formal care, painkillers (47.6%) and anti-swelling (42.9%) medication were the most prescribed treatment. For those that sought informal care, traditional medicine (71.7%) and the use of tourniquet (10.1%) were the most practiced. Overall, traditional medicine was the most reported treatment (67.9%), followed by tourniquet (10.3%), suction of venom (6.4%), and black stone (6.2%). The least reported treatment was antivenom (1.5%).

**Table 5: Summary of snakebite treatment provided to human victims and livestock owners in Bugesera District in 2020.**











## CHAPTER FIVE: DISCUSSION

Although the epidemiology and burden of SBE are unknown, it continues to be an alarming public health issue that is devastating for people in Sub-Saharan Africa where it increases mortality and morbidity in the region (Halilu et al., 2019). WHO's goal is to reduce mortality due to SBE by 50% by 2030 and one of the critical actions needed to reach this goal is to build awareness in affected communities on best/recommended practices in preventing and seeking care after a snakebite incident (WHO, 2021a). On a national level, Rwanda's objective is to reduce morbidity and mortality associated with SBE by 50% by 2024 (RBC, 2021). This study provides an in-depth assessment of care-seeking behaviors after snakebite occurs in Bugesera District, Rwanda. It revealed that informal care is sought more often than formal care. The form of care chosen among human victims was influenced by how near the provider was from where they were bitten, the trust they had in the provider and the perceived cost of treatment. For livestock owners, similarly to human victims, they sought informal care more than formal care. Five livestock owners reported that their livestock died before seeking care, and most owners reported owning livestock for the purpose of generating income. These findings, therefore, help to understand the care sought in rural communities of Rwanda and why they were chosen, and highlight a crucial need to develop tailored interventions that promote WHO recommended care-seeking behaviors within various communities across the country.

In terms of First Aid, almost half of the human victims reported using both tourniquets and gorging herbal drinks before they sought care. Other practices stated were burning of the wound, cutting the bite site, and the use of black stone. The use of tourniquet in our study was 48.2% while other studies reported higher usage in Zimbabwe (63.2%) and Tanzania (63.1%), however, lower usage was reported in Nigeria (24.1%) and a qualitative study in Kenya also stated it being reported from participants (Ibrahim, 2020; Tagwireyi et al., 2011; van Oirschot et al., 2021). The implications of these contradictions might be that some communities have knowledge of or experienced the dangers of using tourniquets more than others. While studies have challenged the use of tourniquet after snake bite as a means to reduce the severity (Amaral et al., 1998; De, 2000; Grenard, 2000), it is a norm in many developing countries. It is recommended to use a light version of a tourniquet (pressure pad) in case of a neurotoxic elapid bite only, since in other cases it may cause pain, swelling, and congestion from locale envenomation (WHO, 2016). Although not reported in this study, the use of tourniquets has been associated with the need for large quantities of antivenom, and sometimes death (Michael et al., 2011; Parker-Cote & Meggs, 2018). The use of traditional herbal drinks or ointment was also reported to be associated with increased risk of death or morbidity, delay in seeking formal care, increase in the cost of care, and wound infection (Michael et al., 2011). Additionally, the use of black stone has shown no efficacy in the treatment of snakebite (Chippaux et al., 2007). None of the First Aid treatments reported were the ones recommended by WHO including removal of anything tight from the bite

site, immobilizing the victim completely, avoiding tourniquets and use of traditional first aid methods, and putting the victim in the recovery position in case of vomiting (WHO, 2016).

Human victims and livestock owners generally sought some form of care after snakebite. Ninety-four percent of victims sought care from informal sources, while 5.4% sought care from formal sources. These findings are similar to estimates reported by WHO that in Sub Saharan Africa 60-80% of victims seek informal care after a snakebite (Bawaskar & Bawaskar, 2019). Informal care was also sought more than formal care in a study in Nigeria (92.9% versus 7.1%) (Igawe et al., 2020). In contrast, Cameroon, South Africa, and Kenya reported lower numbers of people that sought informal care, 38%; 50%, and 68% respectively (Alcoba et al., 2020; RW et al., 1994; Sloan et al., 2007). This difference may be due to high community awareness in identifying severe cases and seeking appropriate care. Additionally, the sampling of participants in these studies used hospital records of patients to identify victims that sought informal care before going to formal institutions for further treatment or complications caused by informal treatment (Alcoba et al., 2020; Snow et al., 1994; Sloan et al., 2007). Livestock owners in this study also sought care from informal sources than formal sources; this was also reported in Fulani communities in Nigeria (M. S. Ismaila, 2012). In the aforementioned study among Fulani communities, the use of informal care was due to the poor knowledge in the community on the recommended providers for effective treatment of snakebite. Implications of seeking informal care can be devastating to individuals, families, and communities for a community like Bugesera District that is dependent of agriculture, while snakebites are prominent among farmers; this can lead to food shortages and poor nutrition in the area. On the national level, seeking care from informal care is an obstacle to the epidemiological surveillance of morbidity and mortality associated with snakebite (WHO, 2016), which blinds stakeholders on the magnitude of the issue and the outcome of care received. At an individual and family level, seeking formal care contributes to delay in seeking appropriate care, it can cause infection on the wound from use of treatments such as black stone and it can lead to loss of livestock (Chippaux et al., 2007; WHO, 2016).

Among those that sought formal care, trust (40%) in the provider was the most reported reason, followed by proximity (30%) and perceived cost (15%). Similarly, among those that sought informal care, trust (44.6%) in the provider was the most reported reason, followed by proximity (16.6%) and cost (11.1%). A study in Nigeria, reported similar reasons, however, at different percentages; trust in the effectiveness of the treatment (33.2%), perceived cost (20.9%), and proximity (11.8%). Trust in the provider can be influenced by norms present in the community or experience from snakebite in the past by the individual, a family member, or an acquaintance (Alcoba et al., 2020; Omara, 2020). Proximity is an important service characteristic that can influence care-seeking behavior (Ibrahim, 2020). It can be influenced by lack of transportation, cost of transportation, and perceived severity (van Oirschot et al., 2021). Perceived cost is a challenge worth noting since 45% of our victims are from Ubudehe 2, a category of people who can afford some form of accommodation but do not have full employment and can only afford to

eat twice or less a day 1 (Ezeanya-Esiobu, 2017). Ubudehe 1 is a category for very poor citizens who are considered homeless and cannot financially afford food, and 18.7% of our participants are from Ubudehe 1 (Ezeanya-Esiobu, 2017). Issues of affordability have been addressed by the government of Rwanda through community-based health insurance, which also covers the full or partial cost of treatment depending on your Ubudehe category. Category 1 is fully covered, while categories 2 and 3 pay a minimal percentage (PM Office, 2019).

