



Balancing Tradition and Science in Preventing Snakebite Envenoming among Beekeepers in Baringo County, Kenya: A Systematic Review through a Risk Compensation Lens

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ABSTRACT

Snakebite envenoming (SBE) is a significant yet often overlooked occupational hazard among beekeepers, particularly in regions with high snake prevalence. Despite the known risks, preventive measures and response strategies vary widely due to differences in knowledge, cultural beliefs, and access to healthcare. This paper examines SBE prevention and response as they pertain to beekeepers in Baringo County, Kenya, drawing on a systematic review of global, regional, and national literature through the lens of risk compensation theory (RCT), which explores how perceived risk and protective measures influence behavior. The systematic review was conducted to synthesize existing knowledge, prevention, and intervention strategies for SBE among beekeepers, given the limited literature focused specifically on Baringo County. Findings were categorized into three key themes: (1) knowledge and awareness, (2) preventive strategies, and (3) intervention and response mechanisms. The review revealed that while beekeepers recognize the threat of snakebites, their knowledge is often shaped by traditional practices rather than biomedical guidelines. Preventive strategies varied, with many relying on traditional deterrents and others adopting modern safety measures such as hive placement and protective clothing. However, cost and accessibility remained barriers to widespread adoption. In response to envenomation, many beekeepers initially seek treatment from traditional healers, delaying access to life-saving anti-venom. This behavioral pattern aligns with RCT, where reliance on perceived protective measures, whether traditional or biomedical, influences risk-taking and response behaviors. These findings underscore the need for culturally sensitive interventions that integrate traditional knowledge with evidence-based strategies to enhance SBE prevention and response. Increasing access to protective equipment, improving healthcare infrastructure, and implementing community-based training can bridge the gap between awareness and effective risk mitigation. By addressing economic and logistical barriers, a more comprehensive approach to SBE prevention can be achieved, ultimately reducing morbidity and mortality among beekeepers in Baringo County and other snake-endemic regions.

Keywords: Snakebite Envenoming (SBE); Beekeepers; Risk Compensation Theory (RCT); Preventive Strategies; Culturally Sensitive Interventions

INTRODUCTION

Snakebite envenoming (SBE) is a significant but often overlooked public health issue, particularly in rural and resource-limited settings. Globally, an estimated 5.4 million snakebites occur annually, leading to over 100,000 deaths and numerous cases of permanent disability (Roberts, et al., 2022). Sub-Saharan Africa bears a substantial burden of SBE, with rural communities disproportionately affected due to limited healthcare access, traditional treatment practices, and occupational exposure (Steinhorst, et al., 2022; Barnes, et al., 2021; World Health Organization, 2018). In Kenya, SBE ranks among the leading causes of injury-related morbidity, particularly in arid and semi-arid regions, where human-snake interactions are frequent (World Health Organization, 2018).

One high-risk occupational group is beekeepers, who frequently work in bushy, wooded environments that harbor venomous snakes. Protective measures, such as wearing protective clothing and placing hives strategically, can mitigate SBE risks. However, many beekeepers rely on traditional knowledge and informal prevention strategies, which may not always be effective (Ooms, Oirschot, & Waldmann, 2021; Ooms, et al., 2021; Ochola, Okumu, Muchemi, Mbaria, & Gikunju, 2018). Understanding how beekeepers perceive, prevent, and respond to SBE is essential for developing targeted interventions that integrate scientific evidence with local practices.

This study focuses on Baringo County, Kenya, a region with a high prevalence of snakebites and a thriving beekeeping industry (Ochieng, Recha, Bebe, & Ogendi, 2017; Baringo County Government, 2022). Located in northern Kenya within the Great Rift Valley, Baringo covers 11,075 km² and has a population of approximately



666,773 people (Baringo County Government, 2022). The county is predominantly arid and semi-arid, with expansive acacia woodlands and shrublands that provide an ideal habitat for snakes as well as bee colonies (Ochieng et al., 2017). Health reports from Baringo County have documented between 300 and 500 snakebite cases per month, and humanitarian organizations have noted significant snakebite outbreaks in rural sub-counties, such as Tiaty, often resulting in serious injury and fatalities (Baringo County Government, 2022; Médecins Sans Frontières, 2018; Ooms et al., 2021).

