

Health cannot be defined by pathogens alone: The disconnect between recommendations and reality for zoonotic disease prevention in Zambia

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Acronyms

FAO Food and Agricultural Organization

FGD Focus group discussion

IDI In-depth interview

USAID United States Agency for International Development

ZNPHI Zambia National Public Health Institute

Executive summary

The country of Zambia has a substantial number of high-risk interfaces between humans, animals, and the environment. Although progress has been made in managing a variety of infectious disease threats, pathogens causing zoonotic diseases (diseases that spread from animals to humans) continue to affect the health and livelihood of communities and their livestock. While some research in Zambia has explored drivers of risk and prevention behaviors related to zoonotic diseases broadly and anthrax specifically, the studies are dated, use data collected outside Breakthrough ACTION's intervention districts, or include insufficient detail to inform communication messages and materials. In collaboration with the Zambia National Public Health Institute (ZNPHI) and the Food and Agricultural Organization (FAO) of the United Nations, Breakthrough ACTION supports the prevention and response to public health threats. With input from ZNPHI, FAO, and other partners, Breakthrough ACTION collected qualitative data in September–October 2023 on drivers of zoonotic spillover and transmission, with a particular focus on prevention and risk behaviors associated with anthrax. The team conducted 15 focus group discussions with members of the general population and cattle herders, and 18 in-depth interviews with health workers, veterinary workers, and community leaders. Data was collected in three districts: Choma and Kazungula in Southern Province and Senanga in Western Province. Based on a framework analysis, several themes and components emerged with respect to the community context for zoonotic disease, such as awareness and risk perception, recent outbreaks, shared spaces between people and animals, trust in health workers and veterinary agents, and concern about the environment.

Additional elements were found to influence certain behaviors. These included how “top of mind” or relevant the behavior is for a person (salience); knowledge of how to perform the behavior; government initiatives or policies; potential influencers or sources of information; and misconceptions or rumors. Perceived social norms such as beliefs about what most people in the community do and economic factors like the cost of vaccines also supported or created barriers, along with how important or useful a behavior was perceived to be (response-efficacy) and whether people felt capable of performing the behavior (self-efficacy).

Overall, participants in the study were very concerned about animal health for the sake of their livelihood, but zoonotic diseases were not particularly top of mind for human health. Participants tended to view rabies as more relevant than other zoonotic diseases such as anthrax, which was viewed as a severe but not necessarily urgent threat for animals or people. Certain prevention behaviors, such as vaccination and avoiding the consumption of potentially infected meat, were well understood. However, economic factors, perceived norms, and sociocultural factors tended to undermine the adoption of these behaviors. Other behaviors were not well known or were perceived to be very uncommon. These behaviors included covering open wounds when handling live or dead animals, keeping new animals temporarily separate from the herd, wearing protective gear during slaughter, and properly cleaning instruments used during slaughter or hide preparation.

Gender dynamics influenced access to information as well as behaviors in activities such as cooking meat. Care-seeking beliefs and practices varied considerably based on participants' experiences with and trust in veterinary staff and health workers. Some participants felt the veterinary workers were accessible and trustworthy. Others felt that veterinary care was expensive or that staff were stretched too thin or had uncertain control over animal outcomes. Similarly, although participants tended to say that health centers offered competent and compassionate care, several barriers to care-seeking were present, such as the expense of medications, competing options from traditional or religious healers, and potential loss of decision-making power at the health center.

To enable communities to prevent, detect, and respond to outbreaks of anthrax, rabies, and other emerging diseases, risk communication and community engagement implementers should consider, among other activities:

- Addressing concerns about vaccination through testimonials, and pairing demand generation with mass vaccination events.
- Making costs transparent and covering costs as frequently as possible.
- Improving knowledge about practices, such as how long to quarantine new or sick animals and how to cook meat thoroughly.
- Directly messaging on covering wounds when touching animals or animal products and properly cleaning instruments used for slaughter or hide preparation.
- Continuing to reinforce the dangers of consuming meat from an animal that died of illness or unknown causes to tip the careful cost/benefit analysis that people do in the context of financial constraints, appealing to the economic benefits of health.
- Reinforcing knowledge about how to contact veterinary staff and encouraging transparency around fees and what happens if a sick animal is diagnosed.
- Creating job aids and conducting joint activities between health care workers, veterinary workers, and pharmacists to harmonize messaging.
- Expanding infodemic management activities to detect rumors that may influence key prevention behaviors or skew trust or risk perception, paying particular attention to women's groups to ensure equitable access to accurate information.

Finally, the study suggests that meaningfully engaging community-based organizations and leaders around emerging and zoonotic diseases will motivate adoption of key behaviors.

Introduction

The country of Zambia has a substantial number and variety of high-risk interfaces between humans, animals, and the environment, and the population consequently faces numerous infectious disease threats. These threats include zoonotic diseases, which are caused by pathogens that spread from animals to humans. Anthrax, for example, is an infectious disease caused by bacteria that naturally occur in soil. Infected animals can then spread the disease to humans who are in direct contact with them or products from them.¹ Routine vaccination of livestock reduces the risk of infection for both animals and humans; nevertheless, by late 2023, an anthrax outbreak had affected nine out of 10 provinces in Zambia.² Rabies is another disease of concern in Zambia.³ This viral disease infects the central nervous system and mostly spreads to humans from unvaccinated dogs; however, other animals can be infected and pass the virus to humans. Annually, there are approximately 15,000 reported dog bites and 50 human deaths from rabies in Zambia.⁴

The risk of contracting a zoonotic disease is especially high for people in close contact with animals,⁵ including people who raise livestock, consume wild animals, or prepare and use animal products. In July 2023, the Zambia National Public Health Institute (ZNPPI), the Africa Centre for Disease Control and Prevention, the World Health Organization and other partners conducted a prioritization workshop, which culminated with the creation of a list of 10 zoonotic diseases or disease groups that the country would prioritize: African trypanosomiasis, anthrax, enteric diseases (Salmonella), viral hemorrhagic fevers (e.g., Ebola), rabies, plague, zoonotic avian influenzas, zoonotic tuberculosis, cysticercosis, and brucellosis.

Breakthrough ACTION Zambia is part of a global cooperative agreement between the United States Agency for International Development (USAID) and the Johns Hopkins Center for Communication Programs to lead social and behavior change programming around the world. The project works in partnership with governments, civil society, communities, and other stakeholders to implement creative, evidence-based social and behavior change programming. A major component of Breakthrough ACTION's work is the concept of "One Health." One Health reflects the reality that human health, animal health, and the environment are all interrelated, and that interventions to protect humans from infectious diseases cannot neglect animal and environmental health or collaboration across sectors. Breakthrough ACTION Zambia is working with ZNPPI and One Health stakeholders to strengthen the risk communication and community engagement capacity of Zambian institutions to effectively address high-risk behaviors associated with priority zoonotic diseases and mitigate the impact of future public health events.

The Breakthrough ACTION Zambia team conducted a desk review to understand known risk factors and drivers of anthrax and rabies in the country and to inform risk communication and community engagement activities related to the diseases. The desk review suggested that people in the country feel that information about the diseases is scarce.^{6,7} Furthermore, distrust of veterinarians and government

workers as well as cultural beliefs undermine the uptake of prevention behaviors.^{8,9} Food insecurity and the costs associated with care-seeking and vaccines are barriers to preventative practices.^{10,11} In addition, cultural practices such as mixing herds through family trade-offs or dowries, cattle grazing and movement practices, and improper disposal of carcasses have led to the spread of anthrax.⁹

While some research has explored drivers of risk and prevention behaviors related to zoonotic diseases broadly and anthrax specifically, the studies are dated, use data collected outside Breakthrough ACTION's intervention districts, or include insufficient detail to inform communication messages and materials. Therefore, the Breakthrough ACTION team followed the desk review with a qualitative study on prevention and risk behaviors related to One Health topics with a specific focus on anthrax. Research questions included:

- How concerned are people about diseases that come from animals, and anthrax in particular, relative to other health issues they face?
- What do people know about how diseases can spill over from animals, and concerning anthrax, what beliefs do they have about where it comes from?
- What experience and perceptions do community members have toward health workers and veterinary staff (vet techs, inspectors, etc.) in the domain of zoonotic diseases?
- What are current perceptions and barriers for specific prevention behaviors?
- How do people get information about zoonotic diseases, and whom do they trust for information about their health and the health of their animals?
- What are current practices for diagnosing and treating anthrax? What gaps are there in training, standard guidance or policies, tools or support for human and animal health workers?

These research questions guided the study design and implementation and the data analysis.

Methods

Given the multilevel and exploratory research questions, the research team opted for a qualitative methodology through focus group discussions (FGDs) with members of the general population and cattle herders (both male and female groups) and in-depth interviews (IDIs) with veterinary workers, human health workers, and community leaders. The Breakthrough ACTION team developed a list of target behaviors and conducted a prioritization exercise to inform the study as well as other project activities. The Breakthrough ACTION team developed FGD guides for exploring awareness of zoonotic diseases and anthrax specifically; attitudes towards behaviors that prevent or create risk for anthrax such as self-efficacy, response-efficacy, and perceived norms; and trusted sources of information. At the time of data collection, anthrax and rabies were the focus diseases for the project. Anthrax-related behaviors were less well understood and signs and symptoms intersected with other emerging diseases that can be spread through cattle. As such, the behavior-focused aspects of the study centered on anthrax, while also analyzing perceptions of rabies and cross-cutting topics such as encroachment into

protected areas, trust in health workers and veterinary agents, and the information environment. Table 1 presents the list of standard behaviors explicitly explored in the FGD guides.

TABLE 1. STANDARD BEHAVIORS CONSIDERED IN THE STUDY	
BEHAVIOR	
Vaccinate cattle	
Cover wounds while handling live or dead animals	
Avoid eating meat from animals that died of sickness or unknown causes	
Burn or bury carcasses	
Cook meat thoroughly	
Separate animals from the herd (when sick or new)	
Wear appropriate gear to slaughter animals and process hides safely	
Clean instruments after slaughtering or skinning animals	
Seek care for anthrax signs in humans or animals	

The instruments for IDIs explored veterinary and human health workers’ insights on how communities perceive risk and take precautions to protect themselves from anthrax as well as what training health workers have received and what protocols are in place for diagnosing, treating, and reporting anthrax cases. IDI guides for the community leaders also solicited insights on many of the preceding topics and the flow of health information in the country and sought suggestions for interventions that would help communities prevent zoonotic spillover and transmission.

Setting and sample

At the time of the study, Breakthrough ACTION was implementing project activities in three districts:



Figure 1. Study sites

Choma and Kazungula in Southern Province and Senanga in Western Province (see Figure 1). These sites, all of which are at risk for anthrax outbreaks given the high rates of cattle farming and the close proximity between water sources and areas with wild animals, were selected for the research study so that findings could be immediately incorporated into campaign design and other project activities.

Sampling was purposive, with the goal of conducting six FGDs with the general population (three male and three female), nine FGDs with cattle farmers (six male, three female), and 18 IDIs (two veterinary workers, two health workers, and two -

community leaders in each of the three sites). These figures were guided by best practices for sampling in qualitative research as well as practical concerns.^{12,13} With up to eight participants in each FGD, the maximum intended sample size was 138 individuals.

Exclusion criteria included being under the age of 18; being unable to converse in English, Tonga, or Silozi; and lacking the capacity to provide signed consent. During recruitment or explanation of study activities, if the recruiter or data collector perceived that the potential participant was unable to understand the nature and consequences of enrolling in the activity, they thanked the potential participant and ended the conversation. The inclusion criteria were being a member of one of the sampled groups and living in the study areas.

Data collection

Interview guides, recruitment, and consent documents were translated from English to both Silozi and Tonga, the main local languages in the three districts. Data collectors were trained by the Breakthrough ACTION senior research data analyst and research manager, with virtual support from the principal investigator. Interview guides were piloted during the training and revised slightly for appropriate translation wording and flow.

The Breakthrough ACTION team partnered with One Health representatives and the data collectors for community entry and recruitment. To recruit FGD participants, the Breakthrough ACTION team identified the appropriate focal person in each community and oriented them on the study objectives and inclusion criteria. The focal persons occupied roles such as community or religious leaders (chiefs or representatives), government officials (such as members of district health teams), or leaders of agriculture and livestock associations. These individuals used the recruitment script and generated an interest list, and potential participants were called together by data collectors. For participants in IDIs (community leaders, health workers, and veterinary workers), the Breakthrough ACTION team worked with the district and provincial health authorities to identify potential participants.

All participants were given a small reimbursement to cover transportation and lost time. They were informed that their contributions would help inform public health programming in Zambia. Data collection took place in a setting convenient to participants in late September and early October 2023. The priority of the research was to cover a wide range of relevant behaviors and elicit insights for programmatic action; as such, for certain questions, researchers limited the number of probes to stay within the time limit. The FGDs lasted an average of 1 hour and 46 minutes and IDIs lasted an average of 53 minutes. Audio recordings were simultaneously translated (where relevant) and transcribed word-for-word for analysis.

Ethical aspects

Data collectors administered informed consent to all potential participants using a consent form in the preferred language of the participant. The consent form emphasized that participation in the study was

voluntary, and it explained the risks, benefits, and procedures of the study. All willing participants provided written consent using a signature or thumbprint. One refusal occurred after the consent process when a participant had to leave early for personal reasons. Participants did not experience any serious adverse events that caused them harm. The research study was reviewed and approved by the Johns Hopkins Bloomberg School of Public Health Institutional Review Board (IRB#24910) and the ERES Converge ethics committee in Zambia (RHInnO Ethical Approval No.: 2023-Jull-003), and it was authorized by the National Health Research Authority (NHRA-00009/04/09/2023).