Insurance status was significantly associated with the type of care sought. More than 80% of our human victims reported being insured in 2020. However, only 4.2% sought care from formal sources. Community-based health insurance is an insurance scheme developed by the Rwandan government to help all Rwandans access medical services at an affordable cost (RSSB, 2020). Victims being insured and not seeking care from formal institutions might be due to a belief in the population that formal providers are not equipped with the knowledge and skills to treat snakebite compared to traditional healers. Lack of awareness and distrust of the capabilities of healthcare providers have been associated with decreased healthcare seeking behavior, regardless of insurance status (Schurer et al, unpublished data, 2021). Low levels of seeking formal care might also be due to perceived additional costs such as transportation to the clinic, hospitalization, and treatment fees since insurance schemes do not cover 100% of the treatment fees. Although livestock owners were not asked about their insurance status, since 2019, the Rwandan Ministry of Agriculture set a partnership with insurance companies such as Radiant and UAP, to insure livestock owners in case of accidents, diseases of a terminal nature, emergency slaughter advised by a vet and epidemics (AFR, 2018; Ntirenganya, 2019). This insurance is voluntary and although its uptake is unknown in Rwanda, other countries that have similar schemes have shown low uptake (Mahul & Stutley, 2010). Though snakebite is not specifically highlighted in the terms of the insurance, it may apply in terms of recommended emergency slaughter by the vet.

The recommended treatment reported from formal institutions was mostly composed of painkillers (47.6%), anti-swelling medication (42.9%), and antivenom (28.6%), however, other treatments such as the use of tourniquet & black stone that are not recommended were also reported by participants. Moderate to low adherence to recommended treatment was also reported in a study done in 2018 assessing physician adherence to national treatment guidelines in hospitals in Rwanda (Nduwayezu et al., 2021). Other studies in Cameroon, Nigeria, and South Africa did not report the use of tourniquet in formal settings, however, reported a moderate to low level of adherence to recommended treatment (Alcoba et al., 2020; Ibrahim, 2020; Sloan et al., 2007). Lack of compliance from formal institutions may be due to the low level of knowledge among practitioners, low severity of envenomation, or supply shortages of treatment. Treatment from informal sources was mostly composed of traditional medicine (71.7%), tourniquet (10.1%), suction of venom (6.4%) from the wound, and use of black stone (6.2%). Similar practices in informal sources have been reported in rural communities in Kenya and South Africa (Newman et al., 2016; Omara et al., 2021; van Oirschot et al., 2021).

## **Challenges and Limitations**

This study only assessed the health seeking behaviors of snakebite victims in Bugesera District. Hence, the results might not be generalizable to other districts in the Eastern province. Despite this limitation, the study provides insights into the health seeking behaviors of rural communities in Rwanda which might be reflective of similar communities across the country; information that was previously not known. Additionally, the findings of this study are still important as they could guide future interventions within this community.

Another limitation of this study is recall bias as participants were asked to recall events from the past year. To mitigate this, probing questions such as month and year the bite occurred were used to make sure victims were certainly bitten in 2020 and to prompt victims to recollect the memory. Additionally, snakebite is a traumatic experience and is, therefore, easily memorable (Alcoba et al., 2020; WHO, 2016).

A third limitation is response bias, as participants knowing that the study was being conducted to assess their care seeking behavior may have altered how they answered questions to adhere to answers that might be deemed socially acceptable. This was mitigated by emphasizing that there were no wrong or right answers, that participants' responses are anonymous, that results will be aggregated to ensure that participants' individual responses cannot be identified.

The project also faced some challenges. The study had aimed to identify health-seeking behaviors of snakebite victims in the Eastern Province of Rwanda. Ultimately, we only assessed the health-seeking behaviors of victims in Bugesera District. This was due to an inter-district lockdown that made it difficult for principal investigators to obtain data back from CHWs who were collecting information on identifying victims in the six remaining districts of the Eastern Province of Rwanda. Additionally, the number of victims was higher than anticipated. However, this study is still ongoing, and all districts will be assessed once restrictions ease up.

Another challenge encountered in this study was that some participants did not have mobile phones at the time of interviews. To ensure that this was not a barrier to participation, we coordinated with CHWs of the village to use their phones for the interview. In case the CHW had competing priorities, we would ask them to connect us with a neighbor of the victim that has a phone and can lend it to our participant.

## **CHAPTER SIX: CONCLUSION AND RECOMMENDATION**

Snakebite has proven to be a devastating experience for human victims and livestock owners in Rwanda. It mostly affects adults and those that practice farming, which are the wheels that the economy of Rwanda needs to grow and develop. Victims reported the use of dangerous first aid practices such as tourniquets and herbal ointments/drinks, which can lead to severe envenoming or acute complications. At the national level, these practices may hinder Rwanda's goal to

transform its agricultural sector, from subsistence farming to commercialized farming and increase food security, due to a great number of adults practicing farming affected by snakebite seeking informal care. These practices can also hinder children, adolescents, and young adults' education due to missing school, which also affect the government's plans on education for all. Additionally, cost of care, loss of workdays, and loss of livestock may contribute to an endless cycle of poverty within the Bugesera District community and affect the efforts being made by the government to alleviate the community from poverty such as one cow per family initiative. Adequate measures need to be taken to achieve reduced SBE mortality and morbidity by 2024, and proper management of snakebite needs to be available in affected communities.

## **Recommendations**

We recommend community awareness campaigns around recommended first-aid practices and paths to seek care for snakebite in Rwanda. This intervention can be targeted to all members of the community, most especially farmers and parents in Bugesera District as most of the victims worked as farmers and the most affected age group was adults (adults can also share the knowledge with adolescents and children in their households). These community engagement programs could cover important information such as how to avoid snakebite, how to create an environment inside and around their homes that is not favorable for snakes, recommended first aid practices in case of snakebite, and where to seek care. Prevention resources from international snakebite awareness day and Health Action International can be used as training or reference material for the awareness programs (HAI, n.d.).

We would also recommend Rwanda Biomedical Centre to collaborate with medical schools for currently enrolled students and healthcare systems in place in Bugesera District, to be trained on first aid and recommended treatment for snakebite so that they can be better equipped to tend to victims that come to seek care.

In this study, trust in the treatment provider as well as cost of treatment was brought up as a reason influencing care seeking behaviors. Since CHWs work within their communities and are trusted members of their community, we recommend for RBC to train CHWs on first aid and recommended treatment for snakebite. This would help meet the country's plan to increase capacity building for health care providers on case management for SBE, as reflected in Rwanda's current NTD strategic plan (2019-2024).

Additionally, we would also recommend RBC that through the Rwandan government's collaboration with AGA Network Rwanda (Abavuzi Gakondo Rwanda Network) which translates to traditional healers Rwanda network, to engage traditional healers in Bugesera District on SBE treatment. This could be done by training them on recommended first-aid practices. Moreover, the traditional healers could be linked to health centers to create a referral system for snakebite victims and ensure that they practice recommended treatment guidelines

under the supervision of staff within the health centers. Snakebite victims that seek care from traditional healers would be provided with the right first aid when they reach out to traditional healers and be directed to the nearest health facility for treatment.

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## APPENDICES

### APPENDIX 1: ENGLISH DATA COLLECTION TOOLS

#### Snakebite envenomation in Rwanda: A One Health assessment of care-seeking behaviors of snakebite victims in Bugesera District.

