REGIONAL ACTION PLAN FOR PREVENTION AND CONTROL OF SNAKEBITE ENVENOMING IN THE SOUTH-EAST ASIA

2022–2030
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Foreword

More than 5.8 billion people globally are at risk of snakebite envenoming, which kills between 81 000 and 138 000 people per year. In the South-East Asia Region – a biodiversity hotspot for venomous snakes, and home to some of the world’s most densely packed populations – snakebite envenoming is a major public health problem, killing tens of thousands of people every year and causing a range of physical and mental disabilities, including blindness and amputation, and post-traumatic stress disorder.

Snakebite envenoming is a disease of poverty. Agricultural workers, fishermen, working children, and families living in poorly constructed houses are particularly vulnerable. Most deaths and serious consequences of snakebite are entirely preventable by safe and effective antivenoms. Yet, due to lack of awareness, knowledge and access to health care and appropriate antivenoms, young people and children in underprivileged rural areas continue to suffer disproportionate case fatality due to snakebite envenoming. It is also a significant cause of maternal morbidity and pregnancy-loss – an inequity that we must not accept.

In 2018, the Seventy-first World Health Assembly adopted a comprehensive resolution calling for a coordinated response to address the global burden of snakebite envenoming as one related to neglected tropical diseases (NTDs). In the following year, WHO developed a Global Strategy titled: Snakebite envenoming: a strategy for prevention and control, to fulfil our mandate to direct and coordinate global action on snakebite, as had been requested by Member States in the resolution.

This Regional Action Plan for prevention and control of snakebite envenoming in the South-East Asia 2022–2030 aims to accelerate progress to reduce snakebite-related death and disability by 50% by 2030 in line with the Global Strategy. It is intended to guide Member States, WHO, donors and partners to work together to intensify efforts to strengthen health system components and accelerate actions at the human–animal–ecosystem interface through a series of strategies and priority areas.

The people most affected by snakebite are typically those with the least access to services and medicines. Therefore, universal health coverage based on robust health systems and people-centred primary health care is the most powerful force to reduce the impact of snakebite envenoming. Engaging communities and national and international partners to extend awareness, knowledge and access to care as much as possible will ensure that no person or community is left behind, and this is also essential.

I urge all policy-makers and managers in countries, as well as our international partners, to work with WHO to implement this Regional Action Plan and achieve sustained prevention and control of this disease to progress towards a South-East Asia Region in which the neglect of poverty-related diseases is no more.

Dr Poonam Khetrapal Singh
Regional Director
WHO South-East Asia Region
Regional Action Plan at a glance

**Vision**

A South-East Asia Region free of deaths and disabilities due to snakebite envenoming.

**Goal**

Reduce the number of deaths and cases of disability associated with snakebite envenoming by 50% in the South-East Asia Region by 2030.

**Objectives and strategies**

**Objective 1. Prevent snakebites and provide effective first-aid**

- **Strategy 1.1:** Engage, educate and empower communities at-risk on snakebite prevention and first-aid care

**Objective 2. Ensure access to life-saving treatment and care**

- **Strategy 2.1:** Strengthen effective pre-hospital care and rapid transport
- **Strategy 2.2:** Strengthen health-care and referral system capacity
- **Strategy 2.3:** Improve the inventory management system and storage conditions of antivenoms

**Objective 3. Improve availability of quality, effective, safe and affordable antivenoms**

- **Strategy 3.1:** Optimize production, procurement and distribution of locally appropriate antivenoms
- **Strategy 3.2:** Strengthen pharmacovigilance and post-market surveillance for antivenoms
- **Strategy 3.3:** Strengthen regulation of antivenom quality, efficacy and safety

**Supporting areas**

1. Strengthen leadership, governance and programme planning and management
2. Establish surveillance and monitor and evaluate progress
3. Enhance regional partnership and multisectoral collaboration for advocacy, research and innovation
Background

1.1 Disease

Snakebite envenoming is a medical emergency resulting from contact with a complex and varying mixture of toxins (venom) injected during a bite or sprayed into the eyes by a snake as part of its defence mechanism (1,2). Bites by venomous snakes can cause severe paralysis that may prevent breathing; bleeding disorders that can lead to fatal haemorrhage; generalized muscle breakdown; irreversible kidney failure and severe local tissue destruction that can result in permanent disability including blindness, extensive scarring, contractures and limb amputations (Fig. 1) (1,2).