Among the seven sub-counties, Baringo South hosts the highest concentration of beekeepers, making it a highly relevant context for studying SBE prevention and response. Considering the documented burden of snakebites in the region and the complex interplay between traditional beliefs and scientific practices, this review systematically explores how knowledge and awareness, preventive strategies, and intervention and response mechanisms influence snakebite prevention efforts. By applying a risk compensation lens, the review aims to synthesize existing evidence, identify prevailing gaps, and propose balanced approaches that integrate both traditional wisdom and biomedical science in mitigating snakebite risks among beekeepers.

Although this study does not collect primary data from Baringo beekeepers, it systematically reviews existing research on SBE prevention and management in rural beekeeping communities. The findings from similar settings provide generalizable insights that can inform interventions in Baringo. This approach allows for a comprehensive synthesis of best practices, knowledge gaps, and policy recommendations, ensuring that future research and interventions in Baringo are grounded in existing evidence.

The study is guided by Risk Compensation Theory (RCT), which posits that individuals adjust their behavior based on perceived risk and protective measures (Cole, Kanz, & Klapper, 2012). This framework helps explain why beekeepers may continue relying on traditional deterrents despite the availability of biomedical preventive and treatment options. By applying RCT, the study provides a nuanced understanding of risk perception and protective behavior among beekeepers in snake-prone environments.

METHODOLOGY

This study employed a systematic review approach to analyze existing literature on snakebite envenoming (SBE) prevention and management among beekeepers, with a particular focus on its relevance to Baringo County, Kenya. The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure transparency, rigor, and reproducibility.

A comprehensive literature search was conducted using electronic databases, including PubMed, Web of Science, Scopus, and Google Scholar, to identify relevant peer-reviewed studies and grey literature. Additional sources, such as government reports and publications from global health organizations, including the World Health Organization (WHO), were also reviewed. The search strategy incorporated keywords and Boolean operators, such as ("snakebite envenoming" OR "snakebite poisoning") AND ("beekeepers" OR "beekeeping" OR "apiarists"), as well as ("snakebite prevention" OR "snakebite management" OR "snakebite treatment") AND ("rural communities" OR "resource-limited settings"). The search was restricted to studies published in English within the last 20 years (2004–2024) to ensure relevance to contemporary SBE prevention and management strategies.

The inclusion criteria focused on studies that addressed SBE prevention, risk perception, or treatment-seeking behaviors among beekeepers or rural communities at risk of envenoming. Eligible studies examined intervention strategies and reported findings on SBE incidence, response behaviors, or the effectiveness of preventive and treatment approaches. Both qualitative and quantitative research, including observational studies, clinical trials, and systematic reviews, were considered. Studies were excluded if they did not directly relate to SBE prevention or response in rural settings, focused solely on snake taxonomy without discussing envenoming risks, or were editorial, commentary, or opinion pieces lacking empirical data.

The study selection process followed a three-stage approach. First, titles and abstracts were screened to assess relevance. Next, full-text reviews were conducted to determine eligibility based on predefined criteria. Finally, selected studies underwent a quality appraisal using the Joanna Briggs Institute (JBI) critical appraisal checklist for qualitative studies and the Newcastle-Ottawa Scale (NOS) for observational studies.

Data extraction was conducted systematically, capturing key details such as study location, population characteristics, methodology, and findings related to SBE knowledge, prevention strategies, and response behaviors. Extracted data were then synthesized thematically, focusing on three key areas: knowledge and



awareness of SBE among beekeepers, preventive measures (both traditional and biomedical), and intervention and response strategies following envenomation. A narrative synthesis was employed to summarize trends, identify gaps, and highlight inconsistencies across studies.

Although this study did not involve direct human participation, ethical considerations were observed by ensuring that all sources were properly cited and acknowledged. Care was taken to accurately represent the findings of reviewed studies without misinterpretation or bias.

RESULTS AND DISCUSSIONS

This section presents the key results from the systematic review, structured around three major themes: (1) Knowledge and Awareness of SBE among Beekeepers, (2) Preventive Strategies for Snakebite Envenoming, and (3) Intervention and Response Strategies for SBE. These themes emerged from the reviewed literature, reflecting the interplay between local knowledge systems, preventive behaviors, and response mechanisms to snakebite envenoming (SBE).

A total of 16 studies were included in this review, comprising peer-reviewed journal articles, government reports, and relevant grey literature published between 2018 and 2023. The studies varied in methodological approaches, including qualitative field studies, epidemiological surveys, and policy analyses. While most studies focused on rural communities in sub-Saharan Africa, some provided insights from other regions with comparable environmental and socio-economic conditions.