{Thank you for agreeing to participate in our study. My name is \_\_\_\_\_ and I am a researcher working with the University of Global Health Equity in Rwanda. Our research team is interested in learning how livestock owners care for animals bitten by snakes in Eastern Province. This information will help us to advise the government on how to support animal owners. If you agree to participate, we anticipate that the survey will take approximately 10 minutes to complete.}

\*If the participant is willing, take them through informed consent.

Date of interview: \_\_\_\_\_

District: \_\_\_\_\_

Sector: \_\_\_\_\_

Cell: \_\_\_\_\_

Village: \_\_\_\_\_

<b>Demographics</b>	
1) What was your age when your livestock got bitten?	_____ years
2) What is your sex?	<input type="radio"/> Female <input type="radio"/> Male <input type="radio"/> Prefer not to say
3) What is the highest education degree that you have obtained? (Check one)	<input type="radio"/> None <input type="radio"/> Primary <input type="radio"/> Secondary <input type="radio"/> Bachelors <input type="radio"/> Other, please specify: _____

<p>4) What is your primary occupation? (Check one)</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Unemployed</li> <li><input type="radio"/> Homemaker</li> <li><input type="radio"/> Farmer and/or cultivator</li> <li><input type="radio"/> Shopkeeper</li> <li><input type="radio"/> Teacher</li> <li><input type="radio"/> Other: _____</li> </ul>
<p>5) What is your ubudehe category? (Check one)</p>	<ul style="list-style-type: none"> <li><input type="radio"/> 1</li> <li><input type="radio"/> 2</li> <li><input type="radio"/> 3</li> <li><input type="radio"/> 4</li> </ul>
<p>6) What animals did your household own in 2020? How many of each animal did you own? (Check all that apply)</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Goat: _____</li> <li><input type="radio"/> Chicken: _____</li> <li><input type="radio"/> Cattle: _____</li> <li><input type="radio"/> Pig: _____</li> <li><input type="radio"/> Other: _____</li> </ul>
<p>7) For what purpose(s) does your house own animals? (Check all that apply)</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Income generation</li> <li><input type="radio"/> Food</li> <li><input type="radio"/> Leisure</li> <li><input type="radio"/> Other: _____</li> </ul>
<p>8) How many animal(s) were bitten by snakes in 2020?<sup>1</sup> What type of animal?</p>	<p># Animals: _____ Species: _____</p>
<p>9) In which cell did the snakebite occur?</p>	<p>Cell: _____</p>
<p>10) How did you know the animal was bitten by a snake?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> A person witnessed the event</li> <li><input type="radio"/> Fang marks were visible</li> <li><input type="radio"/> Veterinary diagnosis</li> <li><input type="radio"/> Other: _____</li> </ul>
<p>11) Did anyone identify the snake? If yes, please name/describe the snake.</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yes: _____</li> <li><input type="radio"/> No</li> </ul>

<p>12) Where was the animal when it was bitten? (Check one)</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Inside the house</li> <li><input type="radio"/> Inside animal shed/cage</li> <li><input type="radio"/> In the compound (yard)</li> <li><input type="radio"/> Grazing in a field or roadside</li> <li><input type="radio"/> Being transported</li> <li><input type="radio"/> At the market</li> <li><input type="radio"/> Other: _____</li> </ul>
<p>13) Did the snakebite occur during the day or night? (Day: 6 am-6 pm; night: 6 pm-6 am)</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Day</li> <li><input type="radio"/> Night</li> <li><input type="radio"/> I don't know</li> </ul>
<p>14) What part of the animal was bitten? (Check all that apply)</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Hoof/foot</li> <li><input type="radio"/> Leg</li> <li><input type="radio"/> Torso</li> <li><input type="radio"/> Tail</li> <li><input type="radio"/> Head/face/neck</li> <li><input type="radio"/> Other: _____</li> </ul>
<p>15) What signs did the animal display? (Check all that apply)</p>	<ul style="list-style-type: none"> <li><input type="radio"/> No signs, the animal appeared fine</li> <li><input type="radio"/> Uncontrolled bleeding at the bite site</li> <li><input type="radio"/> Swelling</li> <li><input type="radio"/> Difficulty breathing</li> <li><input type="radio"/> Sweating (if applicable)</li> <li><input type="radio"/> Staggering/trembling</li> <li><input type="radio"/> Unable to stand</li> <li><input type="radio"/> Lethargy</li> <li><input type="radio"/> Loss of appetite</li> <li><input type="radio"/> Paralysis (full/partial)</li> <li><input type="radio"/> Loss of consciousness</li> <li><input type="radio"/> Reduced/loss of milk production (if applicable)</li> <li><input type="radio"/> Abortion (if applicable)</li> <li><input type="radio"/> Other: _____</li> </ul>
<p>16) How did you care for the animal? (Check all that apply)</p>	<ul style="list-style-type: none"> <li><input type="radio"/> No treatment</li> <li><input type="radio"/> Owner treated animal</li> <li><input type="radio"/> Traditional healer</li> <li><input type="radio"/> Veterinarian</li> <li><input type="radio"/> Slaughter/Euthanasia</li> <li><input type="radio"/> Other: _____</li> </ul>

17) If owner treated animal, what did they do?

- Tourniquet
- Burning
- Cutting
- Sucking out venom
- Herbal drinks
- Herbal ointments/salves
- Pain relief
- Anti-swelling
- Antivenom
- Black stone
- Other: \_\_\_\_\_

18) If owner sought care from a traditional healer:

(a) What treatment was provided?

(b) What was the time interval between calling the traditional heal and obtaining treatment?

(c) What was the total cost of treatment?

(a) Treatment:

- Tourniquet
- Burning
- Cutting
- Sucking out venom
- Herbal drinks
- Herbal ointments/salves
- Pain relief
- Anti-swelling
- Antivenom
- Black stone
- Other: \_\_\_\_\_
- I don't know

(b) Time interval \_\_\_\_\_ minutes

- I don't know

(c) Cost \_\_\_\_\_ RWF

- I don't know

<p>19) If owner sought care from a veterinarian:  (a) What treatment was provided?</p> <p>(b) What was the time interval between calling the veterinarian and obtaining treatment?  (c) What was the total cost of treatment?</p>	<p>(a) Treatment:</p> <ul style="list-style-type: none"> <li><input type="radio"/> Tourniquet</li> <li><input type="radio"/> Burning</li> <li><input type="radio"/> Cutting</li> <li><input type="radio"/> Sucking out venom</li> <li><input type="radio"/> Herbal drinks</li> <li><input type="radio"/> Herbal ointments/salves</li> <li><input type="radio"/> Pain relief</li> <li><input type="radio"/> Anti-swelling</li> <li><input type="radio"/> Antivenom</li> <li><input type="radio"/> Black stone</li> <li><input type="radio"/> Other: _____</li> <li><input type="radio"/> I don't know</li> </ul> <p>(b) Time interval _____ minutes</p> <p>(c) Cost _____ RWF</p>
<p>20) Why was the provider mentioned above your choice?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> It was cheaper than other options</li> <li><input type="radio"/> I trusted the provider</li> <li><input type="radio"/> It was near where livestock got bitten</li> <li><input type="radio"/> Other: _____</li> <li><input type="radio"/></li> </ul>
<p>21) Did the animal(s) survive?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yes, the animal recovered fully</li> <li><input type="radio"/> Yes, but the animal did not recover fully</li> <li><input type="radio"/> No, the animal died</li> </ul>
<p>22) What was the market value of the animal?</p>	<p>_____ RWF</p> <ul style="list-style-type: none"> <li><input type="radio"/> I don't know</li> </ul>
<p>23) Did anyone kill the snake?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> </ul>