Snakebite can be a significant cause of maternal morbidity and pregnancy loss among underprivileged rural dwellers. Young children (aged under 5 years) suffer higher case-fatality (3,4). In addition to long-term physical sequelae involving the musculoskeletal, neurological, renal and endocrine systems, survivors can also suffer from post-traumatic stress disorder at rates comparable to those observed after the 2004 Asian tsunami or after major road traffic accidents (4,5).
Background

3

Haemorrhage due to damaged blood vessel walls, consumption of clotting factors and degraded platelets

Local tissue damage including swelling, oedema and necrosis due to destructive effects of some snake venoms and secondary effects on blood supply

Leaking capillaries throughout the body caused by direct and indirect effects of toxins

Toxin effect on mineral balance causing low serum sodium concentration

In humans and animals, snake venom can precipitate multi-organ or multi-system disease

Fig. 1. Multiorgan and multisystem impact of snakebite envenoming in humans and animals (4)
Background

1.2 Regional epidemiology

Snakebite envenoming annually affects an estimated 1.8 to 2.7 million people worldwide, with upper estimates of mortality ranging between 80,000 and 138,000 deaths (6,7). It causes considerable physical and psychological disabilities among survivors though comprehensive data on the magnitude of these long-term effects are currently lacking (5,8–10). The South-East Asia Region is one among the most affected, with nearly 70% of annual global snakebite deaths occurring in South Asia alone (7,11). Although largely overlooked, snakebite envenoming also causes particularly high mortality among livestock in endemic regions (12–14).

A few large or nationwide community surveys have been conducted in Bangladesh, India, Nepal and Sri Lanka, improving awareness of snakebite envenoming as a public health priority (15–18). A community-based nationwide survey in Bangladesh estimated an annual snakebite incidence density of 623.4 per 100,000 person-years (95% CI: 513.4–739.2 per 100,000 person-years) with 710,159 snakebite episodes resulting in 6,041 deaths in 2009 (15).

In India, estimates from a national mortality survey (2001–2014) combined with a systematic literature review yielding nearly 88,000 published Indian snakebite cases between 2000 and 2019, indicate 1.11–1.77 million bites, 0.77–1.24 million envenomings and 58,000 deaths each year (16).

A recent community-based survey in the Terai region of Nepal found annual incidence rates of 251 per 100,000 people and overall casefatality ratio of 7.8%. These figures translate to an estimated 26,749–37,661 people bitten by snakes and 2,386–3,225 deaths across the Terai (17). A nationwide community-based, cross-sectional survey between August 2012 and June 2013 in Sri Lanka revealed an annual incidence of 110,000 bites (95% CI: 107,500–112,500), 45,000 envenomings (95% CI: 32,000–73,000) and 464 deaths (95% CI: 45–884) (18).

Accurate measures of snakebite burden are lacking in most other countries of the South-East Asia Region. In these countries, national estimates tend to rely on hospital-based data, which generally underestimate snakebite incidence, in some cases by up to 60% (19). This is because a considerable number of snakebite victims die before reaching a health centre or preferentially attend traditional healers. Additionally, snakebite is not a notifiable disease and therefore not officially reported in most countries of the Region (11,18).
1.3 Issues and challenges

The South-East Asia Region is a biodiversity hotspot for many venomous snake species (20). At the same time, it also encompasses geographical areas with the highest human population density in the world (21). Within the Region, nearly 70% of the population lives in rural areas and depends on agrarian activities including agriculture, hunting, fishing and forestry for its livelihood (20,22,23). The inevitable intersection of these activities with snake habitats is what makes humans and livestock in the Region particularly vulnerable to snakebite incidents. Consequently, snakebite envenoming in the South-East Asia Region is an occupational and environmental disease originating at the animal–human–snake–agroecosystem interface, in need of comprehensive approaches that recognize interlinkages between humans, livestock and snakes for its effective mitigation (Box 1) (20,24,25).

Snakebite envenoming is also a disease of poverty. Poverty-related factors such as precarious housing with open toilets, use of firewood for cooking, poor lighting, distant sources of water accessed via paths through grasslands and open fields, open defecation, non-mechanized farming techniques, barefoot farming and sleeping on the floor tend to expose vulnerable populations to snakebite risk (26–31). Rural poverty is estimated to heighten snakebite odds by nearly 64 times (22). Snakebite also exerts substantial direct economic effects on impoverished rural communities through treatment-related expenses and disability-related long-term loss of productivity and livelihood, sustaining the vicious cycle of poverty and inequity (28,32–34).

