

RSTMH

Special Report

on Snakebite

Case reports of tropical snakebite victims illustrate the vital humanitarian role and challenges of community action groups

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Foreword

This report has been compiled to mark International Snakebite Awareness Day, 19 September, and to learn more about the stories of people who have suffered from snakebite, as well as the community groups who are currently leading the fight against snakebites locally.

This is an area of real interest to the Royal Society of Tropical Medicine and Hygiene (RSTMH), and one we've been publishing articles on in our journal *Transactions of the Royal Society of Tropical Medicine & Hygiene* since 1921. In 2018, we attended an international conference on the subject in Leiden, the Netherlands, at which we heard more about the complex issues around this neglected tropical disease (NTD).

It was wonderful to hear about the incredible work being done by a number of committed individuals and organisations around the world who helped ensure snakebite was readmitted to the World Health Organization's (WHO) list of NTDs. We also heard about the road map that was being developed by the WHO at the time and has since been launched. So many international and national groups at the conference were able to demonstrate the ongoing issues faced by communities around the world living in regions where snakebites still lead to high levels of morbidity and mortality.

At the meeting we were inspired to join the growing movement of individuals and organisations all trying to raise awareness of the burden of snakebite. Along with a number of partners, we launched the first International Snakebite Awareness Day on 19 September 2018, as a chance to increase the profile of snakebite and its impact.

Like many other NTDs, the journey to reduction and elimination is complex – first and foremost widespread, tailored community education needs to ensure as many snakebites as possible are prevented. The built environment plays an important role as it may not be minimising the potential for bites to occur. Making the homes in which people live safe is key to protecting them from snakebites.

Affordable, accessible and targeted (to the species of snake and patient) antivenoms should be available to communities within short journey times. In many countries, traditional medicine and faith healing are part of the patient journey for snakebite treatment and, as this report shows, can lead to incorrect treatment or delays in antivenoms being administered. Patients, communities and health workers could be more aware of the steps that need to be taken after a snakebite to maximise the chance of survival and recovery. Victims of snakebites who develop scarring or disabilities as a result often experience stigma, which has a huge impact on their ability to work and live fulfilled lives, as well as also affecting their families and communities.

At RSTMH we are keen to help reduce the number of deaths and disability caused by snakebite. We aim to do this by encouraging snakebite research through our small grants programme, publishing a special issue on snakebite in *Transactions* and ensuring that snakebite remains on the agenda for our events and in our policy work.

It is not always easy to hear the stories of patients and their families, but it is important for us to share these as we continue to tackle the problem of snakebite. I hope you find these case studies interesting and informative.



Tamar Ghosh
Chief Executive,
Royal Society of Tropical Medicine and Hygiene



Case reports of tropical snakebite victims illustrate the vital humanitarian role and challenges of community action groups

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Introduction

David J Williams and Robert A Harrison

In the past two years the tropical snakebite disease domain has been radically transformed from a globally neglected medical condition dismissed as an ‘injury or accident’ to a World Health Organization (WHO) priority neglected tropical disease.¹

In May this year, WHO also launched its strategy to halve global snakebite mortality (approx. 138,000 deaths per year) and morbidity (approx. 400,000 disabilities per year) rates by 2030.^{2,3} Prospects of achieving this ambitious aim were boosted by the Wellcome Trust’s simultaneous announcement of a new £80m/seven-year snakebite research programme,⁴ which will support many of the priority tasks outlined in WHO’s strategy. The media coverage of these events^{5,6} delivered a valuable, worldwide advocacy message as to the health burden of tropical snakebite and actions being taken to address it by key health policy decision makers.

These greatly encouraging developments will translate into reduced rates of snakebite mortality and morbidity. But in the meantime, what of the snakebite victims who live in remote, rural communities served by under-resourced health facilities with inadequate access to expensive antivenom treatment? We describe here that the healthcare of these victims is, and has been for years, often dependent upon local community charities. For example, the Eswatini Antivenom Foundation (EAF), the Remote Envenomation Consultancy Services (RECS) in the Philippines, the Madras Crocodile Bank Trust in south India and the Snakebite Healing and Education Society (SHE) in west India all provide substantial community health benefits but are all dependent upon unstable charitable incomes and the extraordinary commitment and expertise of volunteers.