Data analysis

A framework analysis was used to synthesize a subset of data into thematic concepts and components.¹⁴ Framework analysis is a qualitative analysis methodology that uses a subset of the collected data to identify key themes (called components). The rest of the data is then considered in light of those components. During this process, seven out of the 15 FGDs and four out of the 18 IDIs (one or two transcripts from each population group) were read deeply, memoed, and organized by component in a matrix. Memoing is a process of note taking that involves written reflections on qualitative data and organizing emerging themes.¹⁵ Then, the full set of transcripts was reviewed and indexed using the matrix to add subcomponents and illustrate the themes with quotations.

Findings

Overall, 114 individuals participated in 15 FGDs and 18 individuals participated in IDIs, for a total of 132 participants (87 men, 45 women). Table 2 summarizes the sample and indicates which methodology was used for each type of participant.

TABLE 2. PROFILE OF STUDY SAMPLE AND RESEARCH METHODS					
POPULATION	ACTIVITY	CHOMA	KAZUNGULA	SENANGA	TOTAL N (INDIVIDUALS)
General population					
Male	FGD	1	2	1	32
Female	FGD	1	1	1	24
Cattle herders					
Male	FGD	2	2	2	43
Female	FGD	1	1	—	15
Community leaders	IDI	2	2	2	6
Health workers (human)	IDI	2	2	2	6
Veterinary workers	IDI	2	2	2	6

Concern about zoonotic diseases in general and anthrax specifically were discussed in the context of a larger set of themes that emerged from the data. These themes are described in Table 3.

TABLE 3. COMMUNITY CONTEXT	
COMPONENT	DESCRIPTION
Awareness of and risk perception for zoonoses	Are people aware that they can get diseases from animals?
Cases of anthrax, rabies, or other outbreaks in recent memory	Do people refer to recent outbreaks?
Proximity to high-risk interfaces (animals, game reserves, forests)	How much exposure do people have to animals in their daily life or during particular seasons?
Trust in health workers/health system	To what extent do people trust health workers and have confidence in health facilities?
Trust in veterinary staff/animal health	To what extent do people trust veterinary workers?
Environmental/climate concerns	What environmental and climate conditions may influence zoonotic behaviors?

The perceived importance and feasibility of performing the desired behaviors and the information-seeking patterns varied across groups and individuals. The context and potential behavioral drivers for each behavior are described in Tables 4 and 5.

TABLE 4. BEHAVIOR CONTEXT	
COMPONENT	DESCRIPTION
Awareness/salience	How “top of mind” is the behavior?
Knowledge	Do people know concretely how to do the behavior?
Government initiatives	Are there government policies or initiatives related to the behavior?
Influencers and information sources	Who influences the behavior? How do people get information?
Misconceptions (infodemic)	What rumors or misconceptions are circulating?

TABLE 5. BEHAVIORAL DRIVERS	
COMPONENT	DESCRIPTION
Response efficacy/perceived importance	To what extent do people feel the behavior is important or useful to prevent disease?

Self-efficacy	To what extent do people feel the behavior is feasible or easy to do?
Perceived norms	Do people feel the behavior is commonly done? Do people feel others think the behavior should be done? Is there community support?
Economic factors	What are the financial barriers or facilitators with regard to the behavior?
Sociocultural and gender factors	What religious or cultural practices or gender norms or dynamics influence behavior?
Structural factors	What regulations, policies, or access issues may influence the behavior?

Insights from the analysis are summarized in the next sections. First, the components of the community context are discussed, and then the context and potential drivers for each behavior are examined. As anthrax and rabies were explored using different methodologies (anthrax through direct exploration and rabies through spontaneous mention), many of the sections are organized by disease.

Concern about diseases from animals relative to other health issues

Zoonotic diseases were not top of mind as a human health concern

When participants were asked about top health concerns for humans in their communities, they tended

- Common human health concerns**

 - Malaria
 - Diarrhea
 - Flu/coughing
 - High blood pressure
 - Yellow fever
 - Vomiting
 - Toothache
 - Sores
 - Tuberculosis
 - Asthma
 - Crocodile attacks
 - HIV
 - Rabies

to list influenza-like symptoms (cough, headaches) or other symptoms such as diarrhea, rather than specific pathogens. COVID-19, HIV, and malaria were considered concerning. Malaria was identified as being ever present by some, with a participant saying, “malaria is always prevalent. There is never a time when there is no malaria. It is always there” (male community member, FGD, Senanga).

Other participants’ concerns about certain illnesses varied by season. For example, an individual felt that when it is cold, malaria is a top worry, and when it is hot, stomach issues and swollen legs may occur. Noncommunicable diseases such as blood pressure and diabetes were also top of mind for the general population. Health concerns were defined more broadly than pathogens, with people expressing concerns about facts such as the health facilities being far away, people not having access to mosquito nets, wild animals attacking

individuals, and their communities having challenges in keeping drinking water safe. A participant said,

The water we drink is found to be untreated water. It comes direct from the river. So as a result, some time back, this our clinic, the health [clinic] used to give us chlorine,

but these days it is not there. These days we boil but no one is concentrating on that, we forget. (Male community member, FGD, Kazungula)

Zoonotic diseases appeared to be less salient for the general population, and they did not enter the conversation without prompting from the facilitator. For example, a group in Kazungula did not mention zoonotic diseases as a concern, but when prompted, they expressed that people are at risk of diseases from animals through shared drinking water. During an IDI, a health worker in Choma said, “So, from my practice for the time that I’ve been here, I think I’ve never really, I’ve never come across a person dying from a disease that came from an animal.” However, she also described exposure to animals as a problem, saying, “We mingle with these animals more—I’ll give an example. When you go outside sometimes you’ll find a cattle is just moving all over in your compound; it’s different from the urban setup.” Veterinary staff tended to list zoonotic diseases as top concerns, particularly rabies and anthrax. Rabies was particularly concerning for health workers and for the general population once the topic of zoonotic diseases was mentioned. Rabies was perceived as a severe disease, with one participant saying, “If a person gets infected by rabies at some point, if that dog was not vaccinated, he or she can even die” (female community member, FGD, Senanga). A health worker indicated that people know how to handle cattle in Southern province, but they fear dogs and take action if bitten, saying

Most people at least they have the little knowledge about the rabies. So, you find even when someone is bitten by a dog, at least they make an effort to go to the veterinary personnel to go and check if the dog is fully vaccinated. (Health worker, IDI, Choma)

Participants in general population groups lacked specific knowledge of how anthrax manifests in humans

The general population groups tended to be unclear about the symptoms of anthrax in humans. For example, in an FGD with male community members in Kazungula, the conversation with the facilitator illustrated this lack of awareness:

Interviewer: How can you know that a human being has anthrax?

Participant: We have no idea.

Interviewer: You have no idea?

Participant: Yes.

Interviewer: All of you have no idea?

All: Yes.

A participant in Kazungula said that anthrax symptoms could easily be mistaken for COVID-19 symptoms.

Some participants expressed the common misconception that anthrax is highly contagious from person to person. Meanwhile, a minority opinion indicated doubt that anthrax really exists, with a participant saying,

Anthrax, we don't take it that it kills. We just take it that it is a story. Because it has never hit us here at [location anonymized], we don't know it, we are just hearing about anthrax, but we don't know that this disease is. (Male community member, FGD, Kazungula)

However, others disagreed, saying "[Anthrax] has no cure. Once you get sick of it, you die" (male community member, FGD, Kazungula).

Some individuals, while having a general sense of anthrax symptoms, confused cutaneous and gastrointestinal anthrax. A female participant in a focus group listed coughing and sores as potential signs of anthrax, saying, "A person can suffer from sores, and when the person goes to the hospital, they will be told that the sore is caused by meat that was eaten" (female community member, FGD, Senanga). In an FGD, a male cattle herder in Senanga likewise said,

You can notice that a person has anthrax disease by thinking maybe a person had eaten such meat. You will see that the person will have a very big sore that is scary and can be on any part of the body and you will notice that it is anthrax.

People felt that anthrax is severe and difficult to treat in humans. A participant said,

The ones that are most concerning are anthrax and rabies. This is because these lead to death. Once you catch the disease, you are likely to die after a short time. These other diseases are not very concerning. For instance, diarrhea...if it is diarrhea, it is easy to go to the clinic to receive treatment and recover within a short time. (Male community member, FGD, Senanga)

On the other hand, the fact that anthrax is rare in some places made it less concerning to some participants even though they considered it to be a severe disease.

Rabies in humans was more salient than other zoonotic diseases

For many participants, rabies was one of the most concerning diseases that could come from animals. A group in Senanga discussed this topic, saying

[Participant 1] For rabies found in dogs, if a dog bites a person it brings problems because even the person gets infected...

[Participant 2] If a person gets infected by rabies at some point, if that dog was not vaccinated he or she can even die. (Female community members, FGD, Senanga)

Although rabies was mentioned by the general population on the list of health issues they faced, community leaders, health workers, and veterinarians expressed strong concern specifically about

rabies and felt that the general population was not sufficiently worried about it. One veterinary worker stated the following:

There are some that are concerned, that are taking measures to prevent those diseases coming to them. But there are others that are just relaxed... [T]hey know, but they just don't bother to take a step because they feel their traditional way is the best. Yes. So, it's in the communities—fifty-fifty, there are others that feel traditional way is the best. And there are others that are coming out, taking a step, preventing these diseases. Like rabies, people are coming out to have the dogs vaccinated. (Veterinary worker, IDI, Kazungula)

Participants had a strong sense that rabies was dangerous for children, but described being in a bind because dogs are needed to protect against thieves. An individual said that

We cannot manage to live without our dogs. We have a challenge because our dogs become mad especially as we approach the cold season. A lot of our dogs go mad. Many of our children have died after being bitten. By the time they get to the clinic, it is too late for them, and they end up dying. (Female community member, FGD, Senanga)

Participants were concerned about diseases that threaten their animals

Common animal health concerns

- Foot and mouth disease
- Contagious bovine pleuropneumonia
- Lung diseases
- Scabies
- Lumps on skin or body
- Anthrax
- Swollen legs
- Blackleg
- Diarrhea
- Heartwater
- East Coast fever

Participants described being concerned about a variety of symptoms in animals, particularly cattle, such as diarrhea, black leg (clostridial myositis),¹⁶ limping, sores, and cough. Cattle herders tended to give more examples and specific disease names, including zoonotic diseases, but still tended to emphasize the signs rather than the causal pathogens. Cattle herders listed foot and mouth disease, contagious bovine pleuropneumonia, heartwater (cowdriosis),¹⁷ East Coast fever,¹ and various other illnesses. Groups rated their concern about animal diseases differently, with some groups expressing more concern about diseases that affect cattle frequently even if they could be treated, and others indicating that the most concerning diseases were those that could not be treated even if they were rare. One individual indicated that prioritizing

health concerns affecting animals is hard because without getting the animals tested, the cause of death remains unknown. Participants also expressed concerns about issues beyond health such as theft.

Cattle herders expressed strong concern about animal health, as cattle are their main source of income and the most important part of their livelihoods. For example, with respect to the economic impact of foot and mouth disease and other animal diseases, an individual said,

¹ <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/east-coast-fever>

It affects people's ability to have food. When their cows die, people are not able to farm. When their cows die, they have no way of transporting their vegetables to come and sell here so that they can have an income to buy soap and other groceries. (Male community member, FGD, Senanga)

This concern was felt to be a communal threat, as explained by a cattle herder in Kazungula,

When cattle are attacked by diseases, everyone complains, because they will have nothing to plough their fields. They will have nothing to use when pulling back firewood. Those with cattle work for everyone. (Male cattle herder, FGD, Kazungula)

Participants were aware of anthrax in animals

For the general population, anthrax is most relevant as an animal disease, not a human disease. Individuals identified anthrax by its symptoms in animals and its origin from animals, primarily conceptualizing it as an animal disease. One male member of a general population FGD mentioned anthrax unprompted, saying

You find you are at an area, when you wake up you find the cow is dead. When it dies, after you skin it, you find it has the disease called anthrax. You find a big part of it is covered with blood. After skinning, people come to cook and eat it. That's where I see most disease come from. (Male community member, FGD, Kazungula)

Participants shared the perception that anthrax has been around for a long time and causes death in animals.

Even naming anthrax caused some controversy. Groups would say that they had never heard of anthrax, but when the signs in animals were listed, it emerged that they had in fact heard of it. No consensus existed on a Tonga name for anthrax, but people tend to call it "spleen." For some individuals, other animal diseases were more relevant even if they had heard of anthrax due to geographic susceptibility. As one participant in Kazungula said, "For anthrax, we don't have much of it here. It's more on the western side. So on this side, we haven't really seen it.... but foot and mouth, every year it's found in cows" (male community member, FGD, Kazungula).

Causes and transmission of anthrax were not well understood

Participants shared a variety of misconceptions about what causes or transmits anthrax. Some said generally that a disease with symptoms like those of anthrax could be suspected of arising from witchcraft or a similar origin, although others did not view anthrax in that way any more than other illnesses. A veterinary worker described a conspiracy theory in which people believed vets were spreading anthrax. Some participants misunderstood the nature of anthrax, saying that it can be transmitted from any animal, that it can come from drinking milk, that it is incurable, or that it spreads through smoke. Some groups believed that anthrax can come from water or wild animals.