<p>24) How many of your other animals have ever been bitten by a snake?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> None</li> <li><input type="radio"/> 1</li> <li><input type="radio"/> 2</li> <li><input type="radio"/> 3</li> <li><input type="radio"/> Other: _____</li> </ul>
<p>25) Do traditional healers in your area provide good care for animals bitten by snakes? Why or why not?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yes: _____</li> <li><input type="radio"/> No: _____</li> <li><input type="radio"/> I don't know</li> </ul>
<p>26) Are traditional animal healers in your area affordable?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> <li><input type="radio"/> I've never sought care from a traditional animal healer</li> </ul>
<p>27) Are traditional animal healers in your area available to provide timely emergency care?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> <li><input type="radio"/> I don't know</li> </ul>
<p>28) Do veterinarians in your area provide good care for animals bitten by snakes? Why or why not?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yes: _____</li> <li><input type="radio"/> No: _____</li> <li><input type="radio"/> I don't know</li> </ul>
<p>29) Are veterinarians in your area affordable?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> <li><input type="radio"/> I've never sought care from a veterinarian</li> </ul>
<p>30) Are veterinarians in your area available to provide timely emergency care?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> <li><input type="radio"/> I don't know</li> </ul>
<p>31) Is there anything you do to protect your domestic animals from snakebites? If yes, please describe.</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yes: _____</li> <li><input type="radio"/> No</li> </ul>
<p>32) Has any person in your household ever been bitten by a snake?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yes</li> <li><input type="radio"/> No</li> <li><input type="radio"/> I don't know</li> </ul>

33) Is there anything you do to protect yourself snakebites? If yes, please describe.	<input type="radio"/> Yes: _____ <input type="radio"/> No
34) When walking at night, do you carry a torch?	<input type="radio"/> Never <input type="radio"/> Sometimes <input type="radio"/> Always
35) Do you sleep under a mosquito net?	<input type="radio"/> Never <input type="radio"/> Sometimes <input type="radio"/> Always
36) Is your house secure from snakes entering?	<input type="radio"/> Yes <input type="radio"/> No
37) Is your house well lighted at night?	<input type="radio"/> Yes <input type="radio"/> No
38) Is there anything you do to control rodents in your house? If yes, what?	<input type="radio"/> Yes: _____ <input type="radio"/> No
39) What advice do you have for other people if their animal is bitten by a snake?	

<sup>1</sup>Snakebite envenomation includes any incidence of physical bite or venom being spat at victim

Thank you for completing this survey! Do you have any questions for the research team?

## APPENDIX 2: KINYARWANDA DATA COLLECTION TOOLS

### Ubushakashatsi ku kuribwa n'inzoka mu Karere ka Bugesera : Kumenya uburyo abaribwa n'inzoka babona ubuvuzi

{Urakoze kwemera kugira uruhare muri ubu bushakashatsi. Amazina yanjye ni \_\_\_\_\_ nkaba ndi mu itsinda rya Kaminuka mpuzamahanga y'ubuzima rusange yo mu Rwanda (UGHE, Rwanda). Turifuza kumenya uburyo abatunze amatungo aribwa n'inzoka bayitaho mu ntara y'iburasirazuba. Ibyo bizadufasha gutanga ubujyanama kuri leta ku ngamba zo gufasha abatunze amatungo. Mu gihe wemeye kugira uruhare, turagirana ikiganiro gushobora gutwara nk'iminota 10.}

\* Mugihe uwitabiriye ubushakashatsi abishaka, musomere ibikubiye mu rupapuro rukubiyemo amakuru no kwemera kugira uruhare mu bushakashatsi ku bushake

Italiki y'ikiganiro: \_\_\_\_\_

Akarere: \_\_\_\_\_

Umurenge: \_\_\_\_\_

Akagali: \_\_\_\_\_

Umudugudu: \_\_\_\_\_

Imyirondoro/Irangamimerere	
1) wari ufite imyaka ingahe itungo ryawe rirumwa n'inzoka?	_____ imyaka
2) Igitsina?	<input type="radio"/> Umugore <input type="radio"/> Umugabo <input type="radio"/> Sinshaka kubivuga
3) Wize amashuri angahe? Ayo warangije (hitamo kimwe)	<input type="radio"/> Ntayo <input type="radio"/> Amashuri abanza <input type="radio"/> Amashuri yisumbuye <input type="radio"/> Kaminuza <input type="radio"/> Iyandi (yavuge) _____

<p>4) Ese ukora iki kigutunze? (Hitamo kimwe cy'ingenzi)</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Ntakazi mfite</li> <li><input type="radio"/> Umukozi wo mu rugo</li> <li><input type="radio"/> Umworozi/Umuhinzi</li> <li><input type="radio"/> Umucuruzi</li> <li><input type="radio"/> Umwarimu</li> <li><input type="radio"/> ibindi: _____</li> </ul>
<p>5) Uri mu kihe cyiciro cy'ibudehe? (Hitamo kimwe)</p>	<ul style="list-style-type: none"> <li><input type="radio"/> 1</li> <li><input type="radio"/> 2</li> <li><input type="radio"/> 3</li> <li><input type="radio"/> 4</li> </ul>
<p>6) Ni ayahe matungo mwatunze mu rugo rwanyu mu mwaka wa 2020? Mwatunze angahe kuri buri tungo? (Hitamo byose bishoboka)</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Ihene: _____</li> <li><input type="radio"/> Inkoko: _____</li> <li><input type="radio"/> Inka: _____</li> <li><input type="radio"/> Ingurube: _____</li> <li><input type="radio"/> Andi: _____</li> </ul>
<p>7) Ese aya matungo mwayoroye kubwo izihe mpamvu? (Hitamo byose bishoboka)</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Uburyo bwo kubona amafaranga</li> <li><input type="radio"/> Kuyarya</li> <li><input type="radio"/> Kwishimisha</li> <li><input type="radio"/> Kuturinda</li> <li><input type="radio"/> Ibindi: _____</li> </ul>
<p>8)Ese ni amatungo angahe yariwe n'inzoka mu mwaka wa 2020<sup>1</sup>. Ni ubuhe bwoko bw'amatungo?</p>	<p># Umubare w'amatungo: _____</p> <p>Ubwoko: _____</p>

