frontiers | Frontiers in Amphibian and Reptile Science

TYPE Perspective
PUBLISHED 26 January 2026
DOI 10.3389/famrs.2026.1742658

OPEN ACCESS

EDITED BY
Deb Prasad Pandey,
Agriculture and Forestry University, Nepal

REVIEWED BY
Moses Banda Aron,
Partners In Health Abwenzi Pa Za Umoyo, Malawi

*CORRESPONDENCE
Choti Singh
MfuweSnakebite@gmail.com
Philipp Berg
p.berg@cantab.net

RECEIVED 09 November 2025
REVISED 27 December 2025
ACCEPTED 02 January 2026
PUBLISHED 26 January 2026

CITATION
Singh C, van Driel M and Berg P (2026) Community-targeted snakebite prevention: implementation barriers and enablers in rural Zambia. *Front. Amphib. Reptile Sci.* 4:1742658. doi: 10.3389/famrs.2026.1742658

Community-targeted snakebite prevention: implementation barriers and enablers in rural Zambia

Choti Singh[1]*, Marcel van Driel[2] and Philipp Berg[3,4]*

[1]Mfuwe Snakebite Prevention, Mfuwe, Zambia, [2]Snake Safety Zambia, Lusaka, Zambia, [3]Erongo Park, Omaruru, Namibia, [4]AfriMed e.V., Mühlheim, Germany

In sub-Saharan Africa, community outreach for snakebite prevention is lacking or faces significant challenges due to logistical, cultural, and financial constraints. Building on experiences from grassroots activities in rural Zambia, this viewpoint emphasises the importance of centering activities around the conditions and needs of at-risk communities and suggests ways to advance snake-related education and empowerment. To be truly effective, such interventions should be accompanied by structural improvements, such as better access to medical care in case of snakebite, and means for the safe resolution of human-snake conflict.

KEYWORDS

community engagement, human-snake conflict, implementation science, resource-limited setting, rural health, social determinants of health, education

1 Introduction

Snakebite envenoming is a neglected health crisis that disproportionately affects people in disadvantaged rural communities in the global south (Harrison et al., 2009; World Health Organization, 2019; Berg et al., 2024). Many snakebite victims in Zambia lack access to timely and effective medical treatment (Ooms et al., 2020; Matafwali et al., 2022). The unequal access to healthcare due to socioeconomical factors results in increased morbidity and mortality following snakebites in remote, rural areas and prevents realistic epidemiological data (Warrell and Williams, 2023; Berg et al., 2024). Therefore, human health depends largely on non-medical social determinants (Marmot, 2005) and understanding determinants of snakebite risk is key for reducing the disease burden.

The practical implementation of community education projects to reduce snakebites under low-resource conditions has received little attention so far. Financial and logistical challenges, social norms and traditions, as well as widespread misinformation and stigma, influence the implementation of snake-related education and prevention. In the following sections, we will discuss contextual factors and barriers of community snake awareness and propose enabling factors from a rural Zambian perspective.

2 Local conditions in rural areas

2.1 Prioritising prevention

In Zambia, healthcare services are characterised by insufficient health facilities and shortages of medical supplies and health workers (Prust et al., 2019). Knowledge of toxinology and snakebite treatment is especially inadequate (Ooms et al., 2020). Primary health clinics have turned snakebite victims away since they are unable to treat them. The launch of national snakebite management guidelines (Republic of Zambia Ministry of Health, 2024) represents progress but considerable efforts are needed to ensure its implementation. In practice, accessing adequate medical care is virtually impossible in many rural, remote areas in Zambia currently. From Mfuwe, for example, the nearest hospital with antivenom and ventilators (critical for neurotoxin management) is in the capital Lusaka (600 km) with transportation being unaffordable for most. Thus, the prevention of venomous snakebites must be given top priority in rural areas.