The case reports included here describe the very difficult, often disturbing circumstances in which they operate. We hope these reports highlight the compelling need to rapidly transition global snakebite policy into benefit for victims in these remote, rural communities. It is instructive to read that the medical, socioeconomic and logistic challenges of delivering effective treatment to snakebite victims are very similar in different parts of India, the Philippines and sub-Saharan Africa. We hope that national and regional policy decision makers can recognise that these shared difficulties in effectively assisting snakebite victims, and the healthcare and advocacy solutions identified by these community charities, provide context-appropriate blueprints that can be expanded to deliver their benefits nationally and regionally.

The following sections describe, in the community groups’ own words:

1. the humanitarian rationale for establishing these charities
2. anonymised case reports testifying to the many different issues dictating the outcome of snakebite in these rural communities, and;
3. the future challenges these community groups need to overcome.

Consent to publish has been obtained for all case reports presented.



Organisation Locations

1. The Eswatini Antivenom Foundation (EAF)

2. Snakebite Healing and Education Society (SHE)

3. Madras Crocodile Bank Trust

4. Remote Envenomation Consultancy Services (RECS)



The Eswatini Antivenom Foundation (EAF)

Thea Litschka-Koen and Jonathan Pons

swaziantivenom.org

We have been working across Eswatini for a decade to ensure that snakes and snakebite are not considered synonymous and that envenomed victims can access effective treatment.

Snakebite is an ever-present hazard in rural communities of the Lowveld; it causes some fatalities and many more victims with disabling disfigurement. The burden posed by snakebite on these poorly educated and resourced rural communities is enormous.

The small Lowveld community of professionals, and those who care, could not stand idle and watch. EAF was established with the following set of objectives and activities in mind:

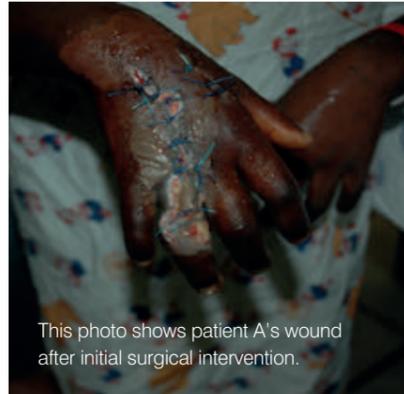
- increasing public awareness of snakes and snakebite prevention through our websites and community meetings and our 42 trained volunteers who respond to community requests to remove both venomous and non-venomous snakes, and remove the terror of snakes
- safeguarding the supply of safe, effective and affordable antivenom by managing stocks of antivenom for private and corporate antivenom banks and, by sourcing donor funds or close-to-expiry antivenom for public hospitals, helping to ensure access to a more reliable supply of antivenom developing tools to measure the incidence and impact of snakebite in the community
- supporting research and audit on snakebite management by developing and maintaining hospital treatment guidelines and admission and treatment outcome records
- advocating for resources and education around snakebite by engaging with the Ministry of Health, antivenom manufacturers, international funders and public forums
- providing an advisory service to clinicians treating snakebite by holding an annual Medical Snakebite Symposium.

Impacts and outcomes of the project

Case Report 1

Patient:

An eight-year-old boy (A) bitten in Vuvulane, Eswatini at 16:00 on the 31 January 2012.



This photo shows patient A's wound after initial surgical intervention.

Circumstance of bite:

A was playing outside when his grandmother called him to help with their evening meal of Indengani (soft maize porridge). He was sent inside their traditional home to fetch the clay pot with milk. As he reached into the cool corner to pick up the pot, he felt sharp pain to his hand. A Mozambique spitting cobra was coiled in the corner, spreading a large hood, and poised to strike again. A was rushed to the nearest clinic, then referred onwards to the regional hospital. Neither had antivenom and the only solution offered was amputation.

What we did:

A's brother called me six days after he was bitten. He had heard I might have antivenom to help his little brother. However, it was much too late to administer antivenom. The only option was to try to save his hand and fingers. A spent three months in hospital undergoing debridement and skin grafts.

Outcome:

Despite our best efforts, A had to have one finger amputated. His hand has severe scarring, but he has the full use of the remaining fingers. He returned to school and is thriving!

This case report illustrates that antivenom is not always available – it wasn't in the two hospitals to which A was admitted. In 2011, this was not uncommon for the majority of hospitals in Eswatini because the product was mistrusted and thought to be ineffective and too dangerous to use. The solution at the time was to amputate the problem away.

Case Report 2

Patient:

A four-year-old boy (B) bitten in Nsoko, Eswatini at 10:00 on 18 Feb 2009.



Circumstance of bite:

B was sleeping on his mother's bed at 10:00 when a Mozambique spitting cobra came into their traditional home, most probably to get out of the searing summer heat. It slithered onto his bed and bit him on the left hand. B woke up and rolled over onto the snake; it then bit him for the second time on the left upper arm.



Credit: Tyrone Ping

What we did:

B's mother brought him to us, hoping we could help him as she'd heard about another patient we had helped. She was desperately trying to save his arm, as an amputee faces numerous challenges in Africa. Once again it was too late to administer antivenom and our only option was to try to treat the wound. He spent three months in hospital undergoing multiple surgical procedures and another four months going for daily and then weekly bandage changes at a nearby health centre. Because of the trauma and pain, he stopped talking for almost six months. The Eswatini Antivenom Foundation sponsored all his medical treatment, as well as the counselling it required for him to get over his nightmares and to talk and smile again.

Outcome:

B's wounds healed well and the additional surgeries corrected the contracture that had prevented him from straightening his arm. He underwent physical therapy for several months. B has full use of his arm today. The image below shows B's fully functioning arm after months of skin grafts and surgical procedures.



This case report illustrates that in 2009 antivenom was not available. Because of B's case, and the challenges we faced financially to acquire antivenom, the Eswatini Antivenom Foundation was founded. This case report also testifies to the need for counselling and many months of multiple surgical interventions and careful wound management required for snakebite victims to regain limb function, interventions that are expensive and not readily available in most rural hospital settings.

Case Report 3

Patient:

An 83-year-old man (C) bitten in Siteki, Eswatini one evening in June 2016.



Circumstance of bite:

C was sitting on his grass bedroll when he felt a sharp burning pain on the heel of his foot. He looked down and saw the Mozambique spitting cobra reared up and ready to bite again. The snake was destroyed. C was taken to the nearest hospital for assistance where he was given five vials of antivenom, the last five vials in their fridge.

What we did:

The foundation supplied the antivenom administered, but it was the last few vials that we had. C still developed necrosis on the back of his left leg, as is typical following a bite from this species. The foundation also paid for the medical treatments and amputation. He had never slept on a bed and once he returned home, didn't have the strength to pull himself up to use the pit latrine outside. The foundation bought him a wheelchair and a bed, to give him mobility and dignity.

Outcome:

The wound would not heal and his leg had to be amputated. C is pictured here at home following the amputation.

This case report illustrates that insufficient antivenom often leads to poor patient outcomes.

The case reports all followed envenoming by the Mozambique spitting cobra (*Naja mossambica*), an aggressive snake whose bites cause massive skin damage and can lead to death in some infants. This pathology seems to respond poorly to antivenom treatment; the reasons for this are poorly understood, which highlights the importance of more research to drive improvements in snakebite care in Eswatini. In 2015 we identified six goals that would enable research:

1. partner with an academic institute that has experience in snakebite research
2. establish a local ethics board
3. gain endorsement from the Ministry of Health
4. seek funding
5. establish a snakebite clinical unit at Good Shepherd Hospital, Siteki, Eswatini
6. recruit a full-time project manager.

We are astounded to find that we are close to achieving all six goals. The stage is now set to open a Snakebite Research and Intervention Centre in time for the next snakebite season, which starts in October 2019.

Current challenges and lessons learned from tackling snakebite in Eswatini

In nearly all the case reports we collect, the factor most affecting the outcome is time to treatment. When we break this down, we have found reasons for delay to include:

- ignorance and panic
- traditional treatments that at best delay definitive treatment and at worst complicate it
- travel and logistics delays with scarce emergency services
- inappropriate medical management or unavailable treatment.

Attending to these causative factors, all of them outside of our control, requires careful patient advocacy at every level. This requires both commitment and time; however, Thea and Jonathan, the two principal EAF volunteers, have commitment but not time. We've learned that we have to transition into a staffed organisation.

Snakebite Healing and Education Society (SHE India)

Priyanka Kadam, Dayal B Majumdar, Jaideep C Menon, Sadanand Raut, Freston Sirur and Vishal Santra

she-india.org

The Snakebite Healing and Education Society (SHE) is registered in Mumbai, Maharashtra State, but works in eight states in India. SHE is a civil society group working on advocacy and community engagement projects to mitigate the grossly neglected burden of snakebites in India. Through SHE's advisors, we also support projects in snakebite management and capacity building of medical personnel and community health workers.

In our communities, snakebite death or disability is a life-changing socioeconomic issue, not just for the victim but for the entire family. In these communities, the right to life, the biggest fundamental right worldwide, is compromised because of broken health systems. In response, SHE engages with various leaders within the State Government Health and Forest Departments (and beyond) to create awareness and bring down snakebite incidence. We use their infrastructure to engage with communities and train medical officers and nursing staff of government, private and remote missionary hospitals.

We started work as individuals in 2011, initially delivering advocacy messages and, after building a network, we started community awareness in 2013. SHE was established in 2014, with capacity building of doctors starting in 2015. While all fieldwork is done by volunteers and advisors on a very tight budget or honorary basis, the SHE Trust employs three part-time staff to manage administration, finance, audit and regulatory reporting. SHE volunteers include doctors, lawyers, ex-bureaucrats, social activists, teachers, field biologists, animal rescuers and students; providing us with a greatly needed breadth of expertise.

We produced an advocacy film on snakebite burden in 2018 and short educational tools for community awareness initiatives in 2019 on ways to prevent snakebites. We also collaborate with multiple government and non-governmental partners to reduce the death and disability caused by snakes in India.

Although our lack of funding prevents us from entering into projects that require big spends, we work with different partners in eight states, including the Maharashtra Forest Department, the West Bengal Forest Department, Health and Family Welfare, West Bengal (<https://wb.gov.in/portal/web/guest/health-and-family-welfare>), the Emmanuel Hospital Association (<https://eha-health.org/>), the Madras Crocodile Bank Trust, the Simultala Conservationist (<http://www.she-india.org/wp-content/uploads/2015/04/SIMULTALA-CONSERVATIONISTS-Foundation-for-Wildlife.pdf>), the Nisarga Vidnyan Sanstha (<http://nisargavidnyan.blogspot.com/>), Bharatiya Bigyan O Yuktibadi Samiti (<https://www.facebook.com/YuktibadiSamiti/>) and Shree Sainath Hospital, Dharampur, Gujarat (<http://snakebites.in/doctors-panel-hospital-staff.html>). Our vision is to bring together people from different walks of life under a common platform and to gratefully use advisors and experts to design and deliver various mitigation efforts, including:

- capacity building of doctors to treat snakebites as per WHO protocols
- training of snakebite first aid and do's and don'ts to community health workers and first responders
- documenting victim stories for advocacy purposes
- conducting community awareness programmes in villages and Panchayats (rural governing bodies)

- engaging with educational institutions, society complexes (in cities) and state forest departments
- collaborating with antivenom manufacturing companies in India to provide antivenom to non-government facilities, e.g, missionary hospitals
- facilitating the distribution of 5,000 free antivenom vials during natural calamities like the Kerala floods in 2018.
- SHE's outreach has enabled us to document snakebite incidents across India by interviewing victims and their families over the last six years. This has:
 - created a document evidencing the misery, social and financial struggle and lack of human dignity suffered by snakebite victims and their families
 - been assimilated into an advocacy film describing the challenges faced in India at every level and suggesting solutions that can be implemented to bring down death and disability rates
 - informed the design and delivery of educational tools like posters, banners and short educational videos for community awareness that can be used by volunteers across India.

Impacts and outcomes of the project

Case Report 4

Patient:
A four-year-old boy (D) bitten in Dimbhe village, Taluka Ambegaon, Pune, Maharashtra state at 20:30 on 21 May 2019.

Circumstance of bite:

Because of the oppressive heat of a summer night, D along with his family, was sleeping outside his house when he was bitten twice by a spectacled cobra (*Naja naja*).



The boy's father saw the snake, which then slithered away. Within 15 minutes of the bite, the child was taken to a primary health centre (PHC), where three vials of antivenom were administered. He was then transported, without respiratory support, to another PHC. D exhibited vomiting and respiratory distress that was followed by a cardiac arrest. Doctors used cardiopulmonary resuscitation (CPR) and injected him with atropine and neostigmine. They also started ten vials of antivenom immediately and referred the patient to a private hospital run by Dr Sadanand Raut, a SHE advisor.

What we did:

D reached Dr Raut's hospital at 22:50 in a deeply comatose state, with pupils fixed and dilated and not reacting to light. The patient was comatose for 13 hours. He required ventilation for 16 hours. There was reoccurrence of ptosis 44 hours after the bite. Another five vials of antivenom were administered.

Outcome:

A total of 30 vials of antivenom was given to the patient overall, who recovered in the afternoon of 28 May. However, the patient also suffered severe necrosis in the bite area and will need to undergo skin grafting operations.

This case report illustrates that the delayed, fragmented treatment of the patient with insufficient vials of antivenom would have been catastrophic had the patient not arrived at a hospital capable of long-term resuscitation and further antivenom treatment. It also evidences that administration of as much as 30 vials of antivenom may be required to reverse envenoming in India.

Case Report 5

Patient:
A 25-year-old, heavily pregnant woman (E) was bitten in Moti Kosabdi near Vadapada Falsu, Taluka Dharampur, Gujarat state at 17:00 on 16 April 2009.



Circumstance of bite:

She was fetching water for cooking when she was bitten by a suspected spectacled cobra (based on the description of the snake and manifestation of symptoms at the hospital). She was transported 50 km to Shree Sainath Hospital at 20:45.

What we did:

She was admitted to the intensive care unit (ICU) and Dr Lochan Shastri (SHE volunteer) administered 18 vials of antivenom along with adjunct medications (atropine, steroids, etc). Three days after admission the patient went into labour and delivered a healthy baby. However, her stay in hospital was complicated by reoccurrence of snakebite envenoming symptoms and infection of the bite site wound, which progressed into an abscess necessitating surgical drainage under general anaesthesia. The patient was discharged 20 days later and was asked to visit the hospital for further wound management. The patient never turned up for further treatment as her village was far away and livelihood meagre.

Outcome:

Nine years later, SHE was working on an advocacy film called 'The Dead Don't Talk' and, through the treating doctors and local leaders, asked the family to document their story. We were shocked to find the patient still nursing an old ulcer wound, as pictured here. The treating doctors have decided to fund a skin grafting operation for the patient.

This case report illustrates that the prevailing poverty and long distances to healthcare facilities for snakebite victims that need post-operative wound management means victims may suffer many years of physical pain and disability. It also documents that the good will of local doctors means that the patient will finally receive the medical treatment she deserves.

Case Report 6

Patient:

A 55-year-old woman (F) was bitten in Tebhumi village, Naigaon Taluka, Nanded district, Maharashtra state at midnight on 27 April 2019.

Circumstance of bite:

F was bitten by a spectacled cobra ('black morph') on her left hand while sleeping on the floor. She was brought to Dr Dileep Punde's (SHE advisor) hospital in Mukhed, Maharashtra at 02:00.

What we did:

F was treated with immediate CPR, antivenom, atropine and neostigmine to manage her envenoming, respiratory arrest and secondary cardiac arrest. While intubation was difficult in this case, she was put on a mechanical ventilator for six hours. There was also recurrence of neuro-paralysis. A total of 30 vials of antivenom were administered.

Outcome:

The patient made a full recovery in two days.

This case report illustrates that Dr Punde's extensive snakebite management experience gave him the knowledge that envenoming by the 'black morph' spectacled cobra can be especially severe. His motto "Catch a breath and save a life" ensured this patient's survival. Dr Punde's training of junior doctors ensures this expertise is being disseminated, including information that efforts to resuscitate victim may need to continue for 45 minutes.

Case Report 7

Patient:

An eight-year-old girl (G) was bitten in Lohar Pada in Radhanagar village district, Bishnupur State, West Bengal at 01:00 on 18 July 2017.

Circumstance of bite:

The girl was sleeping on the ground in a mud and brick hut with her parents, grandmother and younger brother. No one noticed a juvenile common krait (*Bungarus caeruleus*) that had taken shelter in a tiny crevice on the broken floor of the room.



Sometime close to 01:00, G was bitten by the snake but did not raise an alarm. Some hours later, she woke her mother complaining of pain in the abdomen and a little later started vomiting. Her parents assumed she was suffering from indigestion. It was only after the child was not able to lift her head (broken neck syndrome), that her parents panicked and took her to the Radhanagar Block Primary Health Center, West Bengal.

The child died within five minutes of reaching the hospital.

To assist her parents in claiming the state government snakebite compensation of INR 100,000, Soumya Sengupta (the victim's class teacher) recorded a video and took photographs of the patient as evidence.

What we did:

This tragic story was shared with SHE to raise awareness. Visiting the patient's house was shocking as they live very close to a water body and farmland, which is a perfect habitat for rodents and snakes. The house had several holes and crevices where juvenile snakes