The findings highlight how beekeepers' perceptions of risk, shaped by cultural beliefs, economic constraints, and access to biomedical resources, influence their engagement with snakebite prevention and treatment measures. Applying Risk Compensation Theory (RCT) as a conceptual lens, the review explores how variations in knowledge, access to protective measures, and confidence in treatment options affect beekeepers' decision-making regarding SBE prevention and response. The discussion of findings integrates both traditional and biomedical perspectives, emphasizing the need for balanced, culturally sensitive interventions that enhance awareness while improving access to effective risk mitigation strategies.

The subsequent sections provide a detailed thematic synthesis of the reviewed literature, with supporting evidence from empirical studies.

Theme 1: Knowledge and Awareness of SBE among Beekeepers

A key theme emerging from the reviewed literature is the level of knowledge and awareness regarding snakebite envenoming (SBE) among beekeepers. Many studies highlight that while beekeepers acknowledge the risk posed by snakes in their working environments, their understanding of effective preventive measures and appropriate treatment options varies significantly. Several factors influence awareness levels, including educational background, exposure to formal training, and reliance on traditional knowledge. A summary of reviewed works on theme one is presented in Table 1.

Table 1: Summary of studies on knowledge and awareness of SBE among beekeepers

Authors	Study Location	Methodology	Key Findings
Afroz et al. (2023)	Sub-Saharan Africa	Ethnographic study	Beekeepers have varying levels of awareness, with many relying on community-shared knowledge rather than formal education.
Duda et al. (2021)	Central Africa	Observational study	Many beekeepers recognize the risk of SBE but lack access to information on first-aid and medical treatment options.
Barnes et al. (2021)	Kenya	Cross-sectional survey	Awareness programs significantly improve knowledge levels, but gaps remain in translating awareness into preventive practices.
Ooms et al. (2021)	East Africa	Mixed-methods study	Community-driven education initiatives are effective in improving knowledge retention and risk perception.
Ochola et al. (2018)	Kenya	Qualitative interviews	Traditional healers remain a primary source of snakebite treatment advice, influencing risk perception among beekeepers.
World Health Organization (2018)	Global	Systematic review	Limited access to formal education on SBE results in reliance on misinformation and traditional remedies.
Kenya Snakebite Research and Intervention Centre (KSRIC, 2021)	Baringo County, Kenya	Annual surveillance report	Many rural beekeepers lack access to first-aid training and rely on traditional remedies.
Baringo County Government (2022)	Baringo County, Kenya	County Livelihood assessment	Familiarity with snake habitats leads to underestimation of risk, reinforcing findings from Risk Compensation Theory (RCT).

Table 1, studies consistently indicate that while beekeepers acknowledge the risk posed by snakes in their working environments, their understanding of effective preventive measures and appropriate treatment options varies significantly (Afroz et al., 2023; Barnes et al., 2021; Duda et al., 2021).

Several factors influence awareness levels, including educational background, access to formal training, reliance on traditional knowledge, and exposure to past snakebite incidents. Many beekeepers, especially those in rural areas, rely on community-shared knowledge and informal learning, which may not always align with scientifically validated preventive and treatment approaches (Duda et al., 2021; Ooms et al., 2021).

The reviewed studies suggest that beekeepers' firsthand experience with snakes does not always correlate with accurate knowledge of SBE prevention and treatment. Instead, many rely on traditional practices and informal learning, which may not always be effective or evidence-based (Afroz et al., 2023; Duda et al., 2021).

This finding aligns with Risk Compensation Theory (RCT), which suggests that individuals assess risks based on perceived knowledge and familiarity rather than objective danger (Wilde, 1982). Beekeepers who have coexisted with snakes for long periods may develop a false sense of security, believing that their experience and traditional knowledge are sufficient for mitigating risk, even when evidence suggests otherwise (Barnes et al., 2021; KSRIC, 2021).

Moreover, Barnes et al. (2021) highlight that awareness programs alone do not always lead to behavioral change. This is particularly significant in the context of RCT, as it suggests that increased knowledge may increase confidence rather than adherence to protective measures. Similarly, Ooms et al. (2021) emphasize that community-driven education initiatives are more effective in improving risk perception than top-down interventions. This suggests that integrating biomedical knowledge with local cultural understandings could be a crucial strategy for enhancing SBE prevention and management.