2.2 Contextual risks

Living conditions in vulnerable communities necessitate special attention as they are directly linked to the risk of venomous snakebites (Figure 1). Potential dangers arise, for example, from housing that snakes can enter and lack of in-house sanitary facilities; over 90% of households in rural areas lack electricity (World Bank, 2025). In addition, livestock, firewood and rubbish in close proximity to dwellings provide hiding places and attract potential prey for snakes. Unprofessional attempts to get rid of snakes are associated with a high risk of snakebite. Moreover, a constant risk of snake encounters remains during daily activities such as walking cross-country without shoes and in the context of subsistence farming (Harrison et al., 2009), common in rural Zambia. Contact with wildlife is part of daily life in areas such as Mfuwe and wildlife is often within village areas. However, lack of knowledge and superstition are particularly pronounced with regard to snakes and further increase the risk of snakebite. Misconceptions and fear surrounding snakes are widespread in societies around the world and influence how people respond to these animals and to snakebite risk (e.g, Pandey et al., 2016; Musah et al., 2022; Tusabe et al., 2025), highlighting the need for education strategies that are adapted to local contexts. Health-related interventions that are effective elsewhere may fail if perceptions of illness and care seeking based on cultural beliefs are not taken into account (Sivalogan et al., 2023).

3 Community engagement in rural Zambia

3.1 Objectives of community outreach

Community education aims to reduce the risk of snakebite, improve first aid and treatment seeking behaviour, and enable safe coexistence of humans and snakes. Minimum knowledge of snakes in the region, snake ecology, and ways to avoid dangerous snake encounters (e.g., using flashlights, snake-proofing houses) are crucial. Most people are unaware that their own behaviour can modify snakebite risk and of the existence of recommended preventive measures (Republic of Zambia Ministry of Health, 2024). In this context, knowledge of native snakes and snakebite prevention and care helps to overcome fear and enables safer responses in potentially frightening situations (Pandey, 2023; authors' pers. obs.). An experience that cannot be overestimated is seeing and touching a live snake. It is not uncommon to believe that contact with a snake will lead to immediate death, a misconception that can be easily and effectively refuted.

3.2 Empowering communities

Knowledge is a prerequisite for informed action but not necessarily sufficient to achieve behavioural change. A crucial but often ignored aspect is the context in which behaviour occurs and the decision architecture that influences choices (Kelly and Barker, 2016). In addition to teaching about risk mitigation, affordable access to helpful tools such as flashlights, closed shoes, bednets, etc. as well as infrastructural improvements are needed to empower communities and effectively reduce snakebite risk. Informing communities about first aid (Republic of Zambia Ministry of Health, 2024) and treatment seeking behaviour should be matched by capacitated health centres that can provide basic management and organise referral if needed. While community education can increase health literacy by enabling a conscious approach to snakes, it does not change underlying inequities (Nutbeam and Lloyd, 2021). Political commitment and accountable governance, for instance, are important elements to achieve improvements of general healthcare services (Manyazewal et al., 2016). It was noted that community engagement in sub-Saharan Africa often lacks cooperation, shared control, and opportunity for empowerment (Koricha et al., 2024). In the context of snakebite prevention, community education and volunteer training for safe snake handling and removal complement each other and help build relevant expertise among community members. When required, community snake removers are a safe alternative to dangerous behaviour such as killing or chasing snakes. This requires funds for training, equipment and expenses and could be an integral part of effective snakebite mitigation.

3.3 Challenges and barriers of community outreach

Apart from limitations due to a lack of financial resources, implementation challenges can be grouped into three main domains: i) logistics and information materials, ii) bureaucratic hurdles, and iii) community trust and superstition.

i. Distances in rural areas are vast and result in considerable travel costs. Participants must walk longer distances,

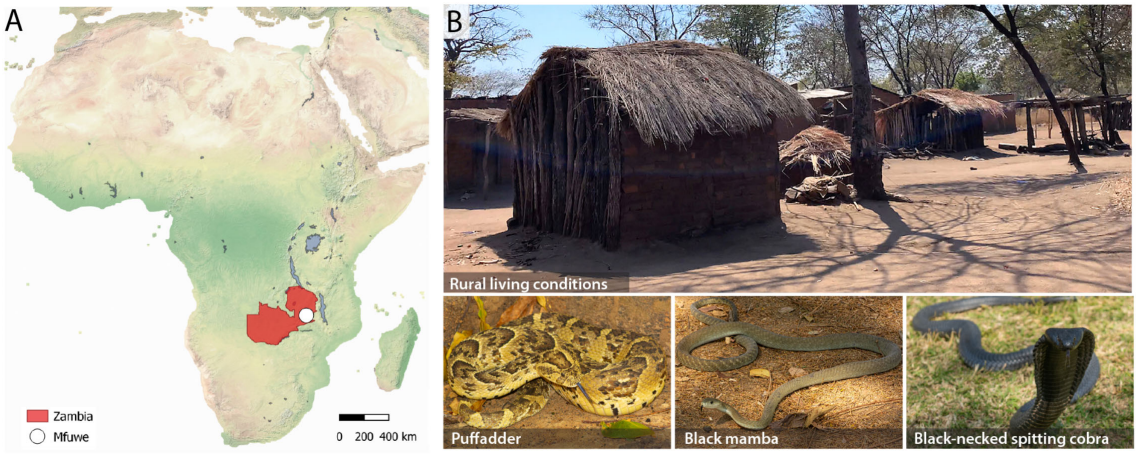

FIGURE 1
Geographical location of Mfuwe within Zambia **(A)**. The living conditions in rural and remote areas and associated risks of snake encounters must be taken into account in education and empowerment efforts **(B)**.