9) Ese ni mukahe kagari ibyo byabereye?	Izina ry'akagali: _____
10) Ese wamenye gute ko itungo ryariwe n'inzoka?	<input type="radio"/> Hari umuntu wabibonye <input type="radio"/> Amenyoyaho yariye yaragaragaraga <input type="radio"/> Byemejwe n'umuvuzi w'amatungo <input type="radio"/> Ibindi: _____
11) Ese haba hari uwabonye iyo nzoka? Niba ari yego, vuga uko iyo nzoka yari imeze	<input type="radio"/> Yego: _____ <input type="radio"/> Oya
12) Ese itungo ryari he igihe ryaribwaga n'inzoka? (Hitamo kimwe)	<input type="radio"/> Imbere mu nzu <input type="radio"/> Mu kiraho <input type="radio"/> Mu rugo <input type="radio"/> Iri kurisha hanze <input type="radio"/> Itwawe mu modoka <input type="radio"/> Ku isoko <input type="radio"/> Ahandi: _____
13) Ese inzoka yayiriye nijoro cyangwa ku manywa Did the snakebite occur during the day or night? (Amanywa: kuva saa kumi n'ebiri za mu gitondo kugera saa kumi n'ebiri za nimugoroba; ijoro: kuva saa kumi n'ebiri za nimugoroba kugera saa kumi n'ebiri za mugitondo)	<input type="radio"/> Ku manywa <input type="radio"/> Ijoro <input type="radio"/> Simbizi

<p>14)Ese itungo ryariwe ku kihe gice cy'umubiri? (Hitamo byose bishoboka)</p>	<ul style="list-style-type: none"> <li>○ Ikirenge/ikinono</li> <li>○ Ukuguru</li> <li>○ Igihimba</li> <li>○ Umurizo</li> <li>○ Umutwe/Mu maso/Ijosi</li> <li>○ Ahandi: _____</li> </ul>
<p>15) Ese itungo ryagaragaje ibihe bimenyetso? (Hitamo byose bishoboka)</p>	<ul style="list-style-type: none"> <li>○ Ntakimenyese, itungo ryari rimeze neza</li> <li>○ Kuva amaraso cyane aho yariwe</li> <li>○ Kubyimba</li> <li>○ Guhumeka bigoranye</li> <li>○ Kubira ibyuya (niba bishoboka))</li> <li>○ Gutitira</li> <li>○ Kutabasha guhagarara</li> <li>○ Gucika intege</li> <li>○ Kwanga kurya</li> <li>○ Pararisi y'igice cyangwa umubiri wose</li> <li>○ Guta ubwenge</li> <li>○ Kugabanuka kw'amata (niba bishoboka)</li> <li>○ Kuramburura (niba bishoboka)</li> <li>○ Ibindi: _____</li> </ul>

<p>16) Ese itungo warivuye ute? (Hitamo byose bishoboka)</p>	<ul style="list-style-type: none"> <li>○ Nta buvuzi yahawe</li> <li>○ Nyiri itungo yararyivuriye</li> <li>○ Umuvuzi gakondo</li> <li>○ Umuvuzi w'amatungo wabyize (veterineri)</li> <li>○ Bararyishe</li> <li>○ Ibindi: _____</li> </ul>
<p>17) Niba nyiri itungo yararyivuriye, yarivuye akoresheje iki? Ni ibi yakoze?</p>	<ul style="list-style-type: none"> <li>○ Kuzirika ahariwe</li> <li>○ Gutwika</li> <li>○ Gukeba</li> <li>○ Gukurura/kuvoma ubumara</li> <li>○ Kuyiha imiti y'amazi y'ibyatsi</li> <li>○ Kuyiha imiti y'amavuta y'ibyatsi</li> <li>○ Imiti igabanya uburibwe</li> <li>○ Imiti igabanya kubyimba</li> <li>○ Imiti irwanya ubumara</li> <li>○ Gukoresha akabuye k'umukara</li> <li>○ Ibindi: _____</li> </ul>

18) Niba nyiri itungo yarashatse ubufasha ku muvuzi gakondo

(a) Yavuye itungo akoresheje iki? Ni ibiki yakoze?

(b) Ese byatwaye igihe kingana iki hagati yo guhamagara umuvuzi gakondo kugera aje akavura itungo?

(c) Ese wishyuye amafaranga angahe?

Ibyo yakoze mukurivura:

- Kuzirika ahariwe
- Gutwika
- Gukeba
- Gukurura/kuvoma ubumara
- Imiti igabanya uburibwe
- Imiti igabanya kubyimba
- Imiti irwanya ubumara
- Gukoresha akabuye k'umukara
- Ibindi: \_\_\_\_\_
- Simbizi

Igihe byatwaye \_\_\_\_\_ Iminota

- Simbizi

Igiciro \_\_\_\_\_ RWF

- Simbizi

19) Niba nyiri itungo yarashatse ubufasha ku muganga w'amatungo (veterineri):

(a) Yavuye itungo akoresheje iki? Ni ibiki yakoze?

(b) Ese byatwaye igihe kingana iki hagati yo guhamagara umuvuzi w'amatungo kugera aje akavura itungo?

(c) Ese wishyuye amafaranga angahe?

(a) Ibyo yakoze mukurivura:

Kuzirika ahariwe

- Gutwika
- Gukeba
- Gukurura/kuvoma ubumara
- Kuyiha imiti y'amazi y'ibyatsi
- Kuyiha imiti y'amavuta y'ibyatsi
- Imiti igabanya uburibwe
- Imiti igabanya kubyimba
- Imiti irwanya ubumara
- Gukoresha akabuye k'umukara
- Ibindi: \_\_\_\_\_
- Simbizi

(b) Igihe byatwaye \_\_\_\_\_ Iminota

- Simbizi

(c) Igiciro \_\_\_\_\_ RWF

- Simbizi

20) Ni iyihe mpamvu yatumye uhitamo gushakira ubufasha kuri uyu wavuzwe hejuru?

- hari hahendutse kurusha ahandi
- nari nizeye umuvuzi
- hari hegereye aho inzoka yandumiye
- Ibindi: \_\_\_\_\_