A veterinary worker felt that the knowledge about how anthrax spreads was even more of an issue than the risk perception, saying that people “know that at the end of the day it kills. But where exactly it comes from, they’re not convinced at the moment” (veterinary worker, IDI, Choma).

Certain precautions to prevent zoonotic diseases were more top of mind

Interviewers first asked participants what precautions they could take to prevent anthrax or zoonotic diseases more generally. The interviewers then delved into specific behaviors to determine what people knew about these practices and what they actually did. These discussions also included the perceived importance of the behaviors and the feasibility of performing them, as well as other potential drivers such as supportive norms or gender roles.

With regard to actions people can take to protect themselves and their cattle from illness, dip tanks were a focus for cattle herders, and vaccinating animals also tended to be top of mind. A health worker reinforced this observation, saying “they know the basics like having their animals vaccinated for instance those that [have] the domestic pets like the dogs” (health worker, IDI, Choma). Eating infected meat was one of the few risk factors that was spontaneously mentioned.

[Y]ou go to the bush and you find a dead animal. Then you come and get the meat from that animal and eat it. You don’t even know what killed that animal, you just eat it. Once you finish it, you find that you even get sick. Maybe that animal had a disease that caused it to die. So you have diarrhea and complain that maybe it’s the season. You forget that it’s the animal you ate. (Male community member, FGD, Kazungula)

One participant expressed a lack of efficacy in avoiding diseases in animals at all, saying “Some disease[s] come, just like in humans. It is inevitable, but sometimes it gets healed through medication, but sometimes it fails and we lose” (male cattle herder, FGD, Choma). Others, while acknowledging the risks of diseases in animals, especially those that have died, expressed that people had little choice but to still eat the meat owing to poverty and hunger. Some participants described complacency toward prevention of zoonotic diseases. They suggested that people with domesticated cattle will wait until several die before they start trying to prevent illness rather than simply treating it as it occurs, saying they have no money. The phrase “wake up” was used, referring to the need to invest in preventing illness. However, a health worker felt people are resistant to changing their cultural practices, describing them by saying the following:

We are used to doing things this way. Sometimes, for example, you are telling an elderly person maybe who is 40, 50, or 60 years, this person will tell you, from the time I was born, I have been doing this—so, now what has changed? (Health worker, IDI, Choma)

Key behaviors: Anthrax

Behavior: Vaccinate animals

Vaccination was the most top-of-mind behavior in terms of prevention. One health worker said that people do not necessarily know other precautions and “all they know is vaccinations” (health worker, IDI, Kazungula). Overall, cattle herders felt that vaccinating cattle is important because it is less costly than treating a sick animal. One said, “Protecting animals is better and cheaper than treating. Once a disease hit in a kraal,² it is difficult to have the animals treated” (male cattle herder, FGD, Kazungula). The importance and the feasibility of vaccinating were linked for those convinced of the usefulness of vaccination. When asked if it is easy to vaccinate cattle, a participant replied, “It becomes easy to vaccinate it before it gets sick because once it gets sick, the medicine it will require will be more expensive, about ZMK700 [about \$28]” (female cattle herder, FGD, Choma). Another female cattle herder in a different FGD said something similar. When asked “How does it become easy?,” she responded, “When you see that before it spreads, we should prevent it” (female cattle herder, FGD, Kazungula).

From a financial perspective, a veterinarian added that vaccinating animals allows them to grow and increases their value, saying “Animals that are not vaccinated of course will get diseases so quickly, they don’t grow well and to reach that... that market weight. So each time there is a planned schedule of vaccinations... farmers bring [them]” (veterinarian, IDI, Choma).

On the other hand, participants felt vaccination was expensive, with one cattle herder giving the following explanation:

It is difficult because the medicines are expensive, so government should help us so that vet inject our cattle. As we said that they should be visiting us after six months in order to protect our cattle. Finding money on our own is difficult, that’s why we fail and they die. (Male cattle herder, FGD, Senanga)

Another cattle herder in an FGD in Choma felt that people fail to treat their cattle like a business that involves investment and thinking ahead; they instead have more of a “poverty” mindset, meaning that they only try to find money to treat their animals once the animals are sick. This reactive mindset undermines the people’s ability to grow a business. A similar observation was made by a veterinary worker:

There are people who are business-minded when it comes to cattle, and they make sure that they make sure they manage the livestock in a way they should. But most of the time I think most of people have a have a traditional perception on how to keep their livestock... We have a Tonga tradition where people will just keep the cattle for prestige. They will only sell off the animal when it’s maybe at its end, but then the taking care of [it] is really not done—the management part where you dip

² A kraal is an animal enclosure.

Vaccination of animals Key themes

- Vaccination is a top-of-mind prevention behavior.
- Vaccinating cattle is perceived as important because it is cheaper than treating a sick animal.
- Anthrax vaccination is known to be both a routine and an emergency approach.
- Fear exists that vaccines are low quality.
- Concerns exist about costs.

your animals to make sure there are no ticks on it, where you vaccinate it...”
(Veterinary worker, IDI, Senanga)

Another veterinarian echoed this concern, saying, “Maybe when they have money they would procure the vaccine quickly; at an appropriate time, they vaccinate. But yeah at times also when they don’t have money, they will just like let [laughs]” (veterinary worker, IDI, Senanga). Cattle farmers did point out that some vaccines, including anthrax, involved charges, saying “When the vaccine is done, it’s mostly not free, they bring at a fee. We are still requested to pay” (male cattle herder, FGD, Choma).

One member of the general population expressed concerns about the quality of the vaccines, saying “They should be looking at the vaccines they use on cattle because maybe sometimes it has expired. Because just after [vaccinating] them that’s how they all got sick” (female community member, FGD, Senanga). Women in Senanga and a veterinary worker in Choma referred to rumors that cattle had died after being vaccinated. Participants also expressed a desire for vaccines that are strong, with one participant saying, “as they are protecting against such diseases, vets shouldn’t dilute their medicines so much. Instead, they should bring one that is powerful and can end the disease” (female community member, FGD, Senanga). Surprisingly, a veterinary worker expressed the fear that vaccinating cattle against anthrax when no outbreak was occurring would spread spores into the environment. That worker thought routine vaccination should be discouraged, saying

We really don’t want to encourage farmers to be vaccinating against anthrax when the situation is just calm because, you know, if it’s an imported vaccine and it’s just dropping anyhow those spores. They can still bring—where there was no anthrax, they’ll start having anthrax now.” (Veterinary worker, IDI, Kazungula)

In general, vaccines were acceptable and trusted, but the occasional misconception that was shared may reflect an underlying confidence issue.

From the perspective of a veterinarian in Choma, perceived risk motivates some people to seek vaccination for their animals. He said, “It’s not every farmer who vaccinates, but those that feel like let me do it. And maybe in those places that...outbreaks have been, they are responding” (veterinary worker, IDI, Choma). A veterinary worker in Kazungula echoed this belief, saying

These farmers like for Kazungula, they have never seen anthrax. So, we just talk to them that anthrax is like this, and they hear it is somewhere. So, when they hear it is closer, it will be easier to convince them to have their animals vaccinated.
(Veterinary worker, IDI, Kazungula)

Individuals framed animal vaccination as a seasonal, routine practice and part of the rhythm of cattle raising or as a regular annual practice. However, they were also aware of vaccination as part of an outbreak response, citing examples of past outbreaks in which veterinarians went from kraal to kraal to vaccinate. Participants pointed out that the financial charges for vaccination differ depending on whether vaccination is an outbreak response or part of routine care. A veterinary worker in Senanga said that people may wait to vaccinate until a situation reaches a crisis stage because they know the

vaccines will then be free, owing to the differentiation between “diseases of national importance” for which the government pays and “management diseases” for which the farmer must pay. Veterinary workers also mentioned the unavailability of the anthrax vaccine as a barrier to vaccination.

TABLE 6. BEHAVIOR CONTEXT AND DRIVERS: VACCINATE ANIMALS	
COMPONENT	FINDINGS
Awareness/salience	The behavior was top of mind and mentioned spontaneously.
Knowledge	Participants understood the benefits and process of vaccination, though the reported schedule and costs were not always consistent.
Government initiatives	Cattle herders indicated they are responsible for the cost of anthrax vaccines. However, they were aware that the government may cover the vaccines in an outbreak setting.
Influencers and information sources	Veterinary staff were described as the source of vaccines and influence uptake. Mass media may influence people to be ready for vaccination campaigns or appointments.
Misconceptions (infodemic)	Participants shared rumors about hearing that cows died after vaccination or that vaccines were expired or had low quality.
Response efficacy/perceived importance	Apart from a few misconceptions, vaccination was perceived as very important and useful. Prevention was viewed as being better than treatment.
Self-efficacy	Participants felt equipped for this behavior when the vaccines are part of emergency response and the vets bring them “door to door,” or when vaccinations are included in the rhythms of the year.
Perceived norms	Vaccination was viewed as an acceptable behavior. The barriers were mostly cost and availability.
Economic	Finances were the main barrier when a cost is associated with the vaccine.
Sociocultural and gender	“Business versus prestige” was a component of why people neglect to pay for vaccination, meaning that they keep cattle for social status rather than organizing their finances to invest in prevention of disease.
Structural	Mandates and enforcement were not mentioned.

Behavior: Cover open wounds while handling animals

Participants expressed little awareness of the importance of covering wounds while handling live or dead animals or animal products. This practice was not spontaneously mentioned as an important precaution. One participant in Choma mentioned that “If it’s found that they have a cut, that disease from the animal will mix [with the] blood of the person” (female community member, FGD, Choma). For most groups, covering wounds was not a behavior that participants felt was widely known or was simply not considered important or feasible. With regard to covering wounds when touching animals or animal products, one participant said, “We haven’t had much knowledge about that” (female community

Cover open wounds

Key themes

- Awareness of the importance of covering wounds is low.
- Perceived support for the behavior from others in the community is limited.
- When prompted, respondents agreed people “should” cover wounds.
- Poor accessibility of protective clothing or equipment impairs self-efficacy.

member, FGD, Senanga). In a cattle farmer group, female participants agreed that it is not done, with one saying, “We don’t use anything to protect ourselves. We just cut it. No preventions, you just ignore, you know life as usual... we don’t wear anything, we just hold and cut. We believe the disease cannot enter us in cutting” (female cattle herder, FGD, Choma). When asked the reason, the participants agreed that “most people do not protect themselves because they do not know that they have to” (female cattle herder, FGD, Choma). There did not appear to be a supportive norm around wearing protective equipment particularly to cover cuts or wounds, with one participant even saying she has never seen someone

wearing gear even when slaughtering. A health worker said, “You find that even when they are skinning it, they use bare hands—they don’t use any protection or anything. Them, to them it’s normal” (health worker, IDI, Kazungula). In a couple of cases, individuals could identify what people should wear generally when handling animals or slaughtering (boots, gloves dust coat), but they said that it does not happen, even if the cow is sick: “They just hold. You find he is stepping on the cow barefooted and cutting with his bare hands” (male community member, FGD, Kazungula). An individual in Choma cited economic or access barriers, saying “They do not have what to wear” (female community member, FGD, Choma). When prompted, a few participants indicated that some people do cover wounds and cover their body generally while slaughtering or handling animals, but it was a minority opinion.

TABLE 7. BEHAVIOR CONTEXT AND DRIVERS: COVER OPEN WOUNDS WHILE HANDLING ANIMALS

COMPONENT	FINDINGS
Awareness/salience	The behavior was not top of mind.
Knowledge	The possibility of contracting anthrax or another illness through a skin wound was not well understood. Participants could list protective gear (gloves, boots, apron) for general slaughtering, but they were not knowledgeable about cutaneous anthrax.
Government initiatives	No data
Influencers and information sources	No data
Misconceptions (infodemic)	No data
Response efficacy/perceived importance	Some participants agreed, when asked, that the behavior is a good idea while others felt it is not important.
Self-efficacy	Participants did not feel that the behavior is particularly feasible, but lack of awareness or perception of importance appeared to be the greater barrier.

Perceived norms	Participants felt covering wounds to handle animals was not common or expected.
Economic	Participants mentioned not having the gear.
Sociocultural and gender	No data
Structural	No data

Behavior: Avoid eating meat from animals that died of sickness or unknown causes

Across the board, participants expressed a definite awareness of the dangers of eating meat from a sick animal or one they had found. This practice prompted the most discussion and was associated with the most nuance. Generally, participants framed it as a high-risk, low-adoption behavior, with one participant in a general population FGD saying “No one can even deny that in this area, many cattle are dying from anthrax, but people are selling and eating, even preserving the meat” (female community member, FGD, Senanga).

Participants appeared to experience major dissonance between what they know they should do and what they actually do. Some differentiated between “can” and “should,” saying “it can be eaten” but then later noting that “you are not supposed to eat it” (male community members, FGD,

Kazungula). Individuals struggled to balance the more distant or uncertain threat of illness against the immediate needs posed by hunger. One participant said, “Just a thought of throwing the meat when my children do not have [meat] at home makes me want to eat it, forgetting that we are killing ourselves” (female community member, FGD, Senanga). A male participant in Senanga echoed this cost/benefit analysis, saying “When a person takes into consideration all the money that has been spent, they would rather just eat the meat even though it might lead to death” (male community member, FGD, Senanga).