While most deaths and serious consequences of snakebite are entirely preventable by widening access to safe and effective antivenoms, there are a series of issues and challenges that need to be addressed at the community and health-system levels, in addition to those within the antivenoms manufacturing landscape, to achieve sustainable progress in the prevention and control of snakebite envenoming in the Region (Fig. 2).

At the community level, firstly, a lack of awareness related to snake behaviours and simple preventive measures such as keeping domestic areas free of rubbish, rubble and firewood, controlling rodent populations, constructing safe houses with in-house latrines, using well-tucked mosquito nets while sleeping on the floor and using protective footwear exposes these populations to snakebite incidents (22,35,36).

Secondly, a considerable number of patients die before reaching a health centre after a snakebite due to lack of rapid transport to a medical facility (37–40). Even in instances where emergency transport services are available, they often lack well-trained paramedics and life-saving emergency drugs (41). Many rural communities in the South-East Asia Region continue to rely on faith-healers offering traditional therapies such as chanting, incisions, sucking venom from the bite-site, tying tourniquets or the local application of herbs, animal excrement or snakestones (15,22,42–44). These practices often delay access to effective treatment and can cause harm (1,11).

Within the health system, poor clinical outcomes in snakebite victims can occur despite timely administration of antivenom due to deficiencies in human resources, appropriate antivenoms and infrastructure including an intact cold chain, functioning critical care equipment (such as ventilators and dialysis machines) and blood banks (11,45–47). Furthermore, most snakebite victims are not followed up after discharge to review late antivenom-related reactions and screen for debilitating physical and psychological sequelae, leading to lifelong disabilities (4,5). Loss of livelihood linked to these disabilities and costs of long-term care may lead stricken families into a debt–poverty trap and in some cases even force children to discontinue education to support family income or care for the disabled victims (33).
**Fig. 2. Major issues and challenges in prevention and control of snakebite envenoming in the South-East Asia Region**

- **MINISTRY OF HEALTH**
  - Poor awareness
  - Incorrect first aid practices and medical treatment
  - Financial burden
  - No follow up after discharge from health facility

- **REGULATORY AUTHORITY**
  - Paucity of antivenoms
  - Suboptimal products

- **MARKET**
  - Underproduction due to manufacturing capacity and limited demand
  - Ineffective antivenoms due to the mismatch to local snakes
  - Insufficient quality control mechanism
  - Lack of innovation for better tools (diagnostics and treatments)

- **COMMUNITY**
  - Poor access from victims
  - Poor ambulance and pre-hospital care
  - Absence of appropriate antivenoms
  - Inappropriate storage conditions without cold chain
  - No reporting system of usage and severe adverse events
  - No surveillance system to understand disease burden

- **HEALTH FACILITY**
  - Paucity of antivenoms
  - Suboptimal products

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Background
Box 1.

Integrated health models for the prevention and treatment of snakebite envenoming: The One Health approach and Eco-health perspective

Snakebite occurs in complex interconnected ecological, social, economic, occupational and cultural contexts (25). Its impact in poor rural areas extends beyond direct human health effects and related health-care costs and involves significant added socioeconomic damages through livestock loss (13,25). Snakebites in livestock and poultry can cause a substantial negative economic impact linked to expenses on animal health care, productivity loss from animal disabilities and livelihood losses for households depending on these animals for food, revenue and occupational activities (12,25,32). Snakebite therefore requires to be viewed through more holistic, transdisciplinary perspectives for an effective reduction of its impact (24,25).

The last decade has seen the evolution of such perspectives including the One Health approach and the Eco-health concept (71,72). One Health recognizes the interconnectedness of human and animal health and bridges the previously separated fields of human and veterinary medicine (72). The Eco-health concept incorporates the study of ecosystems, environmental degradation, unsustainable development within this scenario while emphasizing social determinants of health, gender and issues of equity (71,72). In the snakebite context, such frameworks call for the transdisciplinary cross-sectoral involvement of stakeholders from a range of fields including agriculture, ecology, herpetology, forestry and anthropology with closer coordination between human and veterinary health systems (24,25). Potential examples where snakebite interventions could utilize such unified frames include integration of national snakebite control programmes in the national One Health coordination mechanism, integrated human and animal surveillance systems and epidemiological studies on snakebites in human and animal cases (Fig. 3) (12,17,24,26).
**Fig. 3.** Finding common ground for collaboration – example sectors and their objectives involved in a cross-cutting One Health approach for control and elimination of NTDs (73)

