The Global Snakebite Taskforce

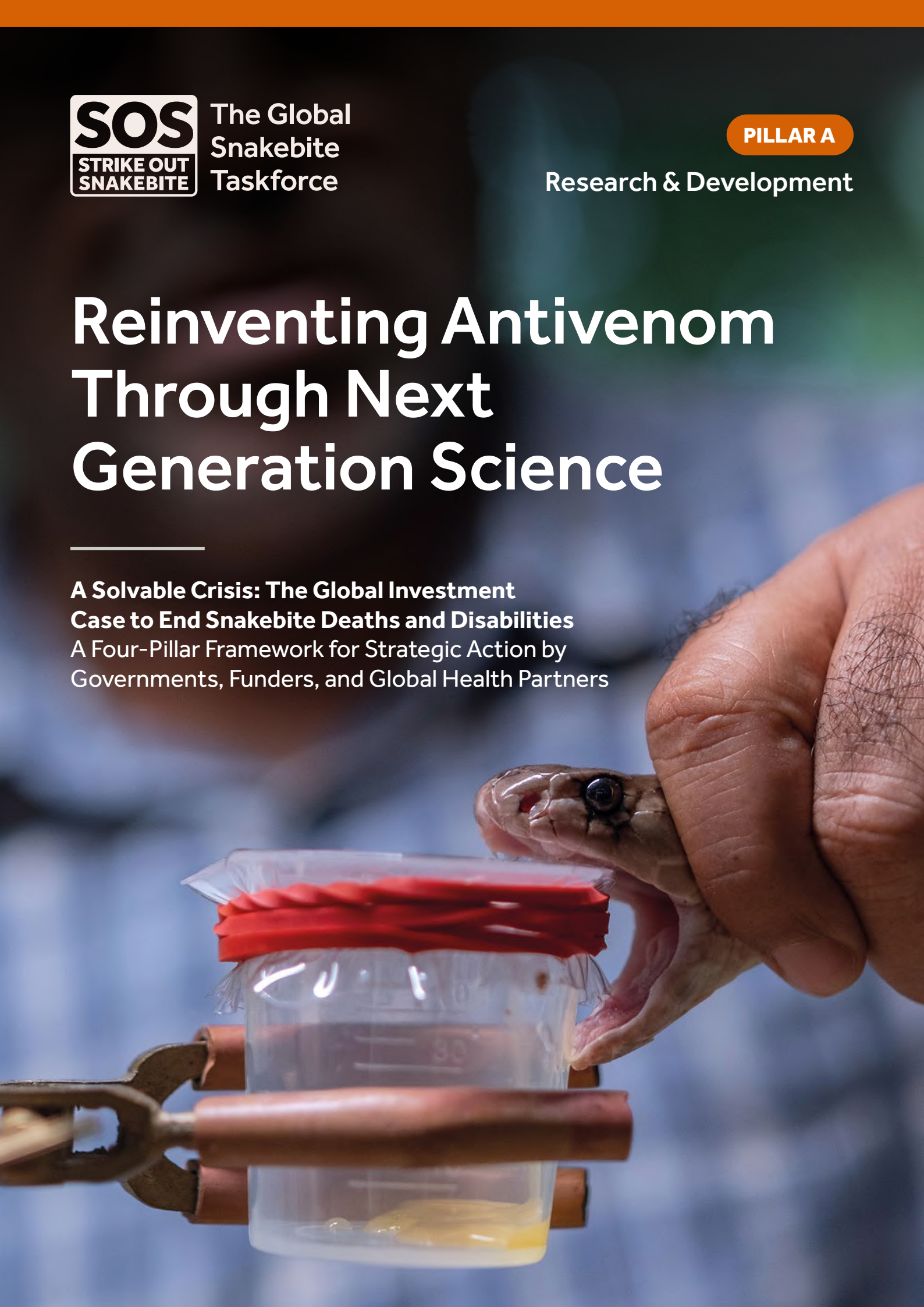
PILLAR A

Research & Development

Reinventing Antivenom Through Next Generation Science

A Solvable Crisis: The Global Investment Case to End Snakebite Deaths and Disabilities

A Four-Pillar Framework for Strategic Action by Governments, Funders, and Global Health Partners



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Reinventing Antivenom Through Next Generation Science

This brief outlines how strategic investment in R&D can unlock a new era of innovation – anchored in Low- and Middle-Income Country research institutions, supported by global partners such as the World Health Organization and regional scientific networks.