Participants felt that losing the value of the animal completely was unacceptable, so urgency was required to figure out how to recover something by eating or selling the animal. A variety of strategies were suggested for dealing with this situation. These strategies largely reflected compromises people were willing to make in light of their inability to reach the ideal, rather than a lack of knowledge about what should be done. One approach participants described was to compromise by removing the sections of meat that appeared diseased—“They can just remove the part which seem to have brought the sickness, they cut that part and throw it away and eat the remaining part, saying it’s okay [participants laugh]” (female community member, FGD, Senanga). A practice that prompted a lot of discussion was selling the meat quickly, knowing that it would bring less money but perhaps still recover part of the animal’s value. Selling the animal was seen as an acceptable compromise, if it was done quickly,

Avoid eating meat from sick or found animals

Key themes

- High perceived risk and awareness of the risks
- Major dissonance between the ideal and what people actually do
- Lack of social support or pressure
- Multiple steps, influencers, and strategies to deal with the scenario involving quickly selling meat at a lower rate, sharing or bartering for the meat, or leaving it

After I see the cow has died on its own, the first priority is the loss that I have incurred. After thinking about it, you say let me just skin it and give it to people to buy it. I don't know what has killed it. Automatically here what we do is just to skin it and take it to people to buy it. (Male community member, FGD, Kazungula).

Another participant in the same group agreed, saying that he would “cut it up into pieces, because pieces here cost about ZMK30 or ZMK20 [\$0.78-\$1.20], then we put it in an oxcart and bring it to the roadside and we start selling it. That is the truth of what we do” (male community member, FGD, Kazungula). Some people offered credit or barter rather than the usual rate for a healthy, slaughtered animal.

The size or value of the animal mattered to participants. They felt they could perhaps throw away a small or skinny cow but not a large one. In this framing, the weight of the benefit in a cost/benefit analysis could be measured in kilograms. A participant said people “can throw away a very skinny cow and whose meat is white but not a big one, even the owner can put in the pot and cook” (female community member, FGD, Senanga). Another said, with respect to which animals could be thrown out, “Let's not lie—we maybe do chickens, not cattle” (female cattle herder, FGD, Kazungula). The secrecy and urgency with which participants discussed the practice highlighted the gap between what should be done and what is done. Individuals described sick animals as something to be hidden: “What we do is, you find the cow is sick, you call a buyer to come and slaughter it because that buyer will not tell the vet, just in case it has diseases. It becomes a secret” (male community member, FGD, Kazungula).

Laughter was common when discussing the cognitive dissonance and compromises people made to deal with the gap between the recommendations and the reality. One group had a heated debate about whether the practice changes depending on whether the animal was sick before it died, with some participants expressing concern about eating sick animals, and others saying “For us, there is no difference between the two when it comes to eating the meat. There is nothing like looking down on the meat because the animal died on its own. We just eat [laughter]” (male community member, FGD, Senanga).

Another participant described first dealing with the dead animal and then calling the vet, saying he would butcher the sick animal and sell the pieces, and then afterward call the vet to get a diagnosis and give the recommended medicine to the other cows. When prompted, participants generally felt they should call the vet to test the animal or the headman to make the decision. This enforcement was felt to be important, with participants feeling that people would not follow through unless the veterinary officer supervised the burning of an animal diagnosed with anthrax or another disease. However, participants expressed low self-efficacy in following all the steps involved in reaching a veterinarian, getting the animal tested, and waiting for the results. One participant explained that one reason that people do not call the vet was that “Some people live far away. In some places such as [anonymized], there is no vet officer. People just eat the meat. Where can they go to report? There is nowhere” (male community member, FGD, Senanga). Other participants complained that veterinarians charge gas money to come to check an animal.

In some cases, participants said that there is no intention to deceive people, but rather that this practice reflects a communal understanding that people have different standards driven by economic factors and misconceptions:

Poverty makes us people get into doing wrong things even when we know very well that it is not right. Because with poverty, when you look at meat you can just say shuu.... Even our neighbors can know exactly how the cow died, but instead of them encouraging us to burn it, they come with money in order to buy some. So, poverty makes us sell the meat so that we can use the money for...even relish [participant laughs]. (Female community member, FGD, Senanga)

Another participant said that even if an animal died of sickness, there was general consensus that the meat could be treated in a way to make it safe to eat. A participant in Senanga explained that

In our communities, what we do is that if we have slaughtered a cow that had anthrax, we make sure that the insects on the meat have died before we cook it. [Other participants murmured in agreement.] We also make sure that we hang the meat to dry. When all the blood has dripped out and all the insects have died, we can then eat the meat. (Male community member, FGD, Senanga)

Some participants noted strong social pressure to eat the meat of an animal, even if it had been sick. A participant asked, “What can we do, if a cattle dies of this same disease, and your neighbor tells you to give them, so they eat it and not burn it? What can you do?” (male cattle herder, FGD, Choma). Another individual said, “Neighbors are not our enemies, and we can’t decide to eat alone” (male cattle herder, FGD, Senanga). A community leader disagreed and said that this was a low-adoption practice, referencing past outbreaks and people’s current fear of eating meat from sick animals. The leader stated that a growing number of people do not eat meat from animals that died of illness or unknown causes.

Some participants were unwilling to eat meat from a sick animal themselves, but they were still willing to share it with or sell it to people who do not mind eating the meat from an animal that died of unknown causes. This mindset applied even to leaving animals for others to find, with a male member of a general population FGD giving an example:

Speaking for myself, the first cow I bought was a bull. Then it got sick, then after that it died. Then I said this animal cannot be eaten, it’s better we leave it even in the bush then the dogs can eat it if they want or if any person wants, they can eat it. But for me, I feel it is not supposed to be eaten because it was sick. (Male community member, FGD, Kazungula)

A small group of participants were concerned about whether meat at markets or restaurants is trustworthy or not, because they assumed that some people lie:

When we see that our animal is sick, and it reaches the extent of dying on its own, and then we skin it and cut the meat properly and take it to the market so when people come, they ask, was this animal just slaughtered or did it die on its own? Then

we say it was just slaughtered, then they buy the meat. (Male community member, FGD, Kazungula)

Another participant described, humorously, the concerns about selling meat from a sick cow and later eating it yourself:

Even at eating places, you will sit and eat the same cow you sold out and then you also contract it and then start accusing Mr. [anonymized] that he has bewitched you, forgetting that you sold the diseased meat from a cow that died on its own. (Male cattle herder, FGD, Choma)

One individual mentioned feeding the meat to another animal such as a dog to test it in order to “see if it can die or not, and if it doesn’t, then we cook it” (male cattle herder, FGD, Senanga).

Some participants, despite the strong reactions around this behavior, felt that cows do not commonly die on their own. One female cattle herder suggested that between dipping and vaccinations, cows typically die of other causes that do not lead to disease.

With respect to hippopotamuses, most participants agreed that some people might eat hippo meat, but hippos were generally frightening both because of their size and wildness and potential legal ramifications. A participant in Kazungula said, “If I go report to Mr. [anonymized] that I have found a dead hippo, they will arrest me” (female community member, FGD, Kazungula). Another participant said, “The way a hippo is, it is a big animal for it to be found dead and rush to say huh let me start cutting. You don’t know what has killed that animal, fear takes over us” (male cattle herder, FGD, Kazungula). Others were afraid to be accused of killing a hippo if they found one dead and would leave it alone. However, some participants described the misconception that animals in water cannot have diseases. Male participants in a cattle herder FGD in Kazungula stated that moving water is safe, but moving animals are not:

[Participant 1]: To us people, there are no dangers because this water is not stagnant. The water is moving, so you will find that where someone drunk from, the things will pass and then you can drink. But what we are talking about is that during the time when the Namibians and the Zambians meet here, like animals come from there coming here and coming from here going there like hippos, elephants but for dangers whereby us people could get diseases, huh there is nothing. What was frightening us was anthrax, but it has not yet reached here.

[Participant 2]: Yes, because it is Zambezi with its children and Zambezi is living water which cannot contain diseases because it is not stagnant. So, there we don’t find any problem there yes, there we don’t see any problem.

TABLE 8. BEHAVIOR CONTEXT AND DRIVERS: AVOID EATING MEAT FROM ANIMALS THAT DIED OF SICKNESS OR UNKNOWN CAUSES

COMPONENT	FINDINGS
Awareness/salience	The behavior was top of mind and often the first risk behavior mentioned.
Knowledge	Participants were clear on the fact that contaminated meat can cause disease, although technical terms (e.g. gastrointestinal, cutaneous, spores) were typically not used. Some unsafe practices, such as air drying meat from an animal that died of illness, were considered acceptable.
Government initiatives	Enforcement of regulations that restrict interactions with live or dead hippos is a supportive contextual factor.
Influencers and information sources	Participants described keeping the practice a secret in some cases, but more commonly it was a multifaceted decision-making process involving a constellation of neighbors, leaders, and veterinary workers.
Misconceptions (infodemic)	Some participants believed that diseased meat can be cut away from safe meat in a sick animal; others felt all meat from a sick animal is unsafe.
Response efficacy/perceived importance	The practice was seen as very important to prevent getting sick, although participants felt certain strategies mitigate the risk and lower the importance.
Self-efficacy	Participants felt that this practice was not feasible, mainly for economic reasons.
Perceived norms	The perceived norm for this behavior was unfavorable, with participants believing that most people eat meat from sick animals or those that died of unknown causes.
Economic	Economic considerations (e.g., loss of investment, poverty) constituted a major factor.
Sociocultural and gender	Participants mentioned religious considerations about eating animals.
Structural	Accessibility of veterinary staff to rapidly test the animal was a factor, although people sometimes avoid calling the vet for economic reasons.

Behavior: Properly dispose of animal carcasses by burning or burying

Once people have decided not to eat a dead animal, participants said that the guidance on properly disposing of carcasses is clear. For most groups, proper disposal was not spontaneously mentioned as a primary behavior to prevent anthrax. When participants were listing top health concerns, an individual in an FGD in Senanga included “the same issue of anthrax that you mentioned. That is very dangerous, so we just bury the cow when it dies. The disease is very scary so that’s how we take care of ourselves” (male cattle herder, FGD, Senanga). However, participants generally felt proper disposal required a lot of commitment to follow through and was difficult to carry out as recommended. A participant summarized the reluctance to go through all the necessary steps, saying “It is not like I am opposing it,

but the patience where we have to bury, burn [participants laugh], it seems that to people it is not there” (male community member, FGD, Kazungula).

Properly dispose of carcasses

Key themes

- Considerable deliberation exists on what to do if an animal dies of illness.
- People take input from neighbors and influencers.
- Burning or burying carcasses requires a lot of commitment and resources.
- Logistical or financial challenges lower self-efficacy.
- Burning is preferred to avoid people or animals digging it up.

Similar to the avoidance of eating meat from an animal that was sick or found dead, there was dissonance between the “ideal” and the actual practice. A participant said, “That rarely happens, people don’t do that but ideally that is what is supposed to be done” (female cattle herder, FGD, Choma). Another participant in the same group said, “That is why we bury, meaning we have also buried the disease. That’s our thinking” (female cattle herder, FGD, Choma). In some cases, disposal of a dead animal was perceived to be a community decision, with individuals calling neighbors to help them decide about calling the veterinary staff versus just burying it. If the

vet could not be reached or was believed to be far away, people would just bury the animal. The headman was also supposed to confirm the decision. There were differing opinions about oversight and notification, with some listing veterinarians or human health workers and others emphasizing the need to notify someone in the local government. In some cases, participants explained that burying an entire cow deep within the ground was too difficult, so the animal would be cut up and the various parts would be buried in different places. Access to shovels or the use of proper protective equipment needed to bury a cow was rarely mentioned. However, an individual in Kazungula described a personal experience:

The disease anthrax, when a cow suffers from anthrax, when it dies, blood comes out on the body, so even us, we have buried about five cows. We found that it was just coming out blood, so we had come to the veterinary to report. They told us not to eat the meat, that it was anthrax, so that’s when we dug a hole that was two meters deep. That’s when we got the dead cow and pushed it in the hole. (Female community member, FGD, Kazungula)

Burning the animal was considered the safer choice, since a buried animal could be dug up and eaten by people or dogs. However, burning posed logistical challenges with finding petrol, taking the time to burn the dead animal to ash, and properly disposing of the ash and any remaining bones. A woman said, “We can’t find diesel in the village, so we can look for oxcarts and go in the bush and collect a lot of leaves, put it in there and burn it” (female community member, FGD, Senanga). Soil transmission had very little discussion, but a male cattle herder described training he had received from vet officers’ teachings:

They tell us that this disease takes long time such that where a cow has died from, the disease can be there for fourteen years on that area. If it is on the ground, a cow that will graze from there will be infected. So that is why there is a protection of burying or burning. (Male cattle herder, FGD, Kazungula)

A community leader felt that a widespread proposal to vaccinate all cattle and incinerate all carcasses of cattle that were sick or died of natural causes would be well received if people understood the financial

and health consequences of zoonotic diseases: “As long as it’s not the kind of measures that appear very stringent, that are easy to understand, or that do not completely go against their experience of the same problems” (community leader, IDI, Senanga).