### Global goals

**A better and more sustainable future for all**

**Shared outcomes**

- **People and communities** that are stable, safe, healthy, and productive
- **Animal welfare**, safe and stable food production, and diverse and protected wildlife
- **Environments** that are healthy and resilient to change e.g. climate change, disease outbreaks, conflict
- **Services** that are accessible, affordable, inclusive and meet community needs

### Sectors

- **Human health**
- **Animal health and agriculture**
- **Environmental health**
- **Municipalities**
- **Education**
- **Tourism**
- **Industry**
- **Other**

### Objectives

- **Human health**
  - Keep people healthy and well
  - Provide health services
  - Manage risks and disasters

- **Animal health and agriculture**
  - Support animal health and welfare
  - Supply safe, nutritious food
  - Protect trade and livelihoods

- **Environmental health**
  - Protect ecosystems and biodiversity
  - Manage risks e.g. pollution, climate

- **Municipalities**
  - Address citizen needs and concerns
  - Implement local policies and programmes

- **Education**
  - Provide inclusive and high-quality education
  - Support transition from learning to employment

- **Tourism**
  - Attract visitors and generate income
  - Provide safe and interesting places to stay, eat, drink, and explore

- **Industry**
  - Develop and supply products
  - Provide employment

- **Other**
  - Finance ministries who set budgets
  - Planning ministries who inform construction
  - Technology, etc...
Finally, the single most important challenge facing antivenoms in the Region pertains to their relative ineffectiveness and low potency in neutralizing venoms of target species in those envenomed. This is particularly true for Indian antivenoms which are used across South Asia to treat snakebite envenoming. While robust and comprehensive data on the effectiveness of the standard initial dose in achieving target clinical end-points are lacking, some reports highlight a declining potency of Indian antivenom products, by nearly six times over the past seven decades, to current levels of 0.45 mg/mL for saw-scaled viper and common krait venoms and 0.6 mg/mL for Russell's viper and Indian cobra venoms (48). Upper estimates of the venom mass injected during bites by the latter two species range in hundreds of milligrams and assuming normal distribution, it is likely that greater than average amounts are injected in nearly 50% of victims (49–52). Under these circumstances, an effective neutralization of circulating venom by currently recommended initial doses of these low-potency products is unlikely. These observations are often borne out in the clinical experiences of health providers from some parts of the country who speak of administering close to 100 vials of antivenom when a dose of 10–20 vials would suffice (48,51,52).

Intra-specific variations in venom immunology are another reason for geographical variations in neutralizing efficacy and clinical effectiveness of available products, which are currently being manufactured using venoms sourced from limited geographical areas (50,53–57). Current antivenom products are also ineffective when used to treat patients envenomed by locally prevalent snake species other than those whose venoms they are primarily designed to neutralize (20,58–63).

Acute reactions to antivenom are an important source of concern to clinicians managing snakebite envenoming. In some instances, they can be a frequent and significant enough source of morbidity to discourage doctors in peripheral health centres from administering antivenom to envenomed patients (11). In some parts of South Asia, severe reaction rates can be as high as 43% (64). While the incidence of fatal reactions is unclear due to the overlap of symptoms with those of envenoming, some deaths have been reported (65). Despite these alarming statistics, antivenoms are often excluded from national pharmacovigilance programmes.

Factors likely to contribute to the above challenges include unchanged manufacturing methods that have received little modern technological advancement and innovation; poor compliance with WHO standards and protocols for venom and antivenom production; and the lack of captive husbandry of snakes for venom collection due to stringent legislative restrictions (49,66,67). Regulated venom collection using captive snakes maintained in well-designed serpentariums is superior compared to venom collection from wild snakes since it requires fewer animals, limits impacts on wild populations and results in higher yields of better-quality venom.

Antivenom availability can also be an issue in the Region, either due to the limited manufacturing capabilities of countries producing antivenom for sole domestic consumption or a lack of long-term demand forecast and supply–demand mismatch in countries with larger, well-established infrastructure, which export antivenom in addition to domestic distribution (37,58,68–70).
1.4 Purpose of the Regional Action Plan

Given the global burden of snakebite envenoming justifying concerted public health response, snakebite envenoming was categorized by WHO as a high priority neglected tropical disease (NTD) following the recommendation of WHO’s Strategic and Technical Advisory Group on NTDs in 2017. In 2018, World Health Assembly endorsed a resolution (WHA71.5) to urge Member States and WHO to accelerate global efforts for the control of snakebite envenoming. In response, WHO launched the Global Strategy for prevention and control of snakebite envenoming in 2019. In the same year, the Seventy-second session of the WHO Regional Committee for South-East Asia recommended the development of a Regional Snakebite Prevention and Control Plan of Action to help Member States strengthen their capacity to prevent, control and effectively manage snakebites, by regional adaptation of the Global Strategy.