which increases reluctance to participate. Lack of local infrastructure necessitates non-electrical teaching materials (posters, brochures), an added cost. These are ideally pictorial to facilitate learning among communities with high illiteracy levels. Resources, or the lack of them, are a crucial but sometimes neglected difference between higher and lower income countries (Yapa and Bärnighausen, 2018). Preventive measures that are associated even with small costs (e.g., bednet, torch, closed shoes) may not be affordable for many; this also applies to volunteers willing to get trained in order to assist with snake relocations.

ii. Bureaucratic hurdles play a role as catching and transporting a snake without a permit is considered poaching; presenting a snake for educational purposes is not foreseen under current regulations. However, education about snakes and particularly snake handing training requires live animals.

iii. Another point of consideration is the generally low education level in rural areas. Illiteracy is common, and many individuals are less receptive to new information. Thus, messages and content must be kept simple, relatable, logical and understandable and need to be repeated. Religious and traditional beliefs are a hurdle that needs to be sensitively dealt with. For example, public health efforts in Zambia to control cholera are undermined by misinformation, cultural practices, and stigma (Hakayuwa et al., 2025). Provided information may not be trusted without communication via a trusted messenger. Prior approval by a chief is commonly required. In connection with snakes, communities and some authority representatives will be suspicious about the motives of an educator, may suspect hidden financial interests, with accusations of witchcraft not being uncommon.

3.4 Engaging communities and enabling factors

Trust is the basis for access and collaboration. Establishing this trust takes time, repetition, perseverance, and reliability. Over several years, the Mfuwe Snakebite Prevention Programme has conducted about 50 local engagement events across different settings, including villages, schools, businesses, and conservation organisations (Figure 2). In combination with appearances on community radio shows, this made the initiative widely known in the region and it is regularly contacted by community members requesting snake-related information and education. An increase in requests for identifications or assistance with relocations over the years illustrates the impact of these activities. Community volunteers that schedule village presentations, usually involving chief's consent and support encouraging those living in that community, has proven helpful. Small incentives (snacks, juice drinks, school supplies) greatly increase attendance. Group sizes vary considerably, ranging from 10 to more than 150 individuals, with children consistently well represented. Presentations are informal, made relatable and unintimidating. Being able to present a snake is beneficial, attracts attention and promotes understanding through direct experience. The implementation of such events would enhance through provision of educational tools and through support of the authorities. For example, battery-driven portable projectors and screens would allow for more relatable presentation of snakes of the area and their behaviours, to dispel traditional beliefs. Accurate, ready-to-use, and customisable teaching materials and funds to sponsor them are crucial. The needs and perceptions of communities should be taken into account both in the development and effectiveness assessment of education and training. This includes using pictorial representations of learning materials instead of texts to facilitate learning for illiterate people and avoid translations in local languages (cost

FIGURE 2
Mitigating human-snake conflict in rural areas is crucial to prevent snakebites. Effective conflict mitigation goes hand in hand with education and awareness-raising, both of which rely on sufficient resources and support.

factor). Realistic and affordable snake models would be useful. A regulatory framework is needed to enable experienced and knowledgeable snake handlers to use snakes legally for educational activities. Ideally, this is complemented by funded programmes to educate, train and equip certified snake handlers who safely relocate snakes from conflict situations.

3.5 Support grassroots activities rather than hindering them

Funding remains a critical bottleneck for local snakebite mitigation. While financial support is urgently required, it is important to note that donor-directed priorities and methodology may not align with local needs and priorities. This also happens unintentionally through eligibility criteria established in high-income countries. Disparate perspectives and inadequate involvement of affected communities and local knowledge can raise questions about shared values, affect trust, and shrink solution spaces (Shah et al., 2025). Local expertise needs to be involved in the planning, conduct, and evaluation of outreach activities to make them effective and sustainable. This also allows the use of traditional methods of information sharing.