The Heavy Global Burden of Snakebite Envenoming

Every year, snakebite kills tens of thousands and leaves many more with life-changing injuries. Next generation science can change this. Catalytic investment in R&D can help improve current therapies and transition to a new generation of safe, scalable, effective treatments – and transform outcomes for communities, particularly rural, across Africa, Latin America, South Asia, and South-East Asia.

Each year, an estimated **5.4 million people** suffer snakebites, resulting in **1.8–2.7 million envenomings** and **81,000–138,000 deaths** globally.[1] A further 400,000 individuals suffer lifelong injuries. These figures likely underestimate the true burden because of incomplete reporting, reliance on informal care systems, and the absence of comprehensive surveillance in many high-incidence regions.[2]

Snakebite disproportionately affects **rural, low-income communities** in Low- and Middle-Income Countries (LMICs), particularly those engaged in agricultural labour, seasonal fieldwork, or daily tasks that increase human–snake conflict.

Investing in snakebite response is not only a humanitarian imperative. It is a test case for global equity, resilience, and the future of Universal Health Coverage.

> **The biggest public health crisis you have never heard of.**
>
> Kofi Annan, Former United Nations Secretary General

The Heavy Human and Economic Burden

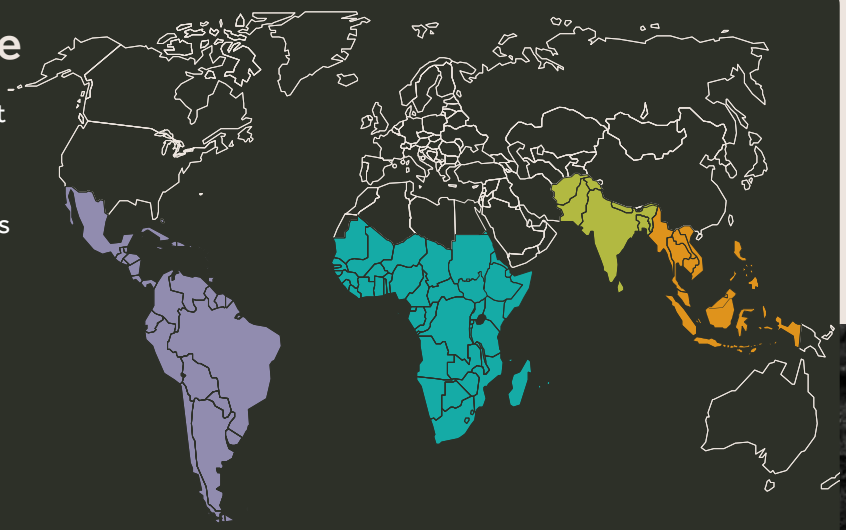
- **Death:**
  138,000 deaths per annum and this figure is undoubtedly underreported.
- **Severe Disability:**
  For every snakebite death, up to four survivors experience permanent disabilities such as amputations, contractures, blindness, or chronic neurological injury.[3] Snakebite accounts for **up to 400,000 long-term disabilities** each year and more than **1 million Disability-Life Adjusted Years (DALYs)** across Africa and Asia.[4]
- **Mental Health Impacts:**
  Between **25-54%** of survivors show major depressive symptoms, and up to **43%** experience PTSD – yet these impacts rarely inform policy, planning or practice.[5]
- **Who Suffers Most:**
  Rural families, farmers, herders, seasonal labourers, women, and children in regions where poverty, climate change, and weak health systems intersect.
- **Economic Consequences:**
  Snakebite drives catastrophic expenditure, reduces household productivity, and strips assets – fuelling entrenched cycles of rural poverty and inflicting significant cost to national economies and health budgets.[6]

Why Snakebite Is Solvable

- **Proven tools already exist:**
  Antivenoms, supportive care, prevention, and trained clinical staff can dramatically reduce preventable mortality and life-changing injuries.
- **Science is advancing rapidly:**
  High throughput venom analyses, recombinant antibody technologies, repurposed small molecule inhibitors, and improved diagnostics provide unprecedented opportunities for innovation.
- **The route to impact is clear and investment pathways exist,**
  spanning R&D, access to quality antivenoms, public health systems, and market stability.
- **Advocacy builds alignment,**
  strengthens policy coherence, and mobilises multisectoral action.
- **Partnerships unlock financing,**
  accelerate technology adoption, and coordinate regulatory and manufacturing reforms.