In this context, the Regional Action Plan for prevention and control of snakebite envenoming in the South-East Asia 2022–2030 was developed through a consultative process with Member States, experts and partners. The Regional Action Plan is intended to guide Member States, WHO, donors and partners to work together to systematically and progressively address issues and challenges and strengthen relevant health-system and programmatic components to accelerate prevention and control of snakebite envenoming in the South-East Asia Region.
Vision, goal, objectives and strategies

2.1 Vision

A South-East Asia Region free of deaths and disabilities due to snakebite envenoming.

2.2 Goal

Reduce the number of deaths and cases of disability associated with snakebite envenoming by 50% in the South-East Asia Region by 2030.
2.3 Objectives, strategies and supporting elements

Major regional challenges facing snakebite mitigation, as discussed in chapter 1.3, will be overcome through the following three objectives, to achieve the stated vision and goal.

- **Objective 1:** Prevent snakebites and provide effective first-aid
- **Objective 2:** Ensure access to life-saving treatment and care
- **Objective 3:** Improve availability of quality, effective, safe and affordable antivenoms

The Regional Action Plan proposes to achieve these three objectives through implementation of seven strategies, each with a list of identified priority actions and the following three supporting areas (Fig. 4).

- **Supporting area 1:** Strengthen leadership, governance and programme planning and management
- **Supporting area 2:** Establish surveillance and monitor and evaluate progress
- **Supporting area 3:** Enhance regional partnership and multisectoral collaboration for advocacy, research and innovation

**Fig. 4 Objectives, strategies and supporting elements to achieve the goal of the Regional Action Plan for prevention and control of snakebite envenoming in the South-East Asia 2022–2030**

- **Strategy 1.1.** Engage, educate, and empower communities-at-risk on snakebite prevention and first-aid care
- **Strategy 2.1.** Strengthen effective pre-hospital care and rapid transport
- **Strategy 2.2.** Strengthen healthcare and referral system capacity
- **Strategy 2.3.** Improve inventory management system and storage conditions of antivenoms
- **Strategy 3.1.** Optimize production, procurement and distribution of locally-appropriate antivenoms
- **Strategy 3.2.** Strengthen pharmacovigilance and post-market surveillance for antivenoms
- **Strategy 3.3.** Strengthen regulation of antivenom quality, efficacy and safety
Health-risk communication and community empowerment on snakebite prevention and first-aid can be cost-effective and sustainable solutions to prevent snakebites and save lives (4). Since snakebite epidemiology in the South-East Asia Region varies considerably across national, subnational and local regions and even within different population subgroups, preventive interventions and resources must be tailored to population clusters at highest snakebite risk. Agricultural workers, fisherfolk, working children, families living in poorly constructed houses and people with limited access to education are all particularly vulnerable (22). These communities are often unaware of risks, simple preventative measures and appropriate emergency response following snakebites, resulting in a considerable number of bites, envenomings and subsequent deaths before reaching a health centre or while attending faith-healers (11).

**Strategy 1.1: Engage, educate and empower communities at-risk on snakebite prevention and first-aid care**

**Priority actions**

1. Identify at-risk areas and communities for each country considering occupational and demographic profiles, distribution of venomous species, ecological and climatic factors and location of snakebite hot spots using geostatistical modelling and predictive maps, when available.

2. Adapt the WHO toolkit for effective communication and training in the regional, national and local contexts to ensure that core messages are standardized and consistent across communities and countries on snakebite prevention, appropriate first-aid, harms of delaying treatment, immediate transport of victims to snakebite treatment centres, etc., using clear, visually represented information to encompass all literacy levels.

3. Organize participatory community training using validated tools and information resources tailored to local contexts (e.g. language, culture, social) delivered by local “champions”, advocacy groups and activists to ensure basic skills and knowledge on prevention of snakebite and appropriate first-aid care.

4. Engage with traditional healers using culturally sensitive and nonconfrontational approaches to encourage them to promptly refer snakebite victims to medical centres and act as first respondents till medical care is available.

5. Engage community health workers and other influential community members, local leaders, civil society and social activists to encourage and support communities in adopting better health care-seeking behaviour.