While future research on snakebite community education could help to develop evidence-based, best practice approaches and help convince funding bodies to support local initiatives and their expansion, this requires sufficient resources. Criteria for impact assessments may be straightforward for some health interventions (e.g., vaccination and screening rates for cervical cancer prevention), but the many-layer complexity of snakebite risk and the lack of baseline data complicate an evaluation perceived as scientifically acceptable. More importantly, research projects accompanying community education are well intended but could add to already existing challenges. Additional aspects, such as providing open-source teaching materials and tools, simplifying regulations and funding, and advocating for snake-focused outreach and mitigation activities in at-risk communities deserve more attention.

4 Reflexivity statement

The authors include researchers and practitioners with natural science and public health backgrounds and many years of experience in snake-related education. The first author grew up in rural Zambia, has first-hand knowledge of living conditions and human-snake conflict, and is known to many affected communities in the area.

The second author grew up in Europe, lived in Zambia for many years, and is familiar with rural living conditions and human-snake conflict. The last author grew up and lives primarily in Europe and gained insights into human-snake conflict in rural areas through repeated stays in southern Africa. The authors acknowledge that their academic training and professional backgrounds may have influenced the focus, framing, and interpretation of this viewpoint. This article is based on personal experiences and perspectives, not on systematic data collection, may not mirror the full range of experiences, and cannot be fully generalised. We believe that the diverse perspectives in our team allowed us to consider different viewpoints and to set practice-relevant priorities. The authors advocate for continued locally led snakebite prevention activities and research.

5 Conclusion

We outline key challenges and propose strategies to facilitate outreach activities in rural, low-resource settings in Zambia. These insights may also be useful for similar settings in southern Africa and worldwide, where snakebite prevention is hampered by knowledge gaps and infrastructural limitations. Fostering the development of local expertise, for example through establishing local community snake catchers, could be an empowering step and facilitate effective snakebite mitigation in rural areas.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding authors.

Author contributions

CS: Conceptualization, Investigation, Writing – review & editing, Validation, Supervision, Project administration, Resources, Data curation, Methodology, Visualization. MvD: Conceptualization, Investigation, Visualization, Validation, Writing – review & editing. PB: Formal Analysis, Visualization, Data curation, Validation, Writing – review & editing, Conceptualization, Writing – original draft.

Funding

The author(s) declared that financial support was not received for this work and/or its publication.

Acknowledgments

We thank Jackson Phiri, Thokozile Phiri, and all volunteers who contributed to community outreach for their valuable support.

Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that generative AI was used in the creation of this manuscript. During manuscript preparation, the authors used GPT-5.2 for spelling and grammar checks and to improve readability and language. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the final publication.

Any alternative text (alt text) provided alongside figures in this article has been generated by Frontiers with the support of artificial intelligence and reasonable efforts have been made to ensure accuracy, including review by the authors wherever possible. If you identify any issues, please contact us.

Publisher's note

References

Berg, P., Theart, F., van Driel, M., Saaiman, E. L., and Mavoungou, L.-B. (2024). Snakebite envenoming in Africa remains widely neglected and demands multidisciplinary attention. *Nat. Commun.* 15, 9598. doi: 10.1038/s41467-024-54070-y

Hakayuwa, C. M., Sibomana, O., and Kalasa, C. S. (2025). Cholera resurges in Zambia: Challenges and future directions. *IJID Reg.* 15, 100640. doi: 10.1016/j.ijregi.2025.100640

Harrison, R. A., Hargreaves, A., Wagstaff, S. C., Faragher, B., and Lalloo, D. G. (2009). Snake envenoming: a disease of poverty. *PLoS Negl. Trop. Dis.* 3, e569. doi: 10.1371/journal.pntd.0000569

Kelly, M. P., and Barker, M. (2016). Why is changing health-related behaviour so difficult? *Public Health* 136, 109–116. doi: 10.1016/j.puhe.2016.03.030

Koricha, Z. B., Abraha, Y. G., Ababulgu, S. A., Abraham, G., and Morankar, S. (2024). Community engagement in research addressing infectious diseases of poverty in sub-Saharan Africa: A qualitative systematic review. *PLoS Glob Public Health* 4, e0003167. doi: 10.1371/journal.pgph.0003167