TABLE 9. BEHAVIOR CONTEXT AND DRIVERS: BURN OR BURY CARCASSES OF ANIMALS THAT DIED OF SICKNESS OR UNKNOWN CAUSES	
COMPONENT	FINDINGS
Awareness/salience	The behavior was not mentioned spontaneously, but general awareness existed.
Knowledge	Cattle herders understood the importance beyond simply preventing people from eating the animal. In the general population, the behavior is linked to the decision about eating meat from an animal that was sick or found dead. Burying was discussed in less detail than burning.
Government initiatives	Participants discussed insurance to cover losses, and “following rules” was mentioned.
Influencers and information sources	A communal decision was sometimes sought. Veterinary workers and headmen influenced and enforced whether the behavior is performed correctly.
Misconceptions (infodemic)	No data
Response efficacy/perceived importance	Participants viewed proper disposal of carcasses as important, once the temptation to eat or sell the animal is overcome. Some participants felt that leaving the dead animal unburied is okay.
Self-efficacy	Participants felt that proper disposal is possible but not easy because of digging, getting the fuel, and committing time to the task.
Perceived norms	The behavior was framed as ideal but often not done.
Economic	Apart from buying fuel, losing the opportunity to eat the meat was considered a greater economic burden than proper disposal.
Sociocultural and gender	No data
Structural	Participants mentioned enforcement through traditional system and suggested the creation or enforcement of a widespread “local” command.

Behavior: Thoroughly cook meat before eating it

With respect to eating meat, there appeared to be a lack of clarity or standard guidance on how to prepare meat so that it was safe. Practices varied, with participants eating organs right away but drying meat for later, or simply frying it, or boiling it for a short time period or for multiple hours. One FGD participant reinforced that cooking time varies, saying “This meat is cooked differently from one person to the other. Others don’t boil it for long, maybe even less than five minutes” (male community member, FGD, Kazungula). Another participant said that older women tended to boil meat longer. Some

participants insisted that meat can still have diseases no matter how long one boils or dries it, whereas others felt that between cooking or salting and drying, the meat will be safe. For some groups, neither time nor temperature was typically measured systematically and was not involved in the assessment. Rather, individuals determine if the meat is thoroughly cooked based on whether it falls apart or sticks to the pot. A participant said,

In our preparations, there is no amount of time or hours that has been agreed upon in which the meat can be cooked. It depends on how each individual household prefers to cook it. Some of them may just pour water once when boiling it and then fry it. (Male community member, FGD, Senanga)

Some participants believed that cooking meat uncovered would allow pathogens to evaporate through the steam. Despite the lack of clear guidance, a veterinary worker in Senanga listed boiling meat as one behavior that is feasible for people to do.

Thoroughly cook meat before eating it

Key themes

- Lack of clear guidance on how to cook to eliminate anthrax.
- People prepare different parts of the animal differently.
- Motivations for thorough cooking may relate more to eliminating medicine or vaccines than pathogens.
- Longer cooking times benefit people without teeth.

Participants listed other benefits to longer cooking times that did not relate to disease. Specifically, they felt that medicines or vaccines could be present in the meat and that the purpose of boiling was to eliminate them, rather than pathogens. Long cooking times were cited as a benefit for people without teeth because they would be able to eat meat more easily.

TABLE 10. BEHAVIOR CONTEXT AND DRIVERS: COOK MEAT THOROUGHLY	
COMPONENT	FINDINGS
Awareness/salience	Participants did not mention the behavior spontaneously, but they had general awareness sometimes for non-disease-related reasons.
Knowledge	Clear guidance is lacking on the method and length of cooking to kill anthrax specifically.
Government initiatives	No data
Influencers and information sources	No data
Misconceptions (infodemic)	Some participants believed that it is not possible to cook meat sufficiently to kill all the diseases. Some believed that cooking is only important to eliminate medicines or vaccines.
Response efficacy/perceived importance	The behavior was perceived as important, but clarity was lacking on what works.
Self-efficacy	Participants felt it is easy since they are cooking the meat anyway.
Perceived norms	The behavior was framed as acceptable, as well as prosocial to help people without teeth.

Economic	No data
Sociocultural and gender	Male groups could answer, but they said that women are in charge of deciding how long to cook meat.
Structural	No data

Behavior: Quarantine a new animal before adding it to the herd and separate sick animals

Separate new or sick animals Key themes

- Awareness of this behavior exists, but it is perceived to be for others (educated people).
- Priority/motivation is the cow getting adjusted to the herd and not running away rather than avoiding disease.
- Separating a sick animal is a good idea but not widely done.

The study explored practices around keeping a new cow separate from the herd to ensure it has no diseases, as well as isolating sick animals to protect other cattle. With respect to waiting to introduce a new cow, this practice was vaguely known, but there was a sense that “others” would do this but not “us.” One participant said, “I have seen somewhere else where they separate them and vaccinate them, and even dipping them before adding them to the fold. These are educated, but for here we just add them” (male cattle herder, FGD, Choma). Another participant indicated that there may be

Tonga beliefs about mixing but “for us we just mix them with the old cattle” (female cattle herder, FGD, Choma). Quarantining a new animal was not really considered in the context of disease but more about the cow’s experience in the herd. In fact, cattle farmers felt that waiting to introduce the cow delayed the cow getting used to the herd and herding practices. If farmers do tie up a new cow, it is to prevent the cow from running away rather than to prevent disease spread. A cattle herder in Senanga did mention foreign cattle as a threat, however, offering his first idea on preventing anthrax: “not mixing them with other cattle that we don’t know where they come from” (male cattle herder, FGD, Senanga).

The concept of generally keeping animals confined to a certain area, separate from human living spaces, was mentioned by a health worker as an important practice:

Our area here is full of cattle. So, one of the practices is that they’ve made a place where cattle are supposed to be found and not in the place where human beings sleep, so those are one of those practices, what they call kraal here, where you keep the cattle. (Health worker, IDI, Choma)

Separating sick cows from other animals was also a consideration. When prompted, participants typically mentioned it in the larger discussion of dealing with a sick or dying animal and the high-stakes decision-making during that time. As with other behaviors, some participants said that it was a common practice, whereas others differentiated between the ideal and reality: “I am saying it’s supposed to be alone so that you can take care of it properly, but here we don’t do that here. But that is a good idea” (male cattle herder, FGD, Choma). With regard to quarantining a sick animal from the rest of the herd, no consensus existed on what was involved. Some participants mentioned tethering the sick animal away from others or putting it in a separate wooden pen, while others mentioned simply manually separating sick animals and keeping an eye on their distance from others.

TABLE 11. BEHAVIOR CONTEXT AND DRIVERS: QUARANTINE A NEW ANIMAL BEFORE ADDING IT TO THE HERD AND SEPARATE SICK ANIMALS

COMPONENT	FINDINGS
Awareness/salience	The behavior was not top of mind. Occasionally, cattle herders mentioned keeping new cattle separate and having them vaccinated before they had contact with other animals.
Knowledge	Low knowledge of benefits and unclear guidance on standard practices were revealed.
Government initiatives	Participants mentioned permits that regulate moving cattle or adding new cattle to herds.
Influencers and information sources	No data
Misconceptions (infodemic)	No data
Response efficacy/perceived importance	The behavior was seen as beneficial or detrimental, sometimes for non-health reasons. It was perceived as important when the cow is sick, but detrimental for helping the cow quickly adjust to the herd. Lack of consensus existed about what type of quarantine works or is necessary.
Self-efficacy	Participants felt the behavior is not easy when it interferes with the cow adjusting to the herd.
Perceived norms	The behavior was not viewed as common or expected.
Economic	No data
Sociocultural and gender	No data
Structural	No data

Behavior: Slaughter animals and process hides safely by wearing appropriate gear

Participants listed many uses for hides, such as selling it or making it into ropes, drums, belts, bicycle seats, and a variety of other products. A male member of a general population FGD said, “The skin is very profitable to us. You can earn something out of it” (male community member, FGD, Kazungula). In one instance before an IDI began, one community leader pulled out five small stools made from cow sinew and hides for the research team to sit on. The idea of wearing protective gear while skinning an animal and preparing the hide did not emerge as a key practice for participants; the discussion did not suggest that people felt that slaughtering animals and processing hides were risky activities. In fact, individuals were more concerned about protecting their clothes from being bloodstained than using

Slaughter animals and process hides safely

Key themes

- Both meat and hides are very important, but the initial emphasis is more on meat.
- Preparing hides is not seen as particularly risky.
- Some people wear protective gear, but it is not a widespread practice.
- Tools are typically washed with water.

clothes to protect their skin, so they would take their clothes off to keep them clean. Some participants did feel that boots, aprons, and gloves should be worn and sometimes did so.

Participants indicated that tools are commonly cleaned with water after animals are slaughtered and skinned. Soap or disinfectant was perceived to be less common. One participant mentioned the importance of washing instruments used to cut meat out of respect for people who do not eat meat. A gender difference emerged in the full dataset. Specifically, men tended to settle for cleaning their instruments with water only, while women who did not have soap or washing paste on hand

would use ash or mealie meal to try to scrub better than water alone.

TABLE 12. BEHAVIOR CONTEXT AND DRIVERS: SLAUGHTER ANIMALS AND PROCESS HIDES SAFELY AND CLEAN INSTRUMENTS AFTERWARD

COMPONENT	FINDINGS
Awareness/salience	The behavior was not well known and was not top of mind.
Knowledge	Male cattle herders listed protective gear (boots, gloves, apron) and felt it was important to use. They saw blood as a health threat.
Government initiatives	No data
Influencers and information sources	No data
Misconceptions (infodemic)	No data
Response efficacy/perceived importance	The behavior was not seen as particularly important. Participants described people taking off their clothes to prevent blood stains rather than wearing gear to prevent contact with blood.
Self-efficacy	Participants expressed low self-efficacy, particularly with regard to lacking soap for washing tools.
Perceived norms	The behavior was perceived as unfavorable and not commonly done except in abattoirs.
Economic	Access to soap was a barrier.
Sociocultural and gender	Women and men may clean instruments differently.
Structural	No data

Behavior: Seek care for anthrax signs or symptoms in humans or animals

With respect to animals, certain signs prompt an immediate response of care-seeking. For example, a participant said that one should always call a vet to test a sick animal, but “especially when it starts going mad” (male cattle herder, FGD, Choma). Calling a veterinarian for a sick animal seemed to be the

simple and obvious action to take, but at times, the decision was being made in the context of financial and health complications. For example, if an illness seemed serious or hopeless, people might not call veterinary staff to avoid being told that an animal must be burned or buried. Participants also worried about calling the vet for testing in case it is an outbreak, and they would be forced to kill all the animals.

What really draws us back in this area is, I don't know if it's lack of knowledge or it's because of too much knowledge because you see that the cow is sick, they don't want to call the vet to check on it while it's still sick and determine what it is sick of. You just leave it until a point where it dies. You are scared that once you call the vet, they can say that all the cows are affected. So, it means we will get them all. So that is what we are mostly scared of, which prevents us from following the rules. Because we are scared to lose out just like as been already mentioned. (Male community members, FGD, Kazungula)

Another person in the group emphasized that they are less afraid of the other cows getting sick than being told not to eat the cow if it dies:

What I can say is this, what we run away from is, we are not scared that they will get all the cows. What we are scared of is that when your cow is sick, if I call the vet and if they find the disease, and tell you what medicine it requires. What we are scared of is to be told that if this cow dies do not eat it but let's cut it to see what went wrong. What we are scared of is cutting the animal without eating it. It's better, even if it's sick but as long as it's moving, I call someone to buy it so that I realize a little profit. Rather than they just cut it up and we lose out. That is what we are mostly afraid of. (Male community members, FGD, Kazungula)

In some cases, because of the rainy season or distance, waiting for a vet to come and test the animal is simply seen as impractical. One participant noted that while they were aware of the recommendation to see a vet to prevent the spread of diseases, the regulations are hard to meet. The participant stressed that "we have heard that the vet is closed. The cows cannot be taken far away, so no one follows the rules given by government" (male community member, FGD, Kazungula). Medicating animals themselves was an option for some participants. They said they would try "our methods" and then afterward would try the veterinary staff if the animal's condition did not improve. An individual in an FGD explained that "sometimes as we wait for the vet we use traditional medicine... we try to treat our cattle before vet arrives" (female community member, FGD, Senanga). An individual mentioned the practice of having medicines on hand to try out, saying

In these times you will find that most people who are rearing cattle have some medicine that they keep. This medicine can easily be bought. When they just see that a cow does not look well, they will usually give the medicine to the cow in order for it

Seek care for anthrax signs Key themes

- Certain signs and symptoms prompt immediate care-seeking.
- Differentiation exists between traditional illness that requires traditional medicine or a relationship response and biomedical pathogens that require the health center.
- Self-medication is an alternative for both humans and animals.

to get better. If it does not get better, they will have to go to the veterinarian so that they can be helped. (Male community member, FGD, Senanga)

A female group in Choma, however, felt that witch doctor medicine would be poison for cows and that modern medicine was needed.

For human symptoms (such as fever, fatigue, cough, chest pain, sore throat, difficulty swallowing, neck swelling, abdominal pain, vomiting, or diarrhea), participants across the board responded that the person should go to a health care facility. Symptom recognition for anthrax in humans was not particularly strong. Participants indicated that lesions or gastrointestinal symptoms could arise from other causes, but seeking care for these types of signs and symptoms was advisable. Health workers were generally perceived as competent to diagnose illnesses, but participants felt that medicines were expensive or inaccessible. When pressed, participants described other strategies people used, such as self-medication or consulting traditional healers. One participant said, “The problem is we first diagnose ourselves before going to the hospital, and that becomes a problem. We want to prescribe ourselves medicine because you have diagnosed yourself” (male cattle herder, FGD, Choma).

With respect to traditional medicine, participants differentiated between an illness caused by a pathogen and an illness caused by relational problems (jealousy or being bewitched). In the latter case, going to the health facility would not solve the underlying problem, as explained by a participant who said, “I was shot one time and I never went to the hospital but to traditional healers, and I got well within 2 days... If it’s traditional then treat it traditionally (male cattle herder, FGD, Choma). Another participant clarified, “If it’s traditional go to the witch doctor, if it’s simple then go to the hospital” (male cattle herder, FGD, Choma). However, participants listed services that only the health center can provide such as intravenous fluids, blood transfusions, laboratory testing, and using a thermometer to check for a fever.

