

Understanding Risk Factors Related to Rabies and Anthrax in Zambia

Desk Review

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Acronyms

CDC	Centers for Disease Control and Prevention
CCP	Johns Hopkins Center for Communication Programs
COVID-19	Coronavirus Disease of 2019
GHSA	Global Health Security Agenda
IHR	International Health Regulations
IVR	Interactive Voice Response
OIE	World Organization for Animal Health
PARACON	Pan-African Rabies Control Network
PEP	Post-exposure Prophylaxis
PVS	Performance of Veterinary Services
RCCE	Risk Communication and Community Engagement
SARE	Stepwise Approach towards Rabies Elimination
SBC	Social and Behavior Change
SOP	Standard Operating Procedures
TOR	Terms of Reference
TOT	Training of Trainers
TWG	Technical Working Group
USAID	United States Agency for International Development
WHO	World Health Organization
ZBRA	Zoonotic Behavioral Research and Assessment

Background

Zoonotic diseases can spread between animals and humans (WHO, 2020). Those who work with livestock, consume wild meat, use wild meat byproducts, and/or live in areas with increased wild animals are more at risk for contracting a zoonotic disease. Transmission of these germs includes “direct contact (close contact of a diseased animal and their bodily fluids), indirect contact (come in contact with places and areas used by infected animals), vector-borne (through insects’ bites), foodborne (consuming meat and byproducts from infected animals, and/or other foods contaminated by these animals), and waterborne (come in contact/using water that has been contaminated by an infected animal)” (CDC, 2021).

In Zambia, the Department of Veterinary Services’ Annual Report (2021) reported eight anthrax outbreaks in cattle and humans and 234 clinical animal cases of rabies (in mostly dogs) (Government of the Republic of Zambia: Ministry of Fisheries and Livestock). Classified by WHO, anthrax is a priority disease in Zambia and has been reported in the Western, Eastern, and Southern Provinces. Anthrax is a serious infectious disease that occurs naturally in soil and can affect both humans and animals. People can get sick with anthrax if they encounter infected animals or contaminated animal products (CDC, 2022a). The disease can be transmitted to humans through animals and infected animal products, but humans are not contagious when infected (Government of the Republic of Zambia: Ministry of Fisheries and Livestock). Through routine vaccination of livestock, humans and livestock are at a lower risk of infection (WHO, 2020).

Rabies is acknowledged as one of the priority zoonotic diseases in Zambia (WHO, 2017). It is a viral disease that infects the central nervous system. It is mostly spread to humans by unvaccinated dogs; however, other animals can be infected and infect humans as well (CDC, 2022b; WHO, 2021). Rabies is transmitted to other humans and animals by close contact with saliva from infected animals (CDC, 2021). Annually, there are approximately 15,000 reported dog bites and 50 deaths from rabies in Zambia (Zambia National Public Health Institute, 2018). Both zoonotic pathogens are preventable through vaccinations of both animals and humans.

In 2015, Zambia joined with the World Health Organization (WHO), Food and Agriculture Organization (FAO), International Organization for Animal Health (OIE), and the Global Alliance for Rabies Control (GARC) to develop global strategies for zero human rabies deaths by 2030 (WHO, 2019). Rabies being endemic in Zambia has made animal vaccination campaigns and prevention a priority in the country. Rabies is transmitted to other humans and animals by close contact with saliva from infected animals (CDC, 2021). As the virus is mostly carried by dogs, the vaccination of domestic and wild dogs would be significant in decreasing the rate of transmission.

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 (CCP) to lead social and behavior change (SBC) programming around the world. The project

works in partnership with governments, civil society, communities, and other stakeholders to implement creative, evidence-based SBC programming.

Breakthrough ACTION Zambia works through a collaborative multi-sectoral approach with the Ministries of Health, Wildlife Services, Environment, Agriculture, and other key One Health stakeholders to build country risk communication and community engagement (RCCE) capacity as part of broader efforts to strengthen implementation of [the Global Health Security Agenda \(GHSA\)](#). Breakthrough ACTION Zambia will initiate work to strengthen the RCCE capacity of Zambian institutions to effectively address high-risk behaviors associated with priority zoonotic diseases and mitigate the impact of future public health events between October 2022 and September 2023. This will be accomplished through the coordinated use of a range of communication channels and approaches grounded in behavioral theory, informed by research and programmatic experience, and designed and implemented following a systematic and proven process to achieve individual and collective behavior change. The Breakthrough ACTION Zambia team, therefore, conducted a desk review to understand known risk factors and drivers, and to inform RCCE activities related to anthrax and rabies in the country.

Methods: Desk Review Articles

The following sources were found using “Google Scholar” and the reference section of the sources included in this desk review. Keywords such as “Anthrax in Zambia”, “Rabies in Zambia”, “Rabies One Health Zambia”, and “Anthrax RCCE Zambia” were the main phrases used in this search. Peer-reviewed articles and grey literature were included in the analysis. To be selected, each source had to be published between 2006 to 2022. The majority of the chosen sources have been published within the last ten years, but the inclusion of a few older articles was significant in providing sufficient background information. These sources were specific to Zambia, and the themes surrounded beliefs, behaviors, structural barriers, previous campaigns, One Health strategies, and RCCE strategies that affected the vaccination and transmission rates of both diseases.

Results

Findings from the desk review are summarized in Tables 1 and 2. In summary, while some efforts have been undertaken to provide information to populations at risk for anthrax and rabies, there are lingering multilevel barriers to protective behaviors, including vaccination.

Table 1. Peer-reviewed journal articles, reports, and other sources related to anthrax in Zambia

ANTHRAX				
SOURCES	TYPE AND POPULATION	RISK FACTORS	INTERVENTIONS/ FINDINGS	BARRIERS TO PREVENTIVE BEHAVIORS
Siamudaala V.M., Bwalya J.M., Munang’andu H.M., Sinyangwe P.G., Banda F., Mweene A.S., Takada A., Kida H. (2006). <i>Ecology and epidemiology of anthrax in cattle and humans in Zambia. Jpn. J. Vet. Res.</i> 2006;54:15–23	Type: Literature review of articles about anthrax in animals and humans and collection of discussions from locals and different	-The proximity to unvaccinated cattle -Resistance against anthrax vaccination programs (some farmers believe the vaccinations infect their cattle with anthrax)	There are routine vaccination programs in Zambia for livestock. Anthrax vaccinations are also developed locally at the Central Veterinary Laboratory, Department of Veterinary	There is resistance to this vaccination due to the following beliefs: -the vaccinations infect cattle with anthrax -farmers prefer to continue using their livestock for

ANTHRAX				
SOURCES	TYPE AND POPULATION	RISK FACTORS	INTERVENTIONS/ FINDINGS	BARRIERS TO PREVENTIVE BEHAVIORS
	<p>veterinary professionals.</p> <p>Population: People who live in areas close to cattle/livestock</p>		and Livestock Development, Ministry of Agriculture, Food and Fisheries.	power and milk production rather than resting the animals to avoid stress-related immunosuppression
<p>Hang'ombe M.B., Mwansa J.C., Muwowo S., Mulenga P., Kapina M., Musenga E., Squarre D., Mataa L., Thomas S.Y., Ogawa H. (2012) <i>Human-animal anthrax outbreak in the Luangwa valley of Zambia in 2011.</i> Trop. Dr. 2012;42:136–139. doi: 10.1258/td.2012.110454</p>	<p>Type: This quantitative study tested for <i>Bacillus anthracis</i> in Humans (n=17), Hippopotamus (n=19), and Soil (n=20) through isolation and culture.</p> <p>Population: People who live in high-risk anthrax areas (close to cattle/livestock)</p>	<p>-Unvaccinated cattle/livestock</p> <p>-Limited surveillance resources to control the spread of anthrax</p>	<p>The World Health Organization Anthrax Working Group (formed in 1990) helps countries develop surveillance and control programs. In their future efforts, it was recommended to re-educate staff and re-stock resources needed to control the spread of anthrax.</p>	<p>-There is resistance to disposing of infected carcasses properly</p> <p>-Vaccination hesitancy for animal and human vaccinations</p> <p>-Limited information for proper diagnosis, surveillance, and reporting</p>
<p>Lehman, M. W., Craig, A. S., Malama, C., Kapina-Kany'anga, M., Malenga, P., Munsaka, F., Muwowo, S.,</p>	<p>Type: A cross-sectional survey was administered</p>	<p>-Food insecurities</p>		<p>Limited access to food in rural areas</p>

ANTHRAX				
SOURCES	TYPE AND POPULATION	RISK FACTORS	INTERVENTIONS/ FINDINGS	BARRIERS TO PREVENTIVE BEHAVIORS
Shadomy, S., & Marx, M. A. (2017). Role of Food Insecurity in Outbreak of Anthrax Infections among Humans and Hippopotamuses Living in a Game Reserve Area, Rural Zambia. <i>Emerging Infectious Diseases</i> , 23(9), 1471–1477. https://doi.org/10.3201/eid2309.161597	through interviews in communities that have had anthrax cases and hippopotamus deaths (n=284). Population: Populations who live in rural Zambia and consume hippo meat	-Eating infected meat due to protein shortage (specifically infected hippo meat) -Improper disposals of infected meat -Carrying, skinning, or butchering hippopotamus meat		
Sitali, D. C., Mumba, C., Skjerve, E., Mweemba, O., Kabonesa, C., Mwinyi, M. O., Nyakarahuka, L., & Muma, J. B. (2017). <i>Awareness and attitudes towards anthrax and meat consumption practices among affected communities in Zambia: A mixed methods approach</i> . PLOS Neglected Tropical Diseases, 11(5), e0005580. https://doi.org/10.1371/journal.pntd.0005580	Type: A mixed methods study was conducted from November 2015 to February 2016 in Mongu, Nalolo, Limulunga (districts in Western province districts), and Chama (district in Muchinga province). A	In the Western and Muchinga provinces of Zambia, anthrax was mostly transmitted through the consumption of infected beef and hippo meat.	Most respondents chose the radio and friends as their sources of information. It is recommended to have more health education and communication centralized around the anthrax vaccine. The majority of respondents heard about anthrax (88%), awareness of anthrax transmission by eating infected meat (85.1%) and knew that both humans and animals can be infected with	The veterinary offices are not as accessible for some communities. Health education resources about anthrax are limited as well, leading to varied community beliefs.

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SOURCES	TYPE AND POPULATION	RISK FACTORS	INTERVENTIONS/ FINDINGS	BARRIERS TO PREVENTIVE BEHAVIORS
	<p>cross-sectional survey was given to six focus groups and seven key informants (n=1,127).</p> <p>Population: People who live in Western province districts and Chama in Zambia</p>		anthrax (64.2%). Overall, the awareness of the different pathogens was high, but the causes of anthrax were unknown.	
<p>Sitali, D. C., Twambo, M. C., Chisoni, M., Bwalya, M. J., & Munyeme, M. (2018). Lay perceptions, beliefs and practices linked to the persistence of anthrax outbreaks in cattle in the Western Province of Zambia. <i>The Onderstepoort Journal of Veterinary Research</i>, 85(1), 1615.</p>	<p>Type: A mixed methods study was conducted from August to December 2015. Professional veterinary staff and community members were given surveys</p>	<ul style="list-style-type: none"> -Low animal vaccination rates -Existence or lack of a cattle risk management system (such as <i>mafisa</i>¹) -Carcass disposal practices 	<p>Farmers believed the anthrax vaccine caused their animals to become ill. This suspicion could also be due to the anthrax vaccine being provided directly by the government. In the study, farmers preferred to be more reactive (treat cattle infected with anthrax) rather than prevent the virus. There is also a belief that</p>	<p>Cattle farmers in the study believed the anthrax vaccine is not effective (low efficacy). In addition, there is mistrust between farmers and animal health workers; police follow veterinarians to protect them as they collect blood samples and administer vaccines. Also, the cost of vaccines is not covered</p>

¹ a traditional cattle risk-management system in Zambia; herders divide cattle among other people to reduce the risk of infected cattle and cattle raiders

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https://doi.org/10.4102/ojvr.v85i1.1615	(quantitative) and were interviewed in 5 focus groups (+5 key informants) (qualitative). Participants were chosen “based on whether they had lost cattle because of anthrax, had a family member who suffered from anthrax or died from the same”. Population: Cattle farmers in Zambia	-Local practice of cattle loaning and exchange including selling cattle to meat companies using same cattle tracks/grazing paths -Infrastructure or lack there of that regulate cattle movement -Cultural practices affecting cattle-rearing	veterinarians bring disease to infect farm workers’ cattle. The process of gaining blood samples from cattle has additional beliefs that it could be demonic and used to kill farm workers’ cattle. When an infected cow dies, the meat is sometimes shared amongst community members or the full carcass is disposed of without incineration.	financially (or sponsored by the government) in the same way that diseases of National Economic Importance (DNEIC) such as contagious bovine pleuropneumonia (CBPP).
Kamboyi, H. K., de Garine-Wichatitsky, M., Hang’ombe, M. B., & Munyeme, M. (2019). Risk mapping and eco-anthropogenic assessment of anthrax in the upper Zambezi basin. <i>Veterinary Medicine and Science</i> , 5(3), 419–427.	Type: This quantitative study distributed 113 surveys in communities with and without a history of anthrax cases.	-Improper disposal of diseased carcasses -Consuming meat and/or using byproducts of diseased carcasses	Most respondents in the study answered that they improperly disposed of the diseased carcasses.	-Access to veterinary services -Food insecurity

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SOURCES	TYPE AND POPULATION	RISK FACTORS	INTERVENTIONS/ FINDINGS	BARRIERS TO PREVENTIVE BEHAVIORS
https://doi.org/10.1002/vms.3.168 .	Population: People who live in the upper Zambezi basin	-Herd size -Cattle management system -Grazing distance, duration, and months -Disease management		

Table 2. Peer-reviewed journal articles, reports, and other sources related to rabies in Zambia

RABIES				
SOURCES	TYPE AND POPULATION	RISK FACTORS	INTERVENTIONS/ FINDINGS	BARRIERS TO PREVENTIVE BEHAVIORS
Mulipukwa, C. P., Mudenda, B., & Mbewe, A. R. (2017). Insights and efforts to control rabies in Zambia: Evaluation of determinants and barriers to dog vaccination in Nyimba district. <i>PLoS Neglected Tropical Diseases</i> , 11(10),	Type: A mixed methods cross-sectional study that was done in “three parts; a review of dog bite cases (n= 215 cases), a household survey	-Low rabies vaccination rates (specifically for dogs) “The study was done in three parts; a review of dog bite cases (n = 215 cases), a household survey	Dog vaccination campaigns were used to increase the number of rabies vaccinations. From the study, less than 9% of respondents (8.7%) had their dogs vaccinated, even knowing the risks of rabies. "It was evident that rabies was	The cost of vaccinations is not always affordable, and access to dog vaccination clinics is limited. In addition, the dog vaccination clinics did not communicate effectively to inform the communities. Community members did not know about their vaccine campaigns. Lastly,

RABIES				
SOURCES	TYPE AND POPULATION	RISK FACTORS	INTERVENTIONS/ FINDINGS	BARRIERS TO PREVENTIVE BEHAVIORS
e0005946. https://doi.org/10.1371/journal.pntd.0005946	and questionnaire (n= 300 households) and in-depth interviews with local rabies experts (n= 5)." Population: People in rural, peri-urban, urban communities in Nyimba district, Zambia with domestic dogs	and questionnaire (n = 300 households) and in-depth interviews with local rabies experts (n = 5)."	greatly feared in the communities as 93.7% (281/300) of the respondents felt that all dog bites could potentially result in rabies infection"... "It was generally agreed that rabies could be prevented by vaccination of dogs by 280 (93.3%) of the respondents." Education campaigns need to be targeted to the right audience for them to be effective.	some dogs did not have proper identification, so it was difficult to determine if a dog was owned or stray, vaccinated or not.
Global Alliance for Rabies Control. (2018). <i>Zambia / Global Alliance for Rabies Control</i> . Retrieved from https://rabiesalliance.org/country/zambia	Type: Country Status Page Population: People who live in Zambia	Low rabies vaccination rates (for animals and humans)	Global Alliance Rabies Control Certificate offers free courses that allow people to become certified rabies health educators. Also, the Stepwise Approach towards Rabies Elimination (SARE) is a planning, monitoring, and evaluation tool to guide, develop and refine rabies control programs. The progress stages range from 0 to 5 in accordance with a rabies-free country. Events	(Not discussed)

RABIES				
SOURCES	TYPE AND POPULATION	RISK FACTORS	INTERVENTIONS/ FINDINGS	BARRIERS TO PREVENTIVE BEHAVIORS
			are also planned on World Rabies Day in the country. A national strategy is being developed to control rabies and a One Health / Rabies taskforce has been formed in Zambia.	
Babaniyi, O., Songolo, P., Matapo, B., Masaninga, F., Mulenga, F., Michelo, C., Mubanga, J., & Kazembe, L. N. (2016). Epidemiological characteristics of rabies in Zambia: A retrospective study (2004–2013). <i>Clinical Epidemiology and Global Health</i> , 4(2), 83–88. https://doi.org/10.1016/j.cegh.2016.01.003	Type: A quantitative, cross-sectional, retrospective study with data “on human dog bites, confirmed rabies cases by province for the period 2004–2013, and on rabid dogs in the period 2005–2012.” It calculated “incidence rates, by year and province, and modeled the spatial variability in risk at province level using Poisson	Dog density, human density, and environmental changes (how land is being used that can affect the rates of rabies transmission)	Improved health communication strategies to prevent the spread of rabies.	Systematic reporting and dissemination resources are limited to track the overall spread of rabies.

RABIES				
SOURCES	TYPE AND POPULATION	RISK FACTORS	INTERVENTIONS/ FINDINGS	BARRIERS TO PREVENTIVE BEHAVIORS
	<p>spatial regression.”</p> <p>Population: People who live in provinces with high rabies transmission rates</p>			
<p>Zambia National Public Health Institute. (2018, October 2). <i>Ending Dog-mediated Human Rabies by 2030: A Zambian Perspective – ZNPHI</i>. Retrieved from http://znphi.co.zm/ending-dog-mediated-human-rabies-by-2030-a-zambian-perspective/</p>	<p>Type: A Pan-African Rabies Control Network (PARACON) and WHO meeting in Johannesburg (2018).</p> <p>Population: -Ministry of Fisheries and Livestock -Ministry of Health</p>	<p>Unvaccinated dogs and humans</p>	<p>The National Rabies Taskforce is a One Health approach that consists of the Ministry of Fisheries and Livestock and the Ministry of Health. A draft strategy document has been developed and shared at the 2nd full Pan-African Rabies Control Network (PARACON) in Johannesburg (2018). There, countries evaluated their strategies to eradicate rabies and hear what other countries thought of these approaches.</p>	<p>(Not discussed)</p>

RABIES				
SOURCES	TYPE AND POPULATION	RISK FACTORS	INTERVENTIONS/ FINDINGS	BARRIERS TO PREVENTIVE BEHAVIORS
<p>Kaneko, C., Omori, R., Sasaki, M., Kataoka-Nakamura, C., Simulundu, E., Muleya, W., Moonga, L., Ndebe, J., Hang'ombe, B. M., Dautu, G., Qiu, Y., Nakao, R., Kajihara, M., Mori-Kajihara, A., Chambaro, H. M., Higashi, H., Sugimoto, C., Sawa, H., Mweene, A. S., Isoda, N. (2021). Domestic dog demographics and estimates of canine vaccination coverage in a rural area of Zambia for the elimination of rabies. <i>PLOS Neglected Tropical Diseases</i>, 15(4), e0009222. https://doi.org/10.1371/journal.pntd.0009222</p>	<p>Type: A cross-sectional survey was distributed in Kalambabakali (the rural Mazabuka District of Zambia). There were 510 households visited to partake in the survey (333 households had at least one dog and 177 households had no dogs).</p> <p>Population: Dog owners in Zambia</p>	<p>Low rabies vaccination rates for dogs</p>	<p>There is a larger number of owned dogs than ownerless dogs. After the mass vaccination campaign, the vaccination coverage increased to 57.9-77.8% in owned dogs (unowned dogs were not mentioned). From the dog owners' responses, the first mass vaccination was unsuccessful due to the lack of information and the owners' unavailability. From the respondents, family, friends, and experiences from keeping or seeing a rabid dog(s) have been the common source of information. Those who were listed as knowledgeable were unable to list the different ways rabies could be transmitted from dog to human. More people were willing to vaccinate their dogs if the vaccines were free or cheaper than ZMW 5.00. The median amount paid for vaccination was ZMW 10.00. Lastly, the majority of</p>	<p>The limited communication around vaccination programs and the vaccination costs are barriers to dog owners in Zambia.</p>

RABIES				
SOURCES	TYPE AND POPULATION	RISK FACTORS	INTERVENTIONS/ FINDINGS	BARRIERS TO PREVENTIVE BEHAVIORS
			respondents (86.8%) vaccinated their dogs only because veterinary officers came to their villages.	
Nakazwe, C. & Gianetti, B. (2019). Zero Human Rabies Deaths: A One Health approach to rabies elimination in Zambia. <i>Health Press Zambia Bull</i> , 3(10), 6-9. Retrieved from http://znphi.co.zm/thehealthpress/wp-content/uploads/2019/12/Policy-2.pdf	Type: A proposal for zero human rabies deaths in Zambia Population: People who live in Zambia	-Unvaccinated dogs -Dog bites from unvaccinated dogs	The vaccination of 70% of dogs in country will stop the spread of rabies. Rabies death can be prevented by completing the course of post-exposure prophylaxis (PEP) (five doses of the rabies vaccine over five clinic visits) before symptoms occur. It was suggested to increase access of PEP and develop “biannual dog vaccination & registration” campaigns. From the total populations, only 4.5% of dogs were vaccinated and 12% of humans had PEP.	The cost of PEP is expensive (average cost per patient in Africa is \$40 USD). Due to inadequate funding, the Central Veterinary Research Institutes (CVRI) has been unable to produce rabies animal vaccines for three years, and PEP is not accessible. As a result, the vaccine is more expensive to import in the country. In addition, there is an added cost for dog owners to register their dogs with the Department of Local Government (close to 1% of dogs are registered).

Discussion

Zoonotic diseases such as anthrax and rabies are impacted by a range of changing factors. Disease prevalence, prevention, and treatment for anthrax and rabies can be best understood by determining the structural, economic, cultural, and environmental barriers which are present. Anthrax and rabies are highly preventable with the use of vaccinations in both humans and animals (CDC, 2021; WHO, 2021; WHO, 2020). Throughout the years in Zambia, the awareness of these zoonotic diseases has increased, but the limitation of vaccine access prevents certain populations from being at a lower risk of transmission (Sitali et al., 2017). Due to few surveillance resources, it is difficult to track disease transmission and rates of vaccination (Hang'ombe et al., 2012). For both diseases, community members have stated that, even with prevention campaigns, information about these viruses is scarce (Kaneko et al., 2021; Sitali et al., 2017; Hang'ombe et al., 2012). The lack of access to information creates barriers for Zambians to receive beneficial information to advocate for their health.

Zambia's interventions and campaigns have focused on vaccinating livestock and dogs rather than preventative education. Throughout the ten provinces, there are varied cultural beliefs that act as risk factors impacting the prevalence of rabies and anthrax (Silitongo et al., 2019). Concerning beliefs, the common sources are social circles including family members, neighbors, and friends, as well as personal experiences coming from first-hand accounts and more generalized community information and perceptions (Kaneko et al., 2021; Sitali et al., 2018). From the sources mentioned, information about both viruses, anthrax and rabies, has been limited. Misinformation and misconceptions held throughout local communities have led to distrust between community members, veterinarians, and government workers (Siamudaala et al., 2006; Sitali et al., 2018).

Cultural beliefs have challenged vaccine efficacy as well as health-risk information. Specifically, in the Western province of Zambia, veterinarians are not trusted and are often seen as people trying to harm or kill animals as opposed to protecting them (Sitali et al., 2018). This belief developed from mistrust of the vaccines' safety for livestock. Therefore, these beliefs also contribute to the low vaccination rates for both anthrax and rabies in animals. The surrounding environments in rural and urban areas can also constitute risk factors and barriers to communication for community members. The location of some rural areas limits access to transportation and various forms of communication. For instance, in Chama District, the majority of villages can only be reached by all-terrain vehicles, and communication is mostly conducted using two-way radios (Nakazwe & Gianetti, 2019). Below, these influencing risk factors are broken down further by disease given the current and existing knowledge.

Anthrax

Structural

The livestock population in Zambia is vast and can put more people at risk if there is limited access to vaccinations for both humans and animals. For animals, there are routine anthrax vaccination programs but if coverage is low then there can be large impacts on rates of Anthrax.

Economic

Regarding anthrax, economic barriers raise the risk for disease transmission (such as limited access to protein choices). In rural areas, some Zambians face food insecurity, and the livestock they have and wild animals (e.g. hippos) with which they come in contact may be the only sources of protein and/or income available. Due to relatively few food choices, there is a risk that meat from an infected animal (often infected hippo meat) could be consumed and used for other byproducts (Lehman et al., 2017). These economic barriers and risk factors can contribute to a higher risk of fatal diagnosis. When the risks of eating contaminated meat are discussed, the fight for survival exceeds the risk of transmission by a great amount (Beaubien, 2017).

Cultural

Cultural risk factors, such as the practice of *mafisa*, contribute to the spread of diseases among animals. *Mafisa* is a cattle risk management program that is used by livestock owners to cut down the size of their herd (it also is considered to prevent disease risks and cattle raiders) (Sitali et al., 2018). Other cultural practices, including the mixing of herds through family trade-offs, cows given as marriage dowries, and returning newborn calves to different herds, can increase the risk of spreading anthrax to a healthy herd. Using *mafisa*, infected cattle are not treated properly and/or carcasses are disposed of improperly. To verify that an infected carcass was not sold, “the herder is expected to dry the meat and or preserve the skin and horns,” which can be a way that Anthrax remains and is spread (Sitali et al., 2018).

Environmental

The disposal techniques of *mafisa* (“drying the meat and preserving the skin and horns”) have led to the growth of anthrax spores within the environment and have lasted in animal products (Sitali et al., 2018). If infected carcasses are not disposed of properly, rainfall and waterfall sources can cause these spores to also spread to different lands and infect healthy herds. These spores can stream into the surrounding environment and local grazing spots. During rainy season, December through March, animals dig and forage land and riverbeds for food and water (due to low crop production); dormant anthrax spores can be antiquated and spread (Nakazwe & Gianetti, 2019). Environmental factors including rainfall and drought impact grazing patterns and herd movement which ultimately can impact the spread of Anthrax.

Rabies

Structural

Rabies vaccination rates seem to be less consistent than anthrax vaccination rates among the animal population. If 70% of dogs were vaccinated, the spread of rabies will cease (Nakazwe & Gianetti, 2019). The limited locations of animal vaccine clinics as well as a lack of veterinarian coverage make it difficult for community members to get their dogs vaccinated. As a result, the clinics have a short supply of vaccinations and provide few notices to the public about their vaccine programs (Kaneko et al., 2021; Nakazwe & Gianetti, 2019).

Economic

The financial limitations on vaccinations also act as a significant barrier which lead to low vaccination rates. In urban areas, there was a 1.6% increase in rabies vaccination rates and 187 fewer dog bite accounts compared to rural areas (WHO, 2019). The majority of households with vaccinated dogs were categorized as financially stable. Access to resources based on location and the economic status of a household coincides with vaccination rates and exposure to different risk factors. Regarding rabies, the cost and accessibility of vaccines are barriers to preventative care (Mulipukwa et al., 2017).

The cost of post-exposure prophylaxis (PEP), the rabies vaccine, is expensive (average cost per patient in Africa is \$40 USD) (Nakazwe & Gianetti, 2019). Due to inadequate funding, the Central Veterinary Research Institute (CVRI) has been unable to produce rabies animal vaccines for three years, and PEP is not accessible. As a result, the vaccine is more expensive to import into the country. In addition, community members are required to register their dogs. There is an added cost for dog owners to register their dogs with the Department of Local Government (close to 1% of dogs are registered) and the lack of veterinary staff (Mulipukwa et al., 2017; Nakazwe & Gianetti, 2019). Other costs associated with rabies prevention, including the cost of collars denoting which dogs have been vaccinated and which are owned, also act as barriers to rabies prevention. Overall, the economic barriers to rabies prevention are vast and cost was repeatedly noted as a significant obstacle to vaccination.

Cultural

The literature review shows that while the risks of being infected with rabies were well known, the vaccination rate for animals remained low (Nakazwe & Gianetti, 2019). Communication materials were not effective because they were not relatable to different provinces. Furthermore, in rural areas, the cultural practices of having many dogs to protect farms and less value being placed on dogs correlated with lower vaccination rates as opposed to people having a few pet dogs (which they valued more in the city and were more likely to get vaccinated) (Nakazwe & Gianetti, 2019).

Environmental

In rural areas, there is a higher dog population compared to urban areas (WHO, 2019). Rural areas with the highest dog populations had fewer vaccine rates and more dog bite accounts. Also, animal vaccination clinics were not widely available in rural areas (Nakazwe & Gianetti, 2019). Expansive, open land, and lack of property boundaries makes it more difficult to discern dog ownership, control dog populations, and have adequate vaccine coverage.

Recommendations

There are varied beliefs and barriers amongst provinces in Zambia that have limited the effectiveness of health communication campaigns. To be more effective, it would be influential to have communication materials developed for the beliefs in each province. The content would be more relatable and relevant to community members.

Breakthrough ACTION Zambia also proposes activities that include social listening, a multi-channel media campaign, training on One Health RCCE for media and other public health communications at various levels (including community), and formative research to better understand issues of trust or acceptable adaptations of *mafisa*/traditional practices that would address key risks.

1. Province-specific, socio-cultural SBC materials:
 - a. Address the mistrust between health workers and community members and find ways to connect human and animal health services at district and community levels through trusted source partnerships within communities.
 - b. Address the importance of vaccine uptake but also other preventive behaviors related to *mafisa* or safe disposal, recognizing signs of anthrax if sharing meat/slaughtering as a way of protecting others, avoiding dog bites, or what to do when bitten (given some of the distance issues) in the case of rabies.
 - i. List the benefits of preventative measures.
 - ii. Provide information on where and how to get (or get to) preventative resources.
 - iii. Include incentives for those who adopt preventative strategies.
 - c. Multi-media activities:
 - i. With radio being the top communication channel in Zambia, there could be radio dramas, jingles, and health education announcements. There is no documentation of radio dramas for these pathogens (anthrax and rabies) in Zambia, so this will be a new approach to utilize. Previous successful examples of radio dramas in Zambia include <https://www.uicc.org/case-studies/tisamala-radio-drama> (the topic was breast cancer).
 - d. Rapid Mapping of One Health Landscape
 - i. Through a series of partner consultations Breakthrough ACTION will identify and map:
 1. the actors in-country that are currently involved in RCCE across emergency preparedness and response and key One Health sectors.
 2. existing coordination structures at national, subnational, and community level.
 3. information and communication channels (e.g., hotlines, information centers, community cadres) that are used to communicate risks and

- essential information to the population as well as receive feedback or monitor public perception.
4. existing messages and materials related to priority zoonotic diseases and the media landscape.
- e. Establish and regularly convene multi-sectoral RCCE National Technical Working Group (TWG)
 - i. Based on the results of the rapid landscaping, provide technical support to the Government to establish (or expand) a functional, permanent multisectoral TWG for priority zoonotic diseases (PZDs) and public health emergency preparedness and response. Breakthrough ACTION Zambia will support the group to collaboratively develop or revise Terms of References (TORs), SOPs, priority tasks, and dedicated responsibilities for communication and decision-making to support the TWG, establishing a foundation upon which to cascade the model to subnational levels moving forward.
 - ii. Support PZD Consensus Workshop if necessary
 - f. Establish a Zambia profile page on Breakthrough ACTION's Zoonotic Behavioral Research and Assessment (ZBRA) [platform](#):
 - i. ZBRA is an interactive, multi-country PZD behavioral research platform that was developed in 2022. It identifies key preventative and risk behaviors that crosscut the top PZDs that could prompt a zoonotic event or propagate person-to-person transmission; offers insights on individual and sociocultural determinants influencing the behaviors based on research conducted by Breakthrough ACTION; and provides quantitative survey questions and qualitative interview guides, by PZD, to explore determinants in local settings.
 - g. Adapt and deliver the One Health RCCE training package for media and other stakeholders as relevant:
 - i. For media and public health communicators, conduct a TOT to deliver the training, and begin a cascade of training with media professionals and One Health stakeholders to strengthen RCCE capacities and collaboration. Other stakeholders will be identified and added as needed and from the recent COVID-19 experience in the country.
 - h. Develop, adapt, and/or revise, and support reproduction and dissemination of communication materials for PZDs:
 - i. Informed by the results of the literature review, rapid formative research, and leveraging learnings from other Breakthrough ACTION GHSA countries of implementation, Breakthrough ACTION Zambia will provide technical and financial assistance to the Government of Zambia, RCCE TWG, and other One Health partners to develop mixed media (visual, audio, digital) materials. Dissemination will prioritize community radio to deliver essential information quickly and broadly across affected areas.

- i. Design and develop a focused, national PZD awareness campaign:
 - i. Based on the results of formative research and linked to broader efforts to develop appropriate communication materials for PZD prevention and response, Breakthrough ACTION Zambia will design and develop a multimedia campaign on one PZD.
- j. Develop an SMS-based interactive voice response (IVR) technology platform:
 - i. Leveraging learnings from other Breakthrough ACTION GHSA countries of implementation, the project will collaborate with the RCCE TWG to design and establish an IVR platform that can be used as a public communication tool system to provide key messages to the public related to PZDs, as part of planned campaigns, awareness events, and during public health emergencies. Linkages with other existing national hotlines will be explored and leveraged.
- k. Develop a Zambia-specific dashboard to identify and listen to social media conversations related to PZDs:
 - i. As part of efforts to strengthen rumor and infodemic management, Breakthrough ACTION Zambia will leverage social listening software Sprinklr to develop a Zambia-specific dashboard to track and analyze social media conversations related to PZDs of interest. Analysis and trends from the dashboard will be reviewed and shared through the national RCCE TWG for appropriate action as part of broader efforts to track and manage infodemics and misinformation related to PZDs and public health emergencies.
- l. Conduct rapid formative research to inform message and material development and targeted PZD campaign:
 - i. Leveraging tools such as ZBRA, IVR-based polling, and other methods, Breakthrough ACTION Zambia will design and conduct rapid research on the behavioral and social determinants of PZD risk in Zambia, in partnership with the One Health Ministries, and disseminate study findings to the regional level in the study regions. Topline findings will be used to inform message and campaign development.

Limitations

There is limited recent data on anthrax and rabies in Zambia, especially for SBC approaches. Due to limitations around surveillance, the analyzed literature also had limited access to information regarding these diseases. Although quantitative data is important, the lived experiences of Zambians living with and/or at high risk for these diseases are also significant when developing better preventative SBC approaches to address high-risk behaviors. The addition of qualitative data provides a more in-depth understanding of beliefs and behavior (Watkins, 2012). As different SBC campaigns expand in Zambia, it would be useful to track effectiveness and more qualitative data pertaining to the audiences.

Summary and Conclusion

In Zambia, rabies has been classified as endemic, and anthrax has had outbreaks. Depending on the provinces, many living spaces are close to wild animals. The risks of these diseases are heightened by weak surveillance systems and limited vaccine access. Even with information and vaccine availability, mistrust of veterinarians has contributed to low vaccination rates of livestock against anthrax. The previous health promotion strategies were limited in scope and were not socio-cultural aware causing the divide between farmers and veterinarians to increase. The process of gaining blood samples from cattle has additional beliefs that it could be demonic and used to kill farm workers' cattle. Rather than a generic one-size fits all approach, future SBC interventions should utilize behavioral and programmatic data to inform the design of multi-channel interventions that address specific audience needs to support their adoption of healthy behaviors (Mulipukwa et al., 2017).

Overall, the perceived susceptibility and perceived severity for both diseases were high, but the usage of preventative resources (action) was low. Structural, economic, and cultural barriers contribute to low vaccination rates, but the communication strategies also were not effective. New program strategies should be more focused on the action of preventative behaviors (such as vaccine uptake and safe disposal processes). From the review, the risk of disease transmission was not documented as a main concern for community members. Instead, for anthrax, the mistrust of veterinarians was often discussed as being a barrier to receiving preventative care. In addition, structural, cultural, and economic barriers also influence overall perceptions of risk and severity.

Breakthrough ACTION Zambia will use the multi-sectoral One Health approach to emphasize the interconnections between humans, animals, and the environment when developing and implementing risk communication and community engagement interventions for prevention and response to rabies and anthrax. The expertise of stakeholders from different sectors and from different levels will be used together to develop effective SBC interventions to address risk behavior and uptake of protective behaviors. Breakthrough ACTION Zambia's work could be a standard used to develop more meaningful and relevant SBC approaches in Zambia.

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