6. Monitor and evaluate the impact of community training over time through pre–post designs to calibrate their effectiveness in target communities.
Snakebite envenomation can progress rapidly to a life-threatening emergency (1). As for many other NTDs, it typically affects remote, hard-to-reach settings where access to adequate treatment and basic health-care infrastructure remains lacking and health systems struggle to provide services, personnel, medicines and technologies to manage the disease effectively (1). To ensure universal access to life-saving treatment, a strong and resilient health-care system with robust primary care services, appropriate referral mechanisms and essential public health functions is required. Strengthening health-systems capacity, creating a competent and responsive health workforce, ensuring appropriate storage and stocking of antivenoms and medical products and appropriate financing mechanisms to protect vulnerable victims and their families while maximizing their health benefits would accelerate the prevention and control of snakebite envenoming and contribute to the overall achievement of universal health coverage in the Region, in consonance with the South-East Asia Regional Strategy for primary health care 2022–2030 (74).

**Objective 2:**
Ensure access to life-saving treatment and care

**Strategy 2.1: Strengthen effective prehospital care and rapid transport**

**Priority actions**

1. Ensure availability of rapid transport and appropriate pre-hospital care from communities at-risk to health facilities.
2. Ensure availability of emergency drugs (e.g. adrenaline, oxygen, atropine, neostigmine, hydrocortisone) and equipment (e.g. oral airway, endotracheal tube, bag valve mask, oxygen mask) in ambulances.
3. Conduct regular training of emergency responders (e.g. volunteers, ambulance staff) in basic life support and the clinical recognition of envenoming and rapid effective response to life-threatening emergencies such as shock, major bleeding, airway obstruction, respiratory paralysis and anaphylactic reactions while in-transit to a medical centre.
4. Ensure that ambulance paramedical staff are trained in emergency procedures such as endotracheal intubation, positive pressure ventilation using bag valve mask and the administration of emergency medications (e.g. adrenaline, atropine, neostigmine).

**Strategy 2.2: Strengthen health-care and referral system capacity**

**Priority actions**

1. Develop or update national snakebite treatment protocols and training tools to standardize clinical diagnosis, treatment, recovery and rehabilitation of snakebite patients including post-discharge ambulatory follow-up and services for disability support and rehabilitation (including treatment algorithm, a pocketbook, posters and training modules).
2. Develop standardized referral protocols to secondary and tertiary care centres. Elements should include early signs of clinical worsening or complications, list of standard transfer criteria, steps to prevent clinical worsening in-transit to a stepup facility (importance of maintaining haemodynamic and respiratory stability before and during transfer) and...
maintaining effective communication between medical providers at each end. Integrate these protocols into national snakebite treatment guidelines.

3. Organize regular (in-service) training for health workers on snakebite prevention, clinical diagnosis, treatment and rehabilitation of snakebite patients using locally adapted training packages. Include hands-on training in cardiopulmonary resuscitation, airway management, endotracheal intubation and positive pressure ventilation using bag valve mask, anaphylaxis management and standard referral protocols.

4. Establish and strengthen the referral network with early communication to health facilities before transfer to ensure transportation to appropriate centres equipped with antivenom and critical care support facilities.

5. Share with communities at-risk a list of proximate health centres equipped to manage snakebite cases. Encourage pilot projects to assess feasibility and effectiveness of the network.

**Strategy 2.3: Improve the inventory management system and storage conditions of antivenoms**

**Priority actions**

1. Establish or integrate an inventory management system to enable visualization of location of health facilities with types and quantity of antivenom stocks.

2. Include inventory management and appropriate storage of antivenoms in training packages for health workers.

3. Ensure the maintenance of cold chain for appropriate storage of liquid antivenoms.
Objective 3: Improve availability of quality, effective, safe and affordable antivenoms

Antivenoms remain the only specific therapy for snakebite envenoming. When used at appropriate doses and against the correct species, they are effective in preventing clinical progression. In combination with interventions, such as mechanical ventilation, renal replacement therapy and transfusions of blood products, antivenoms help in preventing most envenoming-associated deaths (1). However, there currently exist important challenges hampering the availability of potent and safe antivenom in the market as well as in health systems. There is a pressing need to build a sustainable market for safe, effective antivenoms and their assured access to treatment. This requires improving the design, quality and production of current products and strengthening regulatory mechanisms; pathways of procurement, distribution and surveillance and pharmacovigilance, through multisectoral cooperation among Member States, WHO, academia, industry and public and private institutions. WHO is currently assessing regional antivenom products for Bangladesh, Bhutan, India, Nepal and Sri Lanka. This work will provide manufacturers with a comprehensive understanding of antivenom design, production and quality control. WHO involves local regulators in inspections of good manufacturing practices (GMP), and the outcomes of the assessments are shared with the regulatory authorities. Guidelines for the Production, Control and Regulation of Snake Antivenom Immunoglobulins (2017) are also being updated by WHO.