Some individuals would try the herbalist or witch doctor first and only go to the health center if symptoms worsened. Some groups felt that this approach is more about habit than about discerning the cause of the illness, and they suggested that it stems from ignorance:

The other problem is we believe too much in witchcraft. When I get sick we think that I have been bewitched and that’s what we believe in. A lot that’s what they think when you first get sick. Have I fought with anyone, is there any jealous person or have I exchange words with anyone? Then from there, I believe it’s witchcraft. Then you want to visit a witch doctor. (Male cattle herder, FGD, Choma)

Similar to the decision to call veterinary staff, participants expressed a fear that their agency would be taken away in the testing or diagnosis process at a health facility. This theme emerged across multiple groups and was summarized by a participant in Senanga:

Some people are afraid to go to the clinic when they know that they are ill. This is because they may be afraid that they are going to be admitted to the ward. Another fear that some people may have is that they may be found with more infections than

they thought, or they might get some more infections at the clinic. (Male community member, FGD, Senanga)

In addition, HIV looms very large in people’s minds and can discourage care-seeking:

A person that has such symptoms can fail to go to the clinic if the people he stays with have no knowledge about that, just as [another participant] was saying that such people need to be talked to, advising them. So others can come and tell him something else, and he or she can feel lonely that they might tell them something else at the clinic such as AIDS, so the person can decide not to go because they feel ashamed. (Female community member, FGD, Senanga)

Groups described being afraid of finding out they have HIV when going to the clinic for other health concerns, with one participant saying “We believe that once the person is found with HIV/AIDS, then that’s the end of your life, it’s to die. The other thing also is stigma [which] is another problem that we can’t bear” (male cattle herder, FGD, Choma). Others in the same group disagreed, saying that antiretrovirals make it possible to live well with HIV, but the general consensus was that the fear of diagnosis still may block people from going to the facility for generalized symptoms. Health workers agreed that HIV testing is often a first step when anyone comes to the health facility.

TABLE 13. BEHAVIOR CONTEXT AND DRIVERS: SEEK CARE FOR ANTHRAX SIGNS OR SYMPTOMS IN HUMANS OR ANIMALS	
COMPONENT	FINDINGS
Awareness/salience	Certain symptoms are recognized as requiring care-seeking. This need is top of mind.
Knowledge	Participants did not always list or recognize the full set of symptoms associated with anthrax in humans. Mixed awareness of symptoms in animals existed even among cattle herders.
Government initiatives	No data
Influencers and information sources	Neighbors can help with decisions and transportation. Trust in health workers and veterinary workers influences whether people seek immediate, delayed, or alternative care.
Misconceptions (infodemic)	Participants expressed fears about being diagnosed with HIV or their animals having to be killed due to disease.
Response efficacy/perceived importance	The behavior was perceived as important, but there was mixed response efficacy (depending on the “type” of illness).
Self-efficacy	With respect to calling a vet for animal symptoms, participants felt it was feasible. Waiting for a vet and transporting the animal could be complicated. Participants felt it was feasible to go to the health center for symptoms in humans.

Perceived norms	Groups tended to express consensus that seeking care from a veterinarian for animals or a health center for people was the norm.
Economic	Factors that discouraged people were mostly the potential cost of care and transportation costs and logistics.
Sociocultural and gender	Self-medication, traditional medication, and witchcraft were mentioned by participants as playing a role in case-seeking decisions.
Structural	Participants mentioned barriers due to distance and access and a lack of clarity about the consequences of seeking care in terms of additional tests or medications they may be given.

Key behaviors: Rabies

Mentions about rabies prevention behaviors were analyzed across transcripts and synthesized into three key precautions: vaccinating dogs, tying up or confining dogs, and seeking immediate care for a dog bite.

Behavior: Vaccinate dogs

Vaccinating dogs was a clear measure to take and was top of mind for participants when discussing rabies. Health workers, veterinarians, and community leaders in particular expressed this viewpoint. A health worker said,

They know the basics like having their animals vaccinated, for instance those that the domestic pets, like the dogs... Most people at least they have the little knowledge about the rabies so you find, even when someone is bitten by a dog, at least they make an effort to go to the veterinary personnel to go and check if the dog is fully vaccinated. (Health worker, IDI, Choma)

One veterinary worker stated that certain people do not trust or believe in the vaccine. However, in general, making vaccines widely available for dogs was seen as very important and as a crucial intervention for controlling the disease.

So, if we come to rabies, we need a lot of vaccines, a lot of vaccines. There are times when, when we are given free vaccines from, from the government and from, from other people. I want to give an example of just last year, we were given about ten thousand doses, which actually came from Lusaka, so we exhausted all our ten thousand doses. These were free vaccines. So, as we vaccinate, actually we are, we are actually reducing the...the rate at which the disease will be spread from animals to human being. (Veterinary worker, IDI, Choma)

Nevertheless, uptake can be low, and a community leader explained this situation by saying

They are very concerned and they take as much care as they can. They do try to get their animals vaccinated, both the dogs and the cattle, but it's a matter of resources.

Sometimes they don't get enough vaccines, so animals go unvaccinated. (Community leader, IDI, Senanga)

Members of the general population, most commonly in Senanga, indicated that financial barriers are the major reason people do not get their dogs vaccinated. One participant said, "People are too poor to afford paying for their dogs to be vaccinated at the council. They do not have that kind of money. That is why they live with dogs that are unvaccinated" (male community member, FGD, Senanga). A veterinary worker compared rabies vaccines with other animal vaccines for which the government pays, saying

For example, is it foot and mouth disease? The government comes in, it'll pay for everything. The transportation, the vaccine itself—it will come in. But if this is like rabies, individual farmers, they pay for their pets, for their animals, the cattle, dogs, they pay for them. (Veterinary worker, IDI, Kazungula)

With respect to the conflict of dogs being needed for security but also posing a threat to the health of people, particularly children, vaccination was spontaneously mentioned as the solution. However, accessing the vaccine could be difficult, as a participant in Senanga said, "We have a very big challenge, and we need help in finding a solution so that our dogs can have access to medication" (female community member, FGD, Senanga). A woman in an FGD echoed this feeling, saying

The concern is there, but the problem is that vet don't care, because as of now, vaccinating a dog costs ZMK55 [about \$2], so sometimes we fail to pay that ZMK55 when they pass by. That is why most dogs are not being vaccinated because others can't afford to pay, so they are just keeping dogs in order for them to help them at their kraal. (Female community member, FGD, Senanga)

Another challenge with this behavior was that even if some dog owners get their dogs vaccinated, they cannot trust that others will, which leaves their communities exposed.

This disease, we have observed rabies in that most of dogs are not vaccinated, because they are not taken to the veterinarian to be prevented from diseases. So, that's where I notice to say, these diseases come from dogs. Whenever it bites someone, sometimes you might not be able to tell who the owner of the dog is because in the border area where we live, we see dogs whose homes are not known... these dogs that are unknown bring about diseases. (Female community member, FGD, Kazungula)

This uncertainty was compounded by the lack of documentation, such as tags or paperwork. A health worker explained that "We have situations where there is a dog bite, we ask the history of the dog being vaccinated, there is no history—they don't even know when last, the dog was vaccinated" (health worker, IDI, Kazungula). Health workers described government programs to shoot stray dogs without tags, which was felt to reduce the risk of rabies.

Behavior: Confine or tie up dogs

Participants in both FGDs and IDIs described the lack of dog confinement and the prevalence of stray dogs as risk factors. A community leader in Kazungula said,

From the dogs, we are very much scared, very much scared, because each time and every time we'll find that there is a very big number of our dogs just straying around, straying around the communities. So for us to control such things it becomes very, very difficult because you know we are scared, you cannot hold it, you cannot kill it. (Community leader, IDI, Kazungula)

A participant in an FGD echoed this concern, saying,

Dogs that we have as well as the chickens roam around freely within our communities. They are not controlled by being tied up or being enclosed in a fence. So, this roaming around leads to problems because they can end up biting people or eating rotten food. (Male community member, FGD, Senanga)

Generally, comments related to stray dogs indicated that people did not feel there was a community norm to confine dogs.

Behavior: Seek immediate care for dog bites

While a fear of rabies appeared to motivate people to seek care for a dog bite, the fact that medical care must be sought within a specific timeframe was hardly mentioned. Participants shared stories of delayed care-seeking due to complacency or simply trying traditional care first, as illustrated by stories from two veterinary workers in different districts:

Like last year we had a case where we had one dog which was rabid in one of the communities... so the dog went around and bit about two people, an old man and a young child. So, the young child was taken for treatment at the clinic, was brought to the hospital and was given the treatment and also given the vaccinations for the rabies. But the old man, well he decided to go to a sangoma³ and did whatever he was told by the sangoma, but then he later became rabid and then he died. (Veterinary worker, IDI, Senanga)

Some witch doctors say they can cure some diseases. Let's say that a person is bitten by a dog with rabies, they will say that just go and dig up the milk that comes from a Mungongo tree, that disease we can treat it. So the time that is wasted, the disease is doing what? It is growing. It is one of the things that makes one that when you reach the health workers have already noticed that this rabies—if it's rabies—can no longer be treated. So, at times we can blame them to say these people, they don't know how to treat, but you delayed to take that disease for treatment because of that person who was telling you that he can treat it. (Veterinary worker, IDI, Choma)

³ A sangoma is a traditional healer or herbalist.

According to health workers and members of the general population, the perception that treatment is not readily available discourages people from going straight to the health center. A health worker in Choma described the inaccessibility of rabies prophylaxis, saying

I don't know on the part of the veterinary, I'm sure maybe it's always available, they vaccinate the dogs. But on the part of protecting the humankind, I think this is not readily available so as a result, you find the one, the owner of the animal really has to stress to ensure the person bitten should be treated. (Health worker, IDI, Choma)

The treatment was described as being available at large hospitals but not in local clinics. An individual in Senanga reinforced this viewpoint:

We have a very big challenge. When a dog is mad, it may bite someone. That person will be rushed to the clinic, but we find it difficult to get medication and it is expensive as well. Sometimes, when you get to the clinic, you will be told that there is no medicine. That is a challenge for most people. So, for us to protect ourselves, when we see that a dog is going mad, there is nothing else we can do but kill it. (Male community member, FGD, Senanga)

Participants described several myths and misconceptions that may influence care-seeking for a dog bite. Across multiple districts, participants talked about burning fur from the dog that had bitten someone and applying it to the wound. A female group in Kazungula discussed this practice, with one participant saying

They remove fur from the dog for rabies if they bite someone... they burn that fur. After they have burnt it, they make something like charcoal [from] that powder. They apply it on teeth wounds where they have been bitten by the dog so that the poison doesn't spread, so that's the tradition that is in the community. (Female community member, FGD, Kazungula)

A veterinary worker in Choma explained that this self-medication approach interferes with both treatment and reporting:

Instead of advising that particular person to go to the clinic or the hospital, there are some certain herbs that they get, but before they get the certain herbs, they believe that that same dog that has bitten that particular person. If you get some hair from the tail, you burn it, you mix it with that same herb, they'll be fine. And according to them, they believe that it works because that same person that has been bitten, will live for so many years. So, when you tell them that actually they're supposed to go to the hospital, the procedures that you start with, the police, they even tell you we didn't know that you're supposed to go to the police. (Veterinary worker, IDI, Choma)

Participants also expressed the misconception that rabies cannot be treated, which may reflect accurate messaging that rabies is fatal in 99% of cases once symptoms appear. However, members of the general population did not mention or necessarily grasp that rabies can be treated if treatment begins before

symptoms appear, which depends on prompt care-seeking. Immediately washing dog bites for 15 minutes was not mentioned at all.

Testing, treatment, and notification

While veterinary workers and health workers described the existence of testing and treatment protocols, they also felt there was a lack of training and resources to fully implement the protocols. However, notification was generally felt to be standardized once a suspected or confirmed case was identified.

Anthrax

Health workers worried about missing the signs and symptoms of anthrax or mistaking it for something else, with one saying, “This is the reason why time and again we keep on reminding one another about the signs and symptoms about anthrax so that we don’t miss out these such kind of cases” (health worker, IDI, Choma). A health worker said that people might confuse an anthrax lesion with an infection with worms.

Health workers were clear that treatment should follow results from diagnostic testing. According to several health workers, other potential causes of symptoms would be considered before anthrax, such as malaria, COVID-19, occupational exposure, or worms. Because anthrax is a notifiable disease, the workers said they must inform the surveillance officer, who would then report it to the relevant authorities in the district. The health workers also spontaneously mentioned involving animal health workers if anthrax is detected in a human patient. Facility-based health workers felt that community health workers were confident about reporting potential zoonotic diseases found in humans to the health center where they were assigned. Testing was not done at several of the health facilities, as explained by a health worker in Senanga who said, “Here we don’t have the capacity to test for anthrax, but I’ll call my boss also. And then the boss will advise say okay just get the sample and then send it to either Mongu or Lusaka” (health worker, IDI, Senanga). The health worker did indicate that the disease surveillance book includes written protocols for handling a suspected anthrax case.

Health workers expressed a desire for more training at all levels—for community-based health workers as well as facility-based health workers—on signs and symptoms of zoonotic diseases and treatment protocols.