21) Ese itungo ryabayeho/ryarakize?	<ul style="list-style-type: none"> <li><input type="radio"/> Yego, itungo ryarakize neza ntakibazo</li> <li><input type="radio"/> Yego, ryabayeho ariko ryasigaranye ubumuga</li> <li><input type="radio"/> Oya, itungo ryarapfuye</li> </ul>
22) Ese iryo tungo bari kuguha nk'angahe rigurishijwe ari rizima ntakibazo?	<p>_____ RWF</p> <ul style="list-style-type: none"> <li><input type="radio"/> Simbizi</li> </ul>
23) Ese haba hari uwishe iyo inzoka?	<ul style="list-style-type: none"> <li><input type="radio"/> Yego</li> <li><input type="radio"/> Oya</li> </ul>
24) Ese ni amatungo yawe angaheyaba yarigeze kuribwa n'inzoka muri rusange? Ni ukuga andi atari muyo twavuze ya 2020	<ul style="list-style-type: none"> <li><input type="radio"/> Ntayo</li> <li><input type="radio"/> 1</li> <li><input type="radio"/> 2</li> <li><input type="radio"/> 3</li> <li><input type="radio"/> andi: _____</li> </ul>
25) Ese abavuzi ba gakondo bo mu gace kanyu bavura amatungo, ubona batanga ubuvuzi bwiza ku matungo yariwe n'inzoka? Ni abari Yego, kubera iki? Niba ari oya, kubera iki?	<ul style="list-style-type: none"> <li><input type="radio"/> Yego: _____</li> <li><input type="radio"/> Oya: _____</li> <li><input type="radio"/> Simbizi</li> </ul>
26) Ese abavuzi ba gakondo bo mu gace kanyu bavura amatungo, ubona bahendutse?	<ul style="list-style-type: none"> <li><input type="radio"/> Yego</li> <li><input type="radio"/> Oya</li> <li><input type="radio"/> Sindashaka ubuvuzi mu bavuzi ba gakondo bavura amatungo</li> </ul>
27) Ese abavuzi ba gakondo bo mu gace kanyu bavura amatungo ubona baboneka ku gihe mu gutanga ubuvuzi bwihuse?	<ul style="list-style-type: none"> <li><input type="radio"/> Yego</li> <li><input type="radio"/> Oya</li> <li><input type="radio"/> Simbizi</li> </ul>

<p>28) Ese abavuzi bavura amatungo (veterineri) bo mu gace kanyu ubona batanga ubuvuzi bwiza ku matungo yariwe n'inzoka? Ni abari Yego, kubera iki? Niba ari oya, kubera iki?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yego: _____</li> <li><input type="radio"/> Oya: _____</li> <li><input type="radio"/> Simbizi</li> </ul>
<p>29) Ese abavuzi b'amatungo (veterineri) bo mu gace kanyu, ubona bahendutse?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yego</li> <li><input type="radio"/> Oya</li> <li><input type="radio"/> Sindashaka ubuvuzi mu bavuzi b'amatungo</li> </ul>
<p>30)Ese abavuzi b'amatungo (veterineri) bo mu gace kanyu ubona baboneka ku gihe mu gutanga ubuvuzi bwihuse</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yego</li> <li><input type="radio"/> Oya</li> <li><input type="radio"/> Simbizi</li> </ul>
<p>31) Ese haba hari icyo ukora ngo urinde amatungo yawe kuribwa n'inzoka? Niba ari yego, watubwira ibyo ukora muri macye.</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yego: _____</li> <li><input type="radio"/> Oya</li> </ul>
<p>32) Ese haba hari umuntu wo mumuryango wawe waba warigeze uribwa n'inzoka?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yego</li> <li><input type="radio"/> Oya</li> <li><input type="radio"/> Simbizi</li> </ul>
<p>33) Ese haba hari icyo ukora ngo wirinde kuribwa n'inzoka? Niba ari yego, watubwira ibyo ukora muri macye.</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Yego: _____</li> <li><input type="radio"/> Oya</li> </ul>
<p>34) Ese iyo ugenda nijoro, ugendana itoroshi yo kumurika?</p>	<ul style="list-style-type: none"> <li><input type="radio"/> Nta na rimwe</li> <li><input type="radio"/> Rimwe na rimwe</li> <li><input type="radio"/> Iteka ryose</li> </ul>

35) Ese urara munzitiramibu?	<input type="radio"/> Nta na rimwe <input type="radio"/> Rimwe na rimwe <input type="radio"/> Iteka ryose
36) Ese inzu yawe ifite ubwirinzi butuma inzoka zitakwinjiramo?	<input type="radio"/> Yego <input type="radio"/> Oya
37) Ese inzu yawe iba ifite urumuri ruhagije nijoro?	<input type="radio"/> Yego <input type="radio"/> Oya
38) Ese haba hari icyo ukora kugirango wirinde izindi nyamaswa nk'imbeba munzu? Niba ari yego, waba ukora iki?	<input type="radio"/> Yego: _____ <input type="radio"/> Oya
39) Ese ni izihe nama wagira abanda mu gihe itungo ryabo ryaba ryariwe n'inzoka?	

<sup>1</sup>Kuribwa n'inzoka harimo gushingwa amenyo n'inzoka cyangwa se gucirwa amacandwe n'inzoka

Urakoze kwemera kugira ikiganiro natwe! Waba ufite ikibazo waba wifuza kutubaza?

## **APPENDIX 3: INFORMATION AND CONSENT FORM (English and Kinyarwanda)**

**Participant ID:** \_\_\_\_\_

**Project title:** Health seeking behaviors of snakebite envenomation victims in Bugesera District of Rwanda in, 2020.

**Study population:** Snake Bite Envenomation victims (human and livestock owners) in the Bugesera District of the Eastern Province of Rwanda.

**Version date:** 02nd August 2021

### **Principal Investigator:**

Happy Tahirih Kampire, bachelor's in public health

Leandre Ishema, M.D

Master of Science in Global Health Delivery candidates. University of Global Health Equity.

This research project is being conducted by the One Health Center, under the University of Global Health Equity. This study is being carried out as part of our fulfillment for a masters in Global Health Delivery at the University of Global Health Equity (UGHE). The research has gotten the necessary approval from UGHE IRB and is in line with international ethical standards of research.

### **About this consent form**

Dear participant,

You are being invited to participate in this project assessing the health-seeking behaviors of livestock owners and human victims of snakebite envenomation. As we feel you will provide thoughtful and eye-opening information concerning our research question. Before joining this project, it is necessary to understand the content of this study, as it will assist you to decide on participation. Please note that participation is not compulsory, and feel free to ask questions about this research or this consent form.

### **What is the purpose of this project?**

The purpose of this study is to assess the health-seeking behaviors of SBE victims among humans and livestock owners. The findings of this study will be used to make recommendations to community sensitization programs that promote Snakebite envenomation care-seeking behaviors according to WHO guidelines.

### **What is the procedure for participation in this project?**

If you choose to participate you will be invited to take part in a phone interview. The researchers will take you through a 10–15-minute questionnaire, where you will be answering questions regarding your health-seeking behavior after you or your livestock were bitten and envenomed by a snake.

**What are the possible benefits of taking part in this project?**

If you participate in this study, we cannot ensure any direct benefits, but you will be contributing to the development of recommendations to community sensitization programs that promote SBE care-seeking behaviors according to WHO guidelines.

**What are the possible risks or discomforts related to taking part in this project?**

If you decide to participate, we do not envision any foreseeable risks or discomforts. If any discomfort arises, the participant can choose to stop or postpone to a later date.

**If I take part in this project, how will my privacy be protected? What happens to the information you collect?**

All participants will be de-identified using numbers instead of names. The collected information will only be shared with the project team. The information will be stored in password-protected laptops that can only be accessed by the researchers. Results will be used for research purposes only.

**Voluntary participation**

Participation in this study is voluntary, you have the right to change your mind and ask to stop participating in the study at any time. If you choose not to participate, it will not affect you in any way.

**How many people will take part in this research?**

All victims identified by CHWs in the main study.

**What are my alternatives to participating in this study?**

The alternative is choosing not to participate in the study.

**Will I be compensated for participating in this research?**

Participants will not be compensated for participating in this study.