Geography at a Glance

- **South Asia:** India alone may account for **up to 58,000 deaths annually.**[7]
- **South-East Asia:** Around **250,000 bites** and circa **16,000 deaths** across ASEAN countries.[8]
- **Sub-Saharan Africa:** Thousands of deaths each year, with 16 countries exceeding **4,500 deaths combined** annually.[9]
- **Latin America:** High burden in Brazil and other forested or rural agricultural regions.[10]



The R&D Value Chain for Next Generation Snakebite Solutions

DISCOVERY
Toxinology, venomics, antibody discovery, small molecules

- Fragmented toxinology field
- Limited funding for venom research
- No standardised discovery pipeline

- High-throughput venom profiling
- Next generation antibody discovery platforms
- Novel and repurposed small-molecule inhibitors

PRECLINICAL DEVELOPMENT
Neutralisation assays, toxicity models

- Lack of validated, standardised assays
- Limited Good Laboratory Practice (GLP)–compliant facilities in endemic region

- Harmonised neutralisation testing
- Regional preclinical centres of excellence

PRODUCT DEVELOPMENT
Recombinant antibodies, small molecule inhibitors, diagnostics

- High cost & risk of product development
- Few translational bridges from academia to industry

- Biologics platforms reduce risk
- Diagnostics to guide dosing & triage
- Prototype to clinical trial acceleration

TRANSLATIONAL RESEARCH & CLINICAL TRIALS

- Limited murine models
- No pharmacokinetics data available for recombinant antivenoms
- No recombinant antivenom in clinical trials

- Translational large animal models
- Dosing and safety profile of novel products
- Bringing novel products closer to clinics

REGULATORY & QUALITY ASSURANCE PATHWAY
WHO PQ, regional SRAs, harmonisation

- Inconsistent regulatory standards
- No unified pathway for innovative antivenoms
- Quality gaps between manufacturers

- Regional regulatory harmonisation
- WHO-linked QA & standardised protocols
- Predictable pathway for novel products

MANUFACTURING AT SCALE
Biologics platforms, fill–finish, LMIC capacity

- Limited regional manufacturing capacity
- Production bottlenecks
- High unit costs from small-batch production
- Limited access to pilot production plants

- Scalable biologics manufacturing in LMICs
- Tech transfer & fill–finish lines
- Lower cost per vial & supply resilience

Current bottlenecks

Where investment unlocks impact

Quality assurance and **regional supply** make lifesaving antivenom **reliably accessible** to every patient.

Strategic investment across the R&D value chain – discovery to manufacturing – enables scalable products that **have the potential to radically reduce snakebite deaths and disability.**

The Failures R&D Fixes

R&D investment remains significantly below levels seen in other high-burden diseases and:

- Traditional serum-derived antivenoms, based on century-old equine immunisation methods, whilst effective when regulated and administered appropriately often suffer from inconsistent potency, batch variability, and risk of hypersensitivity reactions.[11]
- Diagnostic tools remain limited, hindering timely delivery, accurate dosing and species identification.[12]
- Translational pipelines between discovery and manufacturable products are fragmented, particularly there is a gap between discovery and clinics due to lack of regulatory pathways for recombinant antivenoms. This is all while climate and land-use change are increasing human–snake conflict.[13]

What Investment Enables

- Next Generation Biologics: Recombinant antibodies and small molecure inhibitors designed for safety, efficacy and broad-neutralisation capabilities.[14]
- Advanced Diagnostics: Rapid tests and molecular tools that guide correct dosing and reduce unnecessary use of antivenom vials.
- Translational Pathways: Platforms linking discovery to preclinical, regulatory, and manufacturing pathways.
- LMIC Scientific Sovereignty: Strengthened regional toxinology, assay development, and biologics R&D capacity.