Strategy 3.1: Optimize production, procurement and distribution of locally appropriate antivenoms

Priority actions

1. Continually update the WHO herpetological map to identify locally prevalent snake species of medical importance and model populations at risk of snakebites and antivenom needs in the Region.

2. Conduct evidence-based needs assessment and demand forecast of specific antivenoms of medical importance at the regional level. Ensure that procurement managers perform accurate forward-needs assessments to secure provision of adequate supplies from manufacturers.

3. Amend current wildlife protection and management legislation at the national and subnational levels to ensure that manufacturers of venoms or antivenoms can legally source specimens from wild populations to establish sustainable sources of quality-assured venoms to produce life-saving snake antivenoms through long-term captive husbandry and propagation of those species.

4. Explore the creation of incentive programmes to support increased manufacturing capacity.

5. Explore coordinated and pooled procurement of antivenoms by building on existing initiatives, such as the Initiative for coordinated antidotes procurement in the South-East Asia Region (iCAPS).
Strategy 3.2: Strengthen pharmacovigilance and post-market surveillance for antivenoms

Priority actions

1. Develop a strategy to strengthen pharmacovigilance and post-marketing surveillance of antivenoms (including objectives, actions to stimulate reporting, study methods and risk minimization measures).
2. Integrate antivenom products into existing national pharmacovigilance programmes.
3. Integrate appropriate early management and reporting of adverse drug events as part of the training for health workers.

Strategy 3.3: Strengthen regulation of antivenom quality, efficacy and safety

Priority actions

1. Strengthen quality standards to support the industry and national regulatory authorities (NRA) in ensuring access to safe, effective, and quality antivenoms, through: (i) regional venom reference standards against all medically important snake species for use in the evaluation of antivenoms, which are developed independently from both manufacturers and their research collaborators, with government financing to ensure transparency and avoid conflicts of interest; (ii) standardizing and improving the basis for the parallel preparation of in-house antivenom working reference preparations by manufacturers in consultation with regulators and external experts; and (iii) adequate capacity-building of relevant NRA staff (e.g. marketing authorization assessors, regulatory inspectors, etc.) and manufacturers.
2. Ensure that all antivenoms produced or imported into a country are licensed or approved by NRAs, with support of other regulatory authorities as needed.
3. Encourage research to determine an optimal, safe initial dose of antivenoms through dose-finding and safety clinical trials.
The Sustainable Development Goals (SDGs) were adopted by the United Nations in 2015 as a universal "blueprint to achieve a better and more sustainable future for all" (75). Many of these goals and their targets are relevant to the prevention and control of neglected tropical diseases (NTDs) including snakebite envenoming. National development plans when aligned with SDGs are more likely to expedite the achievement of regional and global targets for the control and prevention of NTDs including snakebite (76,77). Target 3.3 of SDG3 (“ensure healthy lives and promote wellbeing for all”) calls to “end the epidemic” of NTDs by 2030. Many other SDGs and targets are broader in their applicability but address important lacunae in health-systems capacity, treatment availability and prevention in the context of snakebite. These include most importantly target 3.8 calling for “universal health coverage, including financial risk-protection, access to quality essential health-care services and access to safe, effective, quality and affordable essential medicines and vaccines for all” as discussed under Objective 2 of the Regional Action Plan but also SDG7 (better access to electricity and consequently adequate lighting), SDG6 (access to water and sanitation for all), SDG11 target 11.1 (upgradation of slum dwellings) and SDG1 (ending poverty).

Supporting area 1: Strengthen leadership, governance and programme planning and management

Most countries of the Region do not have well-established public health programmes for prevention and control of snakebite envenoming (11). Strong health systems and public health programmes require appropriate governance mechanisms through strategic policy frameworks, effective oversight mechanisms, regulation, collaboration with stakeholders including the private sector and other sectors, and accountability for results and resources. Establishing a national programme to lead prevention and control of snakebite envenoming as an integral part of national health systems will be an important foundation to achieve the goal, objective and strategies identified in this Regional Action Plan.

Priority actions

1. Integrate prevention and control of snakebite envenoming into national health plans and existing public health programmes where feasible. Align them with Sustainable Development Goals (SDGs) and their implementation (Box 2).