**What will I have to pay for if I participate in this research?**

It will not cost you anything to participate in this study.

**What happens if I am injured as a result of participating in this research study?**

If physical injury resulting from participation in this research should occur, although UGHE's policy is not to provide compensation, medical treatment will be available including first aid, emergency treatment, and follow-up care as needed, and your insurance carrier may be billed for the cost of such treatment. In making such medical treatment available, or providing it, the persons conducting this research project are not admitting that your injury was their fault.

### **Can my taking part in the research end early?**

If you decide to withdraw from the research, it will not be held against you. If you choose to leave the research for any reason, it is advised that you contact the researchers.

### **If I have any questions, concerns, or complaints about this project, who can I talk to?**

If you have any questions, concerns, or complaints regarding the research or you would like to talk to the team, please feel free to contact:

Happy Tahirih Kampire, Masters in Global Health Delivery candidate at UGHE.

E-mail: [happy.kampire@student.ughe.org](mailto:happy.kampire@student.ughe.org),

Phone number: 0788328195

Leandre Ishema, MD, Masters in Global Health Delivery candidate at UGHE.

E-mail: [leandre.ishema@student.ughe.org](mailto:leandre.ishema@student.ughe.org),

Phone number: 0785525669.

This research has been reviewed by the University of Global Health Equity Institutional Review Board. If you wish to speak with someone from the IRB, please contact the IRB at [irb@ughe.org](mailto:irb@ughe.org), telephone: 0788316894 or Office of Human Research Administration (OHRA) at Kigali Heights Building, 5th floor, Kacyiru, Kigali, P.O. Box 6955, Rwanda, for any of the following:

- If your questions, concerns, or complaints are not being answered by the research team;
- If you cannot reach the research team;
- If you want to talk to someone besides the research team;
- If you have questions about your rights as a research participant, or;
- If you want to get information or provide input about this research.

### **Statement of consent**

Your verbal consent indicates you acknowledge that:

- You have understood the content of this form.
- You have had the opportunity to ask questions and received answers that were satisfactory.
- If needed, you took time to discuss this information with others to help you decide whether to participate.
- You agree to participate in this project.

Do you give verbal consent to participate in this survey?

Yes

No

## Translated Consent Form

Nomero iranga uwitabiriye: \_\_\_\_\_

**Ubushakashatsi ku kurumwa n'inoka mu Karere ka Bugesera:** kumenya imyitwarire mu gushaka ubuvuzi y'abarumwe n'inzoka ndetse n' abatunzi amatungo yabo yarumwe n'inzoka mu karere ka Bugesera mu mwaka wa 2020.

**Urupapuro Rukubiyemo amakuru no kwemera kugira uruhare mu bushakashatsi ku bushake.**

Abakora uyu mushinga w'ubushakashatsi;

Happy Tahirih Kampire, Umunyeshuri mu kiciro cya kabiri cya kaminuza mu buzima rusange muri UGHE.

Aboneka kuri: [happy.kampire@student.ughe.org](mailto:happy.kampire@student.ughe.org),

Nomero ya telefoni : 0788328195

Dr. Leandre Ishema, Umunyeshuri mu kiciro cya kabiri cya kaminuza mu buzima rusange muri UGHE.

Aboneka kuri: [leandre.ishema@student.ughe.org](mailto:leandre.ishema@student.ughe.org)

Nomero ya telefoni : 0785525669

This research project is being conducted by the One Health Center, under the University of Global Health Equity. This study is being carried out as part of our fulfillment for a masters in Global Health Delivery at the University of Global Health Equity (UGHE). The research has gotten the necessary approval from UGHE IRB and is in line with international ethical standards of research.

Ubu bushakashatsi buri gukorwa n'ikigo cy'ubuzima bukomatanyije muri kaminuzay'ubuzima rusange. Uyu mushinga w'ubushakashatsi buri gukorwa nka kimwe mu bisabwa ku banyeshuri biga mu cyiciro cya kabiri cya kaminuza mu bijyanye n'ubuvuzi rusange ku isi muri Kaminuza y'ubuzima rusange - University of Global Health Equity (UGHE). Ubu bushakashatsi bwarasuzumwe kandi buhabwa icyemezo n'ishami rishinzwe gusuzuma no kwemeza ubushakashatsi ryo muri UGHE kandi bwujije amahame n'amabwiriza mpuzamahanga agenga ubushakashatsi bukorwa mu Rwanda. Twahawe kandi uburenganzira n'ubuyobozi bw'ibitaro bya kaminuza bya Kigali ndetse n'abayobozi bo muri kaminuza ya UGHE babifitiye ububasha.

### Ibyerekeranye n'aya masezerano

Ku usabwa kugira uruhare mu bushakashatsi

Watumiwe kugirango tugusabe kugira uruhare muri ubu bushakashatsi ku kurumwa n'inzoka mu Rwanda. Ubu bushakashatsi buri gukorwa na Kaminuza y'ubuvuzi rusange ifite icyicaro mu murenge wa Butaro, mukarere ka Burera. Mbere yuko dutangira, turagirango tuguhe amakuru

y'ingezi ku bushakashatsi kugirango ubashe gufata icyemezo cyo kuba wakwemera cyangwa wakwanga kugira uruhare muri ubu bushakashatsi.

### **Intego y'ubushakashatsi**

Intego y'ubushakashatsi uburyo abarumwa n'inzoka ndetse n'abatunzi, amatungo yabo yarumwe n'inzoka babona ubuvuzi .Ibizava mu bushakashatsi bizakorehwa mu bukangurambaga no gushishikariza abaturage gushaka ubuvuzi bujyanye n'amabwiriza y'umuryango w'ubuzima ku isi.

### **Uburyo bwo kugira uruhare muri ubu bushakashatsi**

Mu gihe wemeye kugira uruhare muri ubu bushakashatsi, tuzagirana ikiganiro tukubaze ibibazo kuri telefoni. Duteganya ko ikiganiro kizatwara kizatwara hagati y'iminota 10 na 15. Aho muzasubiza ibibazo bijyanye n'ubuvuzi nyuma yo kurumwa n'inzoka cyangwa itungo ryanyu nyuma y'uko rirumwe n'inzoka.

### **Akamaro ko kugira uruhare muri ubu bushakashatsi**

Nugira uruhare muri ubu bushakashatsi nta nyungu zo kuruhande twakwizeza. Kugira uruhare muri ubu bushakashatsi bizadufasha gutanga ubujyanama kuri leta ku ngamba zigomba gufatwa mu rwego rwo mu kuvura abarumwe n'inzoka bijyanye n'amabwiriza y'umuryango w'ubuzima ku isi.

### **Ingaruka mbi zaturuka mu kugira uruhare muri ubu bushakashatsi**

Mu gihe wemeye kugira uruhare muri ubu bushakashatsi, ntakibazo tubona mushobora kugira. Mu gihe mugize ikibazo, ni uburenganzira bwawe kuba wareka gusubiza ibibazo bimwe na bimwe ndetse ushobora no guhagarika kugira uruhare mu bushakashatsi igihe icyo aricyo cyose.