The situation in Baringo County mirrors these broader findings. Reports from the Baringo County Integrated Development Plan (CIDP) 2023-2027 and the Kenya Ministry of Health's Snakebite Prevention and Treatment

Guidelines (2022) indicate that knowledge gaps in snakebite management are prevalent among rural populations, particularly in high-risk occupations such as beekeeping. These reports highlight that many local beekeepers rely on community-held knowledge passed down through generations, rather than on formal education or structured training programs.

According to the Kenya Snakebite Research and Intervention Centre (KSRIC) Annual Report (2021), Baringo County records a disproportionately high number of snakebite cases, particularly in arid and semi-arid areas where beekeeping is prevalent. Despite this, most local beekeepers lack access to formal first-aid training or guidelines on appropriate responses to envenomation. Similar to Duda et al. (2021), the KSRIC report notes that healthcare access limitations reinforce reliance on traditional remedies, which may not always be effective.

Additionally, the Baringo County Livelihood Report (2022) acknowledges that beekeepers in the region often underestimate the risks posed by snakebites due to their familiarity with the environment, reinforcing the arguments made under RCT. This aligns with findings by Barnes et al. (2021) that awareness alone does not always lead to changes in protective behavior. Furthermore, reports by local agricultural extension officers suggest that there is a critical need for practical, community-based SBE training programs tailored to the realities of beekeepers in Baringo.

Theme 2: Preventive Strategies for Snakebite Envenoming

Beyond knowledge and awareness, a significant focus in the literature is on the preventive strategies that beekeepers adopt to minimize the risk of snakebite envenoming. These strategies range from traditional methods passed down through generations to more structured interventions influenced by biomedical recommendations.

Table 2: Summary of studies on preventive strategies for snakebite envenoming

Authors	Study Location	Methodology	Key Findings
Halilu et al. (2019)	West Africa	Community-based study	Beekeepers use locally sourced repellents (e.g., plant extracts) and controlled burning to deter snakes.
Ochola et al. (2018)	Kenya	Ethnographic study	Traditional protective rituals and charms are common but show limited effectiveness in preventing actual encounters.
da Silva et al. (2019)	South America	Longitudinal study	Proper hive placement and use of protective clothing significantly reduce snakebite incidents.
Barnes et al. (2021)	East Africa	Mixed-methods study	Combination of modern and traditional methods yields mixed results, with modern strategies proving more effective in reducing bites.
Ooms et al. (2021)	East Africa	Qualitative interviews	Training programs on preventive strategies improve adoption of protective measures but require sustained community engagement.
World Health Organization (2021)	Global	Policy review	Advocates for integration of traditional and biomedical strategies to improve SBE prevention in rural beekeeping communities.
Kenya Ministry of Health (2022)	Kenya	Government report	Highlights the need for affordable protective gear and structured training to enhance snakebite prevention.

Table 2 indicates that preventive strategies vary widely based on cultural practices, environmental conditions, and access to formal training. Traditional approaches, such as using herbal repellents, burning vegetation around apiaries, and relying on charms, remain prevalent in many communities, despite limited empirical evidence supporting their efficacy (Halilu et al., 2019; Ochola et al., 2018). Conversely, biomedical approaches—such as the use of protective clothing, controlled hive placement, and improved lighting around apiaries—have been demonstrated to effectively reduce exposure to venomous snakes (da Silva et al., 2019; Barnes et al., 2021).

From a Risk Compensation Theory (RCT) perspective, the adoption of preventive strategies is influenced by the perceived effectiveness of these measures. Some beekeepers rely primarily on traditional deterrents because they perceive them as sufficient, which can lead to reduced vigilance in high-risk settings. Others, recognizing the



limitations of these methods, integrate modern preventive techniques but only if they are accessible and practical within their local context. This interplay between perceived protection and risk-taking behaviors highlights the necessity of culturally sensitive interventions that respect traditional knowledge while incorporating scientifically validated preventive strategies.