2. Designate national-level focal points to coordinate regional efforts towards prevention and control of snakebite envenoming.
3. Establish a multisectoral governance mechanism such as a national task force, as part of existing overarching task force where appropriate, for snakebite envenoming to engage relevant stakeholders, such as ministries of agriculture, forestry, environment, rural development and biotechnology, regulatory authority and academia (clinical and nonclinical), herpetologists to jointly plan, monitor and evaluate progress.

Supporting area 2: Establish surveillance systems and monitor and evaluate progress

One of the major difficulties associated with prevention and control of snakebite envenoming is the relative paucity of high-quality epidemiological surveillance data. Access to timely and reliable data is fundamental to evidence-based planning and decision-making. It is a key component of a strong primary health-care-oriented health system and for the elimination or control of NTDs. Strengthening surveillance of snakebite envenoming through the One Health approach as an integral part of national health information system and monitoring epidemiology and impacts of public health interventions at both the national and regional levels will ensure effective implementation of the Regional Action Plan for accelerated control of snakebite envenoming.

Priority actions

1. Define minimum data set requirements and definitions for assessing the burden of disease based on the WHO District Health Information Software-2 (DHIS2) snakebite module.
2. Integrate surveillance and reporting systems for snakebites in humans and domestic animals.
3. Establish standardized data reporting across countries and the Region based on the WHO DHIS2 snakebite module, and integrate into health information systems, collection, compilation, analysis and dissemination of data on snakebite envenoming.
4. Initiate a process for notification of snakebite cases through local public health acts.
5. Develop a consensus-based regional protocol for community-based snakebite epidemiological surveillance to ensure standardized methods of data collection, analysis and interpretation to inform both national and regional decision-making.
6. Conduct baseline assessments on regional and national burden covering snakebites and envenomings, deaths, physical and psychological disabilities, economic burden, identification of hot spots/ areas of high burden and reduced access to antivenom and impact assessment of snakebite envenoming in the South-East Asia Region.
Supporting area 3: Enhance regional partnership and multisectoral collaboration for advocacy, research and innovation

Achieving the ambitious goal of reducing the number of deaths and cases of disability associated with snakebite envenoming by 50% in the South-East Asia Region by 2030 requires strong leadership of Member States, adequate resources, and the development of a dynamic global partnership to drive policy change, implementation and evaluation of outcomes supported by various stakeholders such as academic and research institutions, nongovernmental organizations (NGOs), donors and other partners. There is also a need to invest in innovation for better tools. Building a strong multidisciplinary partnership is essential to facilitate cross-learning, stimulate research and innovation in priority areas and facilitate effective translation of evidence into policies and programmatic practices to accelerate achievement of the regional goal.

Priority actions

1. Establish a regional technical advisory group to advise on strategic directions, programme priorities and challenges in implementation of the Regional Action Plan.

2. Map existing academic and research institutions on diagnostics, surveillance, treatment and operational implementation research and advocate on research related to snakebite envenoming.

3. Establish a regional network of health ministries, regulatory authorities and research and development (R&D) partners/ donors and convene a regular forum to raise the profile of the disease, regularly share programmatic and knowledge gaps and research updates, mobilize necessary resources and catalyse cross-learning and collaboration to accelerate prevention and control of snakebite envenoming at the national and regional levels.

2.4 Milestones and targets

Short-term

1. National burden assessment of snakebite envenoming in the South-East Asia Region conducted in priority countries

2. Priority areas with highest burden of snakebite envenoming identified within each country

3. National focal point for prevention and control of snakebite envenoming designated in priority countries

4. Metrics with minimum data set for annual reporting on snakebite envenoming to WHO developed and disseminated to all countries

5. WHO toolkit for effective communication and training adapted at the national level in priority countries
**Medium-term**

1. National strategy developed for prevention and control of snakebite envenoming in priority countries
2. The national strategy implemented in priority areas with highest burden of snakebite envenoming
3. All countries to collect and report data on snakebite envenoming to WHO annually
4. Evidence-based needs assessment and demand forecast of priority antivenoms completed at the regional level
5. Progress, regional impacts and remaining challenges in implementation of the Regional Action Plan assessed mid-term

**Long-term**

1. Full-scale implementation of the national strategy in priority countries
2. Progress, regional impacts and remaining challenges in implementation of the Regional Action Plan assessed and strategies updated

**2.5 Measuring progress and impacts**

Progress of the implementation of the Regional Action Plan should be evaluated at regular intervals. A minimum set of impact indicators (to monitor achievement of objectives) and outcome indicators (to monitor achievement of strategies) common to the Region will be established and progress will be monitored regularly at both the national and regional levels as articulated in Supporting areas 1–3.
References


References