Headline Impact

- Research on neutralization of local species by currently available antivenoms will inform better product purchasing.
- Next generation antivenoms have potential to dramatically reduce in case fatality when effective products enter the market alongside often poorly-regulated serum-antivenoms.[15]
- Improved diagnostics reduce complications through faster, more accurate treatment decisions.
- Platform spillovers benefiting pandemic preparedness, toxinology, and biologics manufacturing.

Illustrative 10-Year Scenario

If catalytic investment is sustained:

- Next generation therapies (recombinant antibodies and small molecule inhibitors) enter clinical use alone or in combination with high quality serum-based products.
- Molecular diagnostics guide front line treatment in multiple countries.
- Regional R&D hubs lead toxinology and biologics innovation, reinforcing national health sovereignty.

SNAKEBITE IS PREVENTABLE.
DISABILITY IS AVOIDABLE.
DEATH IS NOT INEVITABLE.

Next generation antivenoms and diagnostics – designed through innovative science and manufactured to global standards – can save thousands of lives each year and strengthen scientific sovereignty in regions most affected by snakebite.

CASE EXAMPLE 1

Snakebite-Focused: Breakthroughs in recombinant antivenoms

Recombinant, nanobody-based antivenoms show promising neutralisation activity with improved consistency and potentially lower risk of adverse reactions compared to existing serum products.[16] Early preclinical studies demonstrate broad neutralisation of medically important snake species.

In an international collaboration, led by scientists from Technical University of Denmark (DTU) and funded by Wellcome with GBP 3.08 million, 5 years of dedicated research led to the development of the first recombinant snakebite antivenoms that can neutralise the venoms of cobras, mambas, and rinkhals – some of Africa's deadliest snakes.[17]

CASE EXAMPLE 2

Analogous Global Health Success: Ebola monoclonal antibody therapies

The accelerated development of monoclonal antibody therapies during Ebola outbreaks shows how coordinated R&D funding, regulatory pathways, and manufacturing partnerships can compress timelines and deliver life-saving biologics at scale.[18] Ebola monoclonal antibodies reached clinical use in record time because public funders aligned R&D financing, outbreak-based trials, regulatory flexibility, and manufacturing partnerships. The U.S. National Institutes of Health (NIH) and Biomedical Advanced Research and Development Authority (BARDA) sustained Ebola R&D investment at peak levels of several hundred million dollars per year, while publicly funded trials delivered rapid efficacy data and BARDA contracts ensured manufacturing readiness at scale.[19,20]

Snakebite envenoming presents a parallel opportunity: a high-burden condition with clear biological targets, fragmented markets, and undercapitalised development pathways. A coordinated investment envelope – on the order of USD 250–500 million globally over the next decade – could replicate the Ebola model, enabling next-generation snakebite biologics to move from promise to practice.

PROOF POINTS

What the evidence shows:

- Multi-species neutralisation data for recombinant candidates show promise. Research is accelerating toxin and epitope characterisation, enabling rational antivenom design.[21]
- Diagnostics improve triage and reduce unnecessary product usage.
- Biologics manufacturing in LMICs is technically feasible with investment.
- R&D capacity building and returns spill over into pandemic preparedness and other toxinopathies.
- Climate-driven snake range expansion giving rise to new need for predictive R&D.

What You Can Do Now

Governments

- Co-invest in national or regional R&D hubs.
- Establish regulatory fast-track pathways for innovative antivenoms.
- Support sentinel surveillance sites for trials and diagnostics.

Foundations & Philanthropists

- Fund 5 to 10-year R&D portfolios for biologics and diagnostic innovation.
- Create and back innovation prizes and translational fellowships.
- Support development of Good Manufacturing Practice (GMP).
- Fund pathway development for LMIC manufacturers.

Multilateral Development Banks & Global Agencies

- Blend loans and grants for R&D infrastructure, regulatory science, and laboratory upgrades.
- Support regional preclinical and assay harmonisation platforms.
- Embed snakebite envenoming into R&D into climate and One Health programmes.

Private Investors, Industry & Social Enterprise

- Co-invest in platform biotech with SBE-relevant Intellectual Property.
- Engage in milestone-based financing and early procurement commitments.
- Partner with LMIC manufacturers on technology transfer.

Investing in toxicology and biologics builds national scientific strength and sovereignty and reduces reliance on fragile global supply chains.

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In support of the nation state endorsed WHO Snakebite Envenoming Strategy