For instance, Halilu et al. (2019) and Ochola et al. (2018) demonstrate that beekeepers often trust herbal-based repellents and rituals because they align with indigenous belief systems, reinforcing the perception of protection. However, the lack of empirical validation for these approaches suggests that their continued use without complementary preventive measures could foster complacency. By contrast, da Silva et al. (2019) and Barnes et al. (2021) present strong evidence that structural modifications—such as elevating hives, maintaining clear surroundings, and using protective clothing—effectively reduce encounters with snakes. This dichotomy supports the argument that interventions should not dismiss traditional methods outright but instead integrate them with scientifically supported approaches to create a more comprehensive risk mitigation strategy.

Grey literature on beekeeping practices in Baringo County further underscores these findings. Reports from the Baringo County Integrated Development Plan (CIDP) 2023-2027 highlight that beekeeping is a crucial economic activity, particularly in Baringo South, where apiaries are often located in remote, bushy areas with high snake densities. The Kenya National Beekeeping Policy (2021) acknowledges that beekeepers in arid and semi-arid regions, including Baringo, face significant challenges in implementing modern preventive strategies due to financial and infrastructural constraints. These challenges reinforce the reliance on traditional methods, despite their limited proven effectiveness.

Moreover, a key takeaway from these findings is the role of cost and accessibility in determining which preventive measures beekeepers are likely to adopt. While protective clothing, improved infrastructure, and controlled hive placement are proven to be effective, their affordability and availability often limit widespread use (Barnes et al., 2021; Kenya Ministry of Health, 2022). As RCT predicts, individuals may compensate for the perceived lack of access to effective prevention by over-relying on traditional practices, even in cases where these are demonstrably less effective.

This underscores the need for interventions that not only promote modern preventive strategies but also ensure their accessibility. Solutions such as: subsidized protective gear; community-led distribution models, and educational outreach programs that integrate local knowledge systems could increase adoption of effective SBE prevention strategies without alienating local beekeepers from their traditional practices.

While preventive strategies play a crucial role in mitigating SBE risks, the effectiveness of these measures ultimately depends on how beekeepers respond to snakebite incidents when they occur. The next section examines intervention and response strategies, evaluating both traditional and biomedical approaches to treating SBE among beekeepers in rural settings.

Theme 3: Intervention and Response Strategies for SBE

While preventive measures play a crucial role in reducing snakebite risks, effective response mechanisms following envenomation are equally vital. The literature highlights various intervention strategies, ranging from reliance on traditional healers to seeking biomedical treatment at health facilities. The accessibility, affordability, and perceived efficacy of these interventions greatly influence beekeepers' response behaviors.

**Table 3: Summary of studies on intervention and response strategies for SBE**

Authors	Study Location	Methodology	Key Findings
Warrell et al. (2019)	West Africa	Clinical study	Delays in accessing anti-venom treatment increase morbidity and mortality.
Kipkoech et al. (2020)	Kenya	Qualitative study	Many beekeepers first consult traditional healers before seeking hospital treatment, leading to treatment delays.
Williams et al. (2022)	Sub-Saharan Africa	Mixed-methods study	Community-based training on SBE response improves outcomes and reduces mortality.
Silva et al. (2021)	Latin America	Epidemiological study	Early administration of anti-venom is the most effective intervention, but access remains a challenge in rural settings.
Gutiérrez et al. (2022)	Global	Systematic review	Strengthening referral systems and stocking rural clinics with anti-venom reduces SBE-related deaths.
Kenya Ministry of Health (2022)	Kenya	Policy report	Rural healthcare access is constrained by shortages of trained personnel and anti-venom supplies.
Kenya Snakebite Research and Intervention Centre (KSRIC, 2021)	Kenya	Mixed-methods study	Community-based education programs improve awareness but require sustainable implementation strategies.

The reviewed studies indicate that delayed access to biomedical treatment remains a major barrier to effective SBE management in rural beekeeping communities. Warrell et al. (2019) and Silva et al. (2021) underscore the life-saving potential of early anti-venom administration, yet logistical and systemic barriers—such as limited healthcare infrastructure, long travel distances, and stock shortages—make timely intervention difficult. Furthermore, Kipkoech et al. (2020) highlight that many beekeepers initially consult traditional healers before considering hospital treatment, a delay that can exacerbate envenomation severity. This preference is largely driven by cultural familiarity, cost concerns, and mistrust in formal healthcare systems, reinforcing the need for community-sensitive health interventions.