### **Kugirirwa ibanga**

Abazaitabira ubushakashatsi amazina yabo azavanwamo bahabwe umubare w'ibanga mu rwego rwo gutuma batamenyekana. Ibisubizo uzatanga ndetse n'amakuru akwerekeye ntazasangizwa n'undi muntu uwo ariwe wese utari mu itsinda riri gukora ubu bushakashatsi. Amakuru yose azava muri ubu bushakashatsi azabikwa muri mudasobwa ifungishijwe ijamba ry'ibanga hanyuma akasazibwa nyuma y'imyaka icumi. Amakuru muzatanga azakorehwa mu mpamvu z'ubushakashatsi gusa.

### **Kugira uruhare mu bushakashatsi ni kubushake**

Ni uburenganzira bwawe kuba wakwemera kugira uruhare muri ubu bushakashatsi cyangwa se wabyanga. Ikindi kandi, mu gihe wemeye kugira uruhare muri ubu bushakashatsi, ushobora guhindura icyemezo cyawe igihe icyo aricyo cyose ukaba wava muri ubu bushakashatsi. Kwanga kugira uruhare muri ubu bushakashatsi cyangwa guhagarika kugira uruhare no ku mpamvu iyo ariyo yose ntangaruka bizakugiraho yaba wowe ubwawe cyangwa umuryango wawe.

### **Umubare w'abazitabira ubu bushakashatsi?**

Abantu bose barumwe n'inzoka ndetse n'abo amatungo yabo yarumwe n'inzoka bazatangwa n'abajyanama b'ubuzima.

### **Ubundi buryo bwo kwitabira ubu bushakashatsi?**

Ufite uburenganzira bwo guhitamo kwitabira cyangwa kutitabira ubu bushakashatsi.

### **Hari ubwo nzahemberwa keitabira ubu bushakashatsi?**

Abazitabira ubu bushakashatsi nta gihembo bazhabwa.

### **Hari ikiguzi nzishyura kugirango nitabire ubushakashatsi?**

Ntakiguzi gihari kugirango witabire ubu bushakashatsi.

### **Byagenda gute ndamutse nkomeretse kubera kwitabira ubu bushakashatsi?**

Uramutse ukomeretse biturutse ku bushakashatsi, nubwo amategeko ya Kaminuza avuga ko nta ndishyi itanga, ubuvuzi n'ubifasha bwihutirwa, no gukukurikiranwa uzabihabwa, ubwishingizi bwawe bushobora gukoreshwa mu kwishyura ubwo buvuzi. Mu gihe muhabwa ubuvuzi, abakora ubu bushakashatsi ntago aribo babarwaho gukomereka kwanyu.

### **Ubwitabire muri ubu bushakashatsi bushobora gusozwa hakiri kare?**

Ushobora guhitamo guhagarika ubwitabire bwawe mu bushakashatsi igihe ubyifujye, Kuva muri ubu bushakashatsi ntabwo bihanwa kandi nta ngaruka iyo ariyo yose bizakugiraho. Mugihe muhisemo kuva muri ubu bushakashatsi, musabwa kubimenyesha ababukora.

### **Ese ngize ikibazo, impungenge cyangwa icyo nshidikanyaho kuri ubu bushakashatsi, nabaza nde?**

Uramutse: 1) Ugize ikibazo, 2) Ushatse kuvugisha abakora ubu bushakashatsi, 3) Utekereje ko ubu bushakashatsi bwakugizeho ingaruka mbi, cyangwa 4) Ushatse kuva muri ubu bushakashatsi; wavugisha umwe muri aba bantu: Happy Tahirih Kampire kuri +250788328195, happy.kampire@student.ughe.org cyangwa Dr. Leandre Ishema, kuri +250785525669, leandre.ishema@student.ughe.org .

Ubu bushakashatsi bwagenzuwe na muri Kaminuza y'ubuzima rusange - University of Global Health Equity (UGHE). Wifuzwa kubavugisha, Wakoresha Email: irb@ughe.org, numero ya telefoni :0788316894 cyangwa comite ishinzwe ubuziranenge mu bushakashatsi muri Kaminuza y'ubuzima rusange UGHE, ifite aderesi: Kigali Heights, Plot 772, KG 7 Ave., 5th Floor, PO Box 6955, Kigali, kuva saa 8:00 za mugitondo kugeza 5:00 za nimugoroba.

Kwemera mu magambo bigaragazwa kuri iyi nyandiko, byemeza ko:

- Mwasobanukiwe ibikubiye muri iyi nyandiko.
- Mwahawe amahirwe yo kubaza ibibazo kandi mugahabwa ibisobanuro bihagije.
- Aho biri ngombwa, mwafashe umwanya wo kuganira ibikubiye muri iyi nyandiko na bagenzi banyu kugirango bibafashe gufata icyemezo.
- Mwemeye kwitabira ubu bushakashatsi.

Wemeye mu magambo kugira uruhare muri ubu bushakashatsi ?

Yego

Oya

## APPENDIX 4: IRB APPROVAL



### University of Global Health Equity Institutional Review Board Academic Ethics Review

#### Notification of Approval – Protocol Amendment

*Our Ref: UGHE-IRB/2021/035*

May 8, 2021

<b>Protocol Title:</b>	Snakebite envenomation in Rwanda: A One Health assessment of incidence, demographics, and care-seeking behaviors
<b>Principal Investigator(s):</b>	Janna Schurer, Dieudonne Hakizimana, Lauren MacDonald, Happy Tahirih Kampire, Ishema Leandre
<b>Protocol #:</b>	0126
<b>Funding Source:</b>	Cofounded by UGHE
<b>Initial IRB Review Date:</b>	October 06, 2020
<b>Initial IRB Review Type:</b>	Full review
<b>Additional Review Dates:</b>	January 21, 2021; May 07, 2021
<b>Additional IRB Review Type:</b>	Expedited review of resubmission; protocol amendment review
<b>IRB Review Action:</b>	Approved
<b>Effective Date:</b>	January 21, 2021
<b>Expiration Date:</b>	January 20, 2022

**Dear Dr. Janna Schurer**

On May 07, 2021, the University of Global Health Equity Institutional Review Board (UGHE IRB) approved this resubmission with protocol amendment. **Please note that the approval for this protocol will lapse after one (1) year from initial approval and must be renewed according to the procedures of the UGHE IRB.**

The IRB reminds you that you are responsible for fulfilling the following requirements:

- Changes, amendments, and addenda to the protocol or consent form (if applicable) must be submitted to the committee for review and approval, prior to activation of the changes.
- Only approved consent forms are to be used for the enrollment of participants.
- All consent forms signed by subjects must be retained on file, and are submitted to inspection, along with other project materials, during routine onsite visits or audits.
- Failure to submit an application for continuing review will result in the suspension or termination of the study.
- The UGHE IRB must be notified at the closure of the study.

Please contact the UGHE IRB via email at [irb@ughe.org](mailto:irb@ughe.org) with any questions.

Sincerely,

Daniel Seifu, IRB Chair