Rabies

Health workers also asked for more training on administering rabies prophylaxis and expressed a desire to have the vaccines in stock at local health facilities:

It would be very helpful if, for example, we had the, maybe the rabies vaccine in stock, yeah, then availability of the rabies vaccine. And then also to be trained on maybe how to administer it, to give it, the times that I have been given to say if it’s after 24 hours, you can’t receive and all those. Yeah, I think this one if they can at

least train us in detail, the way we've been training about ah polio, measles. (Health worker, IDI, Senanga)

As with anthrax, there was a desire for training but also a greater emphasis on having the resources (financial as well as medicine or vaccinations in stock) to deal with cases at the local level.

Cross-cutting factors influencing zoonotic disease transmission

Each behavior had specific factors that participants suggested influence whether people perform the desired actions, but some contextual factors cut across multiple behaviors or simply influenced the likelihood of disease exposure in general.

Environmental factors

Participants characterized environmental issues as a major factor in the risk of disease for themselves and their animals and in their ability to perform specific behaviors.

Perceived risk and common practices around human encroachment in animal areas

Participants reflected on the risks and reasons that people move into areas that have typically been dedicated to animals, such as forests, or are formally protected for animals, such as game reserves. Individuals spoke about decreasing water access and the movement of wild animals and people to be closer to certain shared water sources.

Movement and mobility of cattle were seen as natural due to seasonal shifts in water and grazing areas, but participants also noted that mobility poses a threat. One group said that keeping cattle at kraal all the time is the only way to protect them from anthrax. In some cases, movement was not related to encroachment onto game reserves or forests but simply the movement of cattle across distances and borders. As one participant explained, "The same cattle that come from far places are the ones that bring such diseases. When they graze in the same place as those that are sick, they get infected by the disease" (male cattle herder, FGD, Senanga). Another participant suggested strengthening control of borders:

One major thing is that we should put boundaries. We need to put barriers so that when there is a disease, for example, it is in Botswana, animals from Botswana should not cross over here in Zambia because once they come here, our cattle will be affected and will be hit and when they will be sick, they will die and we would be eating and whenever we eat and we are going to be affected as human beings. So to minimize this disease, there should be rules and regulations to say that these two countries should come in terms to say that these animals from this country with the disease should not come here because we don't want our cattle to be infected or even us people to be infected by this anthrax disease. (Male community member, FGD, Kazungula)

Similarly, a cattle herder also in Kazungula said,

One thing that is worrying us is the immigration, the way animals are moving. For example, in Western Province there is an outbreak but you would find that a cow from Western with a disease is here. So that issue is really worrying us. It comes with a disease and brings it here. (Male cattle herder, FGD, Kazungula)

Participants shared their perceptions of the direct risks of encroachment, which mainly included the threat of wild animals biting or killing domesticated animals and humans. One male member of a general population FGD said succinctly that one is “signing up to lose your animals by moving to game parks” (male community member, FGD, Kazungula). Another participant in Choma, explained a local saying that reflected this belief: “They have ‘licked the tail of a scorpion’, they are settled in prohibited places.....it means that, you have touched where you are not supposed to” (male cattle herder, FGD, Choma).

Sharing drinking water was another main concern, and some groups felt that even the air was contaminated in areas dedicated to animals, such as game parks or forests. Participants were very aware of the legal restrictions and mentioned the possibility of getting arrested for moving into game reserves, even though they pointed out that people sometimes ignored the laws. They also talked about the effect of humans on the environment by cutting down trees to make charcoal and ruining the fertility of the soil, a concern echoed by community leaders. Vet staff linked human encroachment to anthrax and other zoonotic diseases by talking about soil transmission and the temptation to eat dead animals such as hippos. Flies were a concern, as was the spread of trypanosomiasis; the threat of flies was mentioned by certain groups, but the disease name was only mentioned by health workers.

Indirect risks of encroachment were also mentioned, especially by cattle herders. When people move into game reserves, they force wild animals out. A participant explained,

These people have problems because in the game park they must fight with wild animals and that also affects us because then they displace the wild animals they move from the game and get here to us like the elephants. This has resulted in loss of life. People should not do that, it’s a mistake and it is dangerous. (Male cattle herder, FGD, Choma).

A community leader echoed this concern, describing elephants roaming into the town and wild animals changing their migration routes as a result of human settlements and burning wood for charcoal in forests. Participants expressed a sense that this experience has increased over the years, with wild animals moving into areas where people are settled and attacking them, as a participant in Senanga said, “They should be going back to where they belong because in the past there was no such things” (male cattle herder, FGD, Senanga).

An indirect risk of human encroachment is that people go into game parks, get infected by diseases that are more common where wild animals live, and then emerge and pass the disease to others. For some, the existence of the protected lands themselves was a problem. A health worker described a group of people who were worried about diseases and were “advocating against the park to say this park should

go, it is the one which has brought what anthrax... but their voices were, went silent; they were not heard” (health worker, IDI, Kazungula).

Driver: Competition over space and resources

Competition over space and resources appears to be the main driver of people encroaching on forests and game reserves. A female cattle herder in Kazungula referred to people as “squeezed” and thus moving to game reserves, or having conflict with neighbors and deciding to move to protected spaces. Another female FGD participant in Choma agreed that people are simply looking for fertile farmland and good grazing. A veterinary staff expressed the same idea, that people who encroach upon protected spaces are driven by needing water and space for cultivation. A community leader linked these needs to population growth and economics, describing that people used to have space to spread out despite lots of wild animals on the plains, including water bucks and kudus. Now, he said, there are a lot of fishers because fishing is the only economically viable activity, “so you can literally say that the plains, I think the humans have now completely taken over” (community leader, IDI, Senanga). Participants described both humans and wild animals moving into new spaces because of the need for space and resources, with one person explaining

We the people are the ones who are encroaching on animal habitats. We are encroaching on where animals are supposed to live. For instance, you can find that people grow crops on the riverbanks where hippos are found. When hippos find these crops, they eat them. Additionally, when animals go into the field to graze, they may come across crops that people have planted in their habitat, and they will eat them. (Male community member, FGD, Senanga)

In contrast, a health worker described hippo and elephant attacks in which people were fishing or simply living and said, “I can’t really say humans are encroaching, but maybe the opposite, animals are encroaching” (health worker, IDI, Senanga).

Seasonality

Seasons played a major role in how people handled their animals. Cattle provide different value at different times of the year in terms of assisting with farming, providing milk, or being a source of meat. Water availability drives cattle movement as well as good grazing. Rhythms may be daily or over the course of the year. Participants did express concern about climate change and anticipated extreme weather and droughts. A cattle farmer said,

We ask that you help us. Climate change has come to stay, so to cushion the impact of climate change in the village, we ask that you help us with water harvest projects. Right now, we don’t have water for our animals and our cows look sick. Meanwhile, it’s only water that reduces the cattle population. (Male cattle herder, FGD, Choma)

Several groups described the effects of climate change accurately and used the term itself. Others credited seasonal changes to differences seen in disease prevalence, saying in the context of discussing anthrax symptoms, “For this disease, I have seen it especially during rainy season then the grass grows

up to a certain level. What causes this is a virus. So, you find it starts behaving like it's mad" (male community member, FGD, Kazungula).

Economic factors

Cattle are economically valuable on a number of levels. They provide nutrition and support food security by assisting with farming. Live cows are used for transporting people and providing milk, but they are also considered an investment or safety net. People can sell or slaughter a cow as needed at any time, so cattle serve as a form of insurance against economic uncertainty. A cow was described as "the engine here, if at any place there is no cow, then there is nothing there, a cow is the one that ploughs for us to have maize" (male cattle herder, FGD, Choma). Cows can be used to transport water and bricks for building, carry drinking water and firewood, and spread manure on fields. Participants expressed a fear of losing cows not only because of their own concerns, but because the community depends on them to accomplish various tasks.

Economic factors appear to influence any kind of care-seeking, whether it is disease prevention, testing, or treatment for animals or people. For animals, the fear of charges, but not necessarily the actual charges, stops people from calling a vet for a sick or dead animal due to a lack of fee transparency or inconsistent charges. As described in the behavior section, people may also decide not to call a vet for fear that they will condemn a sick cow or a herd and take it away or kill it because it is ill. A participant said that people are "scared that once you call the vet, they can say that all the cows are affected. So it means we will get them all. So that is what we mostly scared of which prevents us from following the rules" (male community member, FGD, Kazungula).

The potential for large economic loss would drive someone to eat or sell meat from a sick animal. According to one of the participants, "After I see the cow has died on its own, the first priority is the loss that I have incurred. After thinking about it you say let me just skin it and give it to people to buy it" (male community member, FGD, Kazungula). Due to the large economic value of cows, in order to try and recover something from a sick animal and avoid the possibility of a vet preventing eating or selling a sick animal, many in the community would turn to each other for help and suggested medicine or treatment options before calling a vet. As discussed above, anticipated or actual costs of vaccinations, consultations with animal or human health workers, and treatments posed a major issue for uptake of desired behaviors.

Scarce economic resources led people to prioritize their needs and in some cases divert resources intended for disease prevention toward farming.

Right now, we are vaccinating our cattle against [East Coast fever], and at the same time, there's this program for FISP.⁴ FISP this is where they get their fertilizers from, so you will find that the money that they were supposed to use so that they can have

⁴ The Farmer Input Support Program subsidizes agricultural products like fertilizer and seed for farmers to improve food security.

their animals vaccinated, it goes towards FISP, towards purchase of the fertilizer and the feed. That's one of the challenges that we've actually had. Then there [are] just a few people that don't believe in the animals being vaccinated. Just a few individuals. (Veterinary worker, IDI, Choma)

A community leader described a positive initiative in which communities contributed money each month to a fund to prepare for health emergencies:

I remember last time when we had a meeting there, it seems like a lot of headmen were there, they attended and those from the villages they attended too. And there were options like combining people in the village to do donations so that when this disease is heard to be nearby, so that we could do what? Call the expert. Yes, because it was heard that the medicine for that disease each cow is ZMK10 [\$0.39], so people were getting ready so that they could have money aside so that when people hear that the disease is in Katombola or the area of Katombola, maybe fast-fast they could protect from it. (Community leader, IDI, Kazungula)

Structural factors

Certain regulations—or lack of enforcement of regulations—appeared to influence behaviors. For example, a community leader in Senanga pointed out that meat at small abattoirs may be sold without being inspected by animal health officers. Another community leader also stressed concern about the safety of meat, saying,

I also ask that the vet should also ensure that the meat that is sold to butcheries is safe to be eat and cleared by the vet. They should focus on this as is one of the leading problems here cause some meat sold in butcheries is not okay. They are sick but are sold for people to eat. (Community leader, IDI, Choma)

Other community leaders echoed the desire for more inspection of meat.

Political will to prioritize zoonotic disease prevention was felt to be important, beyond the economic benefits that would come from making certain vaccines “of national importance” free. A community leader in Senanga expressed a sense of powerlessness to enforce regulations around zoonotic disease prevention, cattle mobility, and encroachment on protected areas, saying “as a mere headman, you cannot heal that one, you can't.” He went on to compare zoonotic diseases and One Health issues with early marriage, which had received a lot of attention, saying

We have to have our mouths opened by people like the MP [member of parliament]. If the MP had an agenda on [zoonotic diseases], then this is the time we would talk about it, as we are saying, as we are talking about early marriages, our mouths are open on that one.... We need people to open our mouths, to ignite us, to say no you have the right to talk, to discuss. (Community leader, IDI, Senanga)

Community members and cattle herders felt that animal medicines and vaccines were restricted and could sometimes be hard to obtain. In the absence of a pharmacy dedicated to animal medications, products have to be purchased from vets, and as an FGD member explained, “The other complaint is

that there is nowhere to buy medicine from unless from vet” (female community member, FGD, Senanga). A veterinary worker in Senanga, however, insisted that most vaccines are widely available from any livestock worker, pharmacy, or vet shop. A veterinary officer described issues with availability of vaccine doses, saying “It’s a challenge for vet because you would want to do the vaccination, but the drugs are not there. The farmers would want, but the drugs are not there” (veterinary worker, IDI, Kazungula).

In general, the availability of veterinary staff and animal health workers was perceived as a concern. Participants suggested that additional staff (perhaps with less training required) are needed to travel around and sensitize people on how to prevent anthrax and other zoonotic diseases, as a way of helping the veterinarians. Participants indicated that veterinary staff have too much to do over a large area.

I just wanted to say that we have a request to the government that we only have one person from vet and the person moves to a lot of places. The person is in charge of [our village] and [another village] so when our cattle from here get sick even in [the other village] they get infected so by the time he gets here, the cattle would have already finished. So we ask if it’s possible for them to bring another person so that they work together with the other person. (Female community member, FGD, Senanga)

Veterinary workers themselves echoed this concern, with one saying,

I think we are really understaffed and we are manning very big portions, very big camps. There are, our camps are too vast. They really need to be divided in such a way that a person, one vet, one vet officer should have the sizeable number that he can man so that the people, the community can really appreciate the services from the vet. (Veterinary worker, IDI, Kazungula)

Just as health workers had community health workers extend sensitization and detection of diseases into communities, a veterinary worker suggested reviving the practice of having trained livestock auxiliary workers who could work under the oversight of a veterinary officer and cover more ground.

Dip tanks were a major factor in cattle farmers’ sense that they are keeping their animals safe and healthy, and they expressed frustration in cases in which a dip tank was not close or was unavailable.

Shared living spaces were occasionally described as creating a risk of exposure to zoonotic diseases. For example, close proximity between cooking spaces and animal enclosures was felt to be a risk factor, according to health workers who observed that people cooked outdoors next to the area where cattle roam. The workers said people may drop cooking utensils in the dust and then use them for the food.

Health system factors

Trust in veterinary staff seemed strong among cattle herders, and the Ministry of Livestock was generally viewed as trustworthy, although a community leader pointed out that the ministry should have more staff. Telephone communication is common with veterinary staff, which helps bridge the

distance gap. The main complaint was lack of visits from veterinary staff. A herder in Senanga expressed an interest in learning from vets, saying “It is important that vet have time to sit with us cattle farmers so that we learn in regards to the way they also learn at school,” but he also added, “They don't visit us and give us ways in which we can take care of our cattle” (male cattle herder, FGD, Senanga).

Cattle herders appeared to know the phone number of a vet and felt empowered to call; they also viewed the veterinarian as being responsive. A minority opinion involved a sense of fear when calling veterinary workers due to “not knowing what to say” and feeling that the veterinary staff are too far away and that they would charge fees. A community leader indicated that communities have a good relationship with the vets, but that vets could do more if they had the same resources as other departments.

With respect to human health workers, participants defined trust consistent with the literature, citing confidence in the competence and training of the health workers and a common experience of being warmly welcomed and cared about. A community leader echoed the overall sense of trust, emphasizing that complaints about the facility have more to do with stock-outs or referrals than lack of warmth. Certain participants shared other experiences such as receiving care from students rather than the “real” nurses and doctors, or encountering unkind health workers. Based on the trust determination model,¹⁸ honesty and transparency were not mentioned by members of the general population and cattle herders as components of trust. Veterinary workers mentioned that being honest and keeping commitments rather than going to the highest paid request would build trust with communities. In general, agency was a key factor—including whether people would be tested and diagnosed with HIV or would be given medications they did not want (see “Behavior: Seek care”).

Health workers tended to feel that people trusted them, in particular their competence, and stressed that people knew they would be welcomed warmly. They agreed that most complaints from the community had to do with facilities not offering all services, particularly medications that had to be purchased elsewhere. One health worker said that confidentiality may be an issue with exam rooms being close together where people can overhear the conversation or where male and female patients are kept in the same room. Such factors discourage care-seeking.

Both veterinary staff and human health workers felt technical training on zoonotic diseases would be useful but emphasized the need for logistical support (funding, transportation) to go out and sensitize people on the desired behaviors. They also wanted more communication and coordination between health facilities. A health worker cited an example of a suspected anthrax case in a neighboring area, but they never heard any follow-up about whether the case was confirmed. A veterinary worker highlighted the need for rapid notification across animal and human health, saying “We find that even when they have outbreaks, we are not easily informed” (veterinary worker, IDI, Kazungula). Health workers also expressed a desire for better laboratory facility coverage, such as having laboratories in each district that could return samples within a day, not a week or two.

Sociocultural factors

Religion rarely came up in the subset of data reviewed, except for mentions of the Bible forbidding eating or touching animals that died of unknown causes. One participant characterized the importance of taking precautions in the context of spirituality, saying, “It is very important to be preventive because we need to take care of our bodies that the creator has given us” (male community member, FGD, Senanga). One group suggested clergy and church leaders as potential partners in sensitizing communities about zoonotic diseases. Perceptions of authority, expertise, and leadership were a backdrop to decisions about zoonotic disease precautions. Participants recognized formal training (appreciating the veterinary staff and health workers and the training they received), but they also embraced other sources of knowledge from community leaders, parents, and experienced people in the community. More information is desired, and participants in the FGDs even treated the FGDs themselves as educational opportunities and thanked the facilitator for telling them what behaviors are important.

Cattle farmers saw their role as very important in the community and felt that it was a prestigious position. People looked to them as a resource. They felt people were even jealous that having cattle meant being able to “solve problems” and thereby avoid economic vulnerability. Cattle herders referred to their “big job” and felt that people appreciate the difficulty of their work and their responsibility to know their cows and check them on a daily basis. Cattle and herders played a role in the public life of the community, and as a male herder in Senanga said, “We do a lot of things, going in the bush to get firewood to use for cooking, we also help during funerals. This shows that in this community is we are helpful to each other” (male cattle herder, FGD, Senanga).

In general, the influence of the community and perceived social norms was felt to be strong. A veterinary worker in Kazungula said,

What these farmers, what they do, they just copy what others are doing.... The other friend will say, me, I didn't even vaccinate when he had done, then he puts tattoos. So, the other one will not even vaccinate, will just put tattoos. (Veterinary worker, IDI, Kazungula)

A veterinary worker in Senanga echoed this sentiment, suggesting that the government should identify “focus farms” to highlight where people are following the guidelines and ensure that others can watch and learn from them. This idea also applied to human vaccination and outbreak situations. When reflecting on a health emergency scenario in which people would need to accept a vaccine, a community leader described needing to go first.

They come to me and say, this disease, we want to vaccinate against it, so that those people should trust to say what they're talking about is happening. They'll start with vaccinating me. So if it's an injection, they'll inject me so that when people ask the nurse or ask me if I have been vaccinated, I'll say, I've been injected. It's here so that each and every person can be vaccinated. (Community leader, IDI, Choma)

Gender

At the individual and community level, gender came up as a background factor for certain behaviors. In particular, cooking behaviors were considered to be something women had to think about. As one participant said, “We don’t know how the women prepare the meat [laughter]... I have no idea how our women cook it and to those who eat it if they just roast or what” (male cattle herder, FGD, Kazungula). Another participant in a male group said, “Cooking is a woman's job. So, it is the women who can tell whether the meat is ready or not” (male community member, FGD, Senanga).

Female cattle herders mentioned using cattle to transport people to health clinics, which did not come up in the male groups. This action may reflect differences in care-seeking roles or may not be related to gender roles. Female cattle herders also described a meeting in which anthrax symptoms were covered, but only men were there: “Men are the ones who came, us women we were not around” (female cattle herder, FGD, Kazungula). Information accessibility and training for female cattle herders warrants further exploration.

A health worker in Choma expressed simply that men tend to handle animals more and thus have more knowledge about anthrax and zoonotic diseases, saying

Yes it differs because mostly men, we do understand about these... diseases like anthrax because they know to say normally it comes from animals. Because in our communities we know men they are much [more] into animals than women. (Health worker, IDI, Choma)

However, a veterinary worker highlighted the risk of men creating narratives that influence women, saying “Men would feel maybe it’s just that maybe the neighbor who’s bewitching. Yes, men usually. They’re the ones that come out to say, no me, my animals have been bewitched. Women, generally, they just accept what men say” (veterinary worker, IDI, Kazungula).

Information environment

Participants described a variety of information sources. Many of the sources were based on word of mouth from veterinary staff, health workers, or conversations at dip tanks. Experience was highly valued, with one individual saying “We go to those people who have experienced this disease and ask them how they treated it. Since they have experienced the disease before, that is where we can get proper information” (male community member, FGD, Kazungula). Others mentioned wanting to learn more about anthrax and how to prevent it from experts and from those who directly worked with and experienced the disease,

The reason we call them [vets] is because we want information from them, that what is it that our animals are suffering from. So that I get knowledge from them, I know if there is any protection that can be rendered to our animals. (Male community member, FGD, Kazungula)

In general, people wanted more information about how to take care of animals and avoid zoonotic diseases, and specifically about outbreaks, with a participant suggesting “Maybe we should have meetings which sensitize. We go in the villages and door to door to sensitize that when such a thing happens, we should do this” (male community member, FGD, Kazungula).

Participants mentioned radio as the most common mass media source, but also spoke of television and phones. The radio was particularly a source for government communication, with one participant saying

Some of these diseases we get to be informed by the government because sometimes they do announce on radios. So when they find a cow that has died on its own or selling a cow or those that take to abattoir burn the cattle and this is how we know that the disease is really there and government even ban the selling of cattle or any other animal. (Female community member, FGD, Senanga)

A strong desire was expressed for quick, up-to-date information and for sensitization and training. A participant in Kazungula expressed that for people

Who are in typical villages, the information about cattle that the cattle are sick and if they don't bring them fast even ours get affected. At least that when you are closer you feel fast like nearer you hear the news fast that the cattle need to be what, vaccinated. (Female cattle herder, FGD, Kazungula)

A community leader in Choma disagreed, stressing that news of outbreaks travels quickly by radio and through veterinary officers and health workers.

Participants acknowledged that not everyone has a radio, but that it is possible to find programs on cattle farming and farming and mentioned the “Choma Maanu” program.⁵ A participant expressed the need to adapt information from mass media to the local context.

When you have a TV, there are channels there that are for taking care of animals. So when you watch you will be able to say huh, I should do this to my cow. But where we lack is that we cannot reach the standard of those people. When you reach that point you say huh, I cannot reach that standard but I will reach my standard that I can afford, where I feel here I can do. (Male cattle herder, FGD, Kazungula)

Inspired by the way people care for cattle on television, even with the sense that those practices would be impossible to implement, this individual opted to try something rather than nothing. Participants also suggested leveraging telephones to share information.

Knowledge has to be spread to people so that many know, so that when someone asks I will be able to say something. Like MTN [a mobile network operator], there is a number to call to learn about anthrax and animals if you want to learn about diseases that attack animals. So, others should just follow up the programs with arguments, so that, since it is toll free, you call it and put it on loudspeaker so that they hear that when a cow dies, you rush to the vet, so that they help out with what

⁵ Choma Maanu is a radio station in Choma.

to do who test it and advise if it can be eaten or not. (Female community member, FGD, Kazungula)

Misinformation and myths played a role in several of the key behaviors for both anthrax and rabies, and systematically addressing these myths was considered a priority. For example, one veterinary worker emphasized the need to engage with myths that prevent care-seeking for zoonotic diseases.

I think it is important to get hold of the myths that surround the communities when it comes to these diseases, like for example rabies. Some people believe that when you cut that end of the tail, that fur, you burn it a bit, you apply it on where you where you have been bitten, then it means you are healed [laughs], so I think the myths regarding zoonotic diseases have to be maybe dealt with. They should be found out and dealt with appropriately. (Veterinary worker, IDI, Senanga)

Recommendations

The qualitative data suggests mixed awareness and risk perception with respect to zoonotic diseases in general and rabies and anthrax in particular. Certain behaviors, such as covering wounds when handling or slaughtering animals, are not top of mind and are rarely done. Other behaviors, such as vaccination of animals or burning an animal that died of illness and not eating it (or calling a veterinary worker to test it first) are more well known but require multiple steps with a variety of social, economic, and structural barriers. In light of these and other findings, the following potential interventions are suggested.

Work closely with trusted information sources.

- Identify community leaders such as headmen or clergy who can serve as resources for information and also reinforce desired behaviors.
- Address concerns about vaccination among cattle herders through testimonials and Q&A (debunking) sessions with community radio programs or veterinarians. Provide veterinarians with talking points to avoid spreading misconceptions. Pair demand generation with vaccination events, to avoid generating demand without the supply available.
- Reinforce the accessibility of veterinarians as a phone call away for cattle herders and anyone who owns animals. Conduct listening or dialogue sessions between veterinarians and the community to build trust by making costs more transparent, reinforcing mutual empathy, and clarifying what to expect if a vet is called about a sick animal or herd.
- Create job aids and conduct joint activities between health care workers and veterinary workers (facility- and community-based) as well as pharmacists to harmonize messaging around desired behaviors and notification. Take a holistic view of preventing zoonotic diseases rather than focusing only on vaccination or specific behaviors.
- Work directly with women's groups and associations to ensure that information is accessible and tailored for female cattle herders in particular, and where relevant, female members of the general population.

Add specificity and nuance to messages to address concerns, questions, or misinformation.

- Clarify with cattle herders the timeframe and benefits around quarantining new animals before adding them to the herd and keeping animals from mixing too much. Build on existing uncertainty and suspicion about cattle from other geographic areas by promoting a “wait-and-see” approach that includes vaccination and quarantine.
- Continue to highlight the risk of eating meat from an animal that died of illness or unknown causes for the general population through mass media and community engagement. Reinforce the high cost (physical and financial) of illness to tip the cost/benefit analysis in the context of poverty and hunger, perhaps with messages such as being able to trust what one is eating, or the concept that it is not a gift to share a disease. Particularly for heads of household, highlight the economic cost of illness (their own or their animals).
- Offer clear guidance on how long to cook meat, whether using time and temperature or less objective factors, knowing that members of the general population already perceive benefits to long cooking. Guidance should address when certain parts of an animal are acceptable to eat as opposed to when consumption should be avoided altogether.
- Expand infodemic management activities to detect and respond to rumors and misconceptions around priority zoonotic diseases and related behaviors, both online and offline.

Raise awareness of topics that are not well-known or understood.

- Message directly on covering wounds when touching animals, including having farm clothes versus home clothes, particularly for cattle herders who routinely handle animals. Suggest alternatives for cleaning instruments when soap is not available and equip vets to reinforce the need to cover wounds and fully clean tools used to slaughter animals or prepare hides.
- Provide communication materials at physical locations where medications are sold for animals and provide talking points or FAQs for pharmacists.
- Create awareness and a social norm among cattle herders around annual vaccination of cattle for anthrax. Leverage increased risk perception in order to build vaccination into the rhythms of the year, even if only in high-risk areas.
- Increase information and awareness on anthrax signs and symptoms in animals and people as well as increase information about how anthrax spreads, highlighting the continued risks associated with butchering a sick animal or one that has died and subsequently using the hides and skins.

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