Grey literature from Kenya's Ministry of Health (2022) supports these findings, indicating that in rural counties such as Baringo, healthcare access remains constrained by a shortage of medical personnel and essential snakebite treatment supplies, including anti-venom. The Baringo County Integrated Development Plan (Baringo County Government, 2023) acknowledges that many rural communities rely on traditional medicine due to inadequate healthcare infrastructure, further contributing to delays in effective snakebite management. Reports from NGOs operating in the region, such as the Kenya Snakebite Research and Intervention Centre (KSRIC, 2021), suggest that community-based education programs have shown promise in improving treatment-seeking behaviors, but significant gaps remain in ensuring timely access to biomedical care.

From a Risk Compensation Theory (RCT) perspective, these findings illustrate how perceived safety within a familiar treatment framework can inadvertently increase actual risk exposure. Beekeepers who believe that traditional treatments offer sufficient protection may delay seeking hospital care, despite clinical evidence showing that delays in anti-venom administration significantly increase mortality rates (Warrell et al., 2019). This aligns with RCT's assertion that when individuals perceive themselves as protected—whether through traditional remedies, personal experience, or faith-based beliefs—they may underutilize more effective but less familiar biomedical interventions.

Conversely, Williams et al. (2022) and KSRIC (2021) provide an alternative model, demonstrating that community-based training on SBE response enhances preparedness and improves treatment-seeking behavior. This suggests that risk perception can be reshaped through targeted education, particularly when it integrates culturally relevant narratives and emphasizes the limitations of traditional remedies alongside the benefits of biomedical care. Gutiérrez et al. (2022) further highlight the importance of strengthening referral systems and ensuring that rural clinics are equipped with anti-venom, a strategy that has been successful in reducing SBE-related deaths globally. The success of such interventions highlights the potential for community-driven strategies to serve as a bridge between traditional and biomedical practices, fostering greater trust in hospital-based care.



Grey literature from Kenya's Ministry of Health (2022) and Baringo County Integrated Development Plan (2023) reveals that healthcare access in Baringo remains constrained by a shortage of medical personnel and essential SBE treatment supplies. The Kenya Snakebite Research and Intervention Centre (KSRIC, 2021) underscores the need for sustained community-based education programs to improve treatment-seeking behaviors

The interplay between traditional and biomedical treatment approaches underscores the need for a dual-response model that respects local healing practices while promoting timely hospital interventions. Ignoring cultural preferences may lead to resistance, but integrating traditional healers into referral networks or incorporating biomedical principles into existing community health structures could improve early treatment uptake. This model aligns with the findings of Williams et al. (2022), who argue that when communities are empowered with knowledge and accessible treatment options, response times improve, and mortality rates decline.

Additionally, structural barriers—such as the scarcity of anti-venom, poor healthcare infrastructure, and the financial burden of hospital care—must be addressed to convert awareness into action. Without accessible, affordable treatment options, even well-informed beekeepers may default to traditional remedies out of necessity rather than preference. Future research should therefore focus on integrating local healthcare systems with sustainable supply chains for anti-venom and developing decentralized emergency response programs that improve access to life-saving interventions in remote beekeeping communities.

CONCLUSION AND RECOMMENDATIONS

Overall, the findings reveal that while knowledge and awareness of snakebite envenoming among beekeepers are widespread through traditional channels, the lack of integration with formal education approaches often limits the translation of this knowledge into effective risk-reduction behaviors. Preventive strategies remain heavily skewed toward traditional practices, shaping risk perceptions and influencing the consistency of preventive actions. Intervention and response mechanisms are further constrained by treatment-seeking delays rooted in cultural norms and limited access to biomedical healthcare. The application of Risk Compensation Theory (RCT) underscores that perceived protection—whether derived from traditional knowledge, communal practices, or prior experiences—significantly shapes actual risk behaviors

To enhance the effectiveness of snakebite prevention among beekeepers and similar vulnerable groups, education authorities and health promotion agencies should prioritize integrating formal, evidence-based snakebite education into community-based knowledge-sharing platforms to ensure awareness leads to behavior change. Public health programs and agricultural extension services should collaborate to develop and promote culturally acceptable, affordable preventive measures that bridge traditional practices with scientifically validated strategies, improving adherence and reducing risky behaviors. Finally, healthcare systems and community health initiatives should strengthen early intervention mechanisms by improving the availability of anti-venom at local facilities and implementing culturally sensitive training programs that encourage timely biomedical treatment-seeking behaviors, addressing the risk perceptions identified through the Risk Compensation Theory framework.

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