Manyazewal, T., Oosthuizen, M. J., and Matlakala, M. C. (2016). Proposing evidence-based strategies to strengthen implementation of healthcare reform in resource-limited settings: a summative analysis. *BMJ Open* 6, e012582. doi: 10.1136/bmjopen-2016-012582

Marmot, M. (2005). Social determinants of health inequalities. *Lancet* 365, 1099–1104. doi: 10.1016/S0140-6736(05)71146-6

Matafwali, S. K., Vlahakis, P. A., Daka, V., Witika, B. A., Nyirenda, H. T., Chisompola, N. K., et al. (2022). Assessment of the availability of snakebite

antivenom in health facilities in Ndola District, Zambia: a cross-sectional study. *Trans. R Soc. Trop. Med. Hyg* 116, 592–594. doi: 10.1093/trstmh/trab178

Musah, Y., Attuquayefio, D. K., Pobee, A. N., and Holbech, L. H. (2022). Ophidiophobia, myth generation, and human perceptions: Implications for snake conservation in a typical savanna community of northern Ghana. *Hum. Dimens Wildl* 27, 321–342. doi: 10.1080/10871209.2021.1952357

Nutbeam, D., and Lloyd, J. E. (2021). Understanding and responding to health literacy as a social determinant of health. *Annu. Rev. Public Health* 42, 159–173. doi: 10.1146/annurev-publhealth-090419-102529

Ooms, G. I., van Oirschot, J., Waldmann, B., Bernus, S., van den Ham, H. A., Mantel-Teeuwisse, A. K., et al. (2020). The current state of snakebite care in Kenya, Uganda, and Zambia: healthcare workers' Perspectives and knowledge, and health facilities' Treatment capacity. *Am. J. Trop. Med. Hyg* 104, 774–782. doi: 10.4269/ajtmh.20-1078

Pandey, D. P. (2023). "Global perspectives on human-snake interactions," in *Snakes: morphology, function, and ecology*. Ed. D. Penning (Nova Science Publishers, New York), 547–596.

Pandey, D. P., Subedi Pandey, G., Devkota, K., and Goode, M. (2016). Public perceptions of snakes and snakebite management: implications for conservation and human health in southern Nepal. *J. Ethnobiol Ethnomed* 12, 22. doi: 10.1186/s13002-016-0092-0

Prust, M. L., Kamanga, A., Ngosa, L., McKay, C., Muzongwe, C. M., Mukubani, M. T., et al. (2019). Assessment of interventions to attract and retain health workers in rural Zambia: a discrete choice experiment. *Hum. Resour Health* 17, 26. doi: 10.1186/s12960-019-0359-3

Republic of Zambia Ministry of Health. (2024). *Guidelines for the Prevention and Management of Snake Bites in Zambia*. (Lusaka: Ministry of Health).

Shah, S., Bora, S., Longley, E. S. G., Valtierra, E., and Pai, M. (2025). You can't see what you've never had to live"-Cultivating imagination and solution spaces in global health and development. *PLoS Glob Public Health* 5, e0005242. doi: 10.1371/journal.pgph.0005242

Sivalogan, K., Banda, B., Wagner, J., Biemba, G., Gagne, N., Grogan, C., et al. (2023). Impact of beliefs on perception of newborn illness, caregiver behaviors, and care-seeking practices in Zambia's Southern province. *PLoS One* 18, e0282881. doi: 10.1371/journal.pone.0282881

Tusabe, J., Muhoozi, M., Kajungu, D., Mukose, A., Kasasa, S., and Sebina Kibira, S. P. (2025). Knowledge, perceptions and healthcare practices of communities for management of snakebites in Kamuli District, Eastern Uganda. *Trans. R Soc. Trop. Med. Hyg* 119, 418–431. doi: 10.1093/trstmh/trae105

Warrell, D. A., and Williams, D. J. (2023). Clinical aspects of snakebite envenoming and its treatment in low-resource settings. *Lancet* 401, 1382–1398. doi: 10.1016/S0140-6736(23)00002-8

World Bank (2025). Zambia poverty and equity assessment. Available online at: http://hdl.handle.net/10986/42859 (Accessed October 05, 2025).

World Health Organization (2019). Snakebite envenoming: a strategy for prevention and control. Available online at: https://iris.who.int/handle/10665/324838 (Accessed October 05, 2025).

Yapa, H. M., and Bärnighausen, T. (2018). Implementation science in resource-poor countries and communities. *Implement Sci.* 13, 154. doi: 10.1186/s13012-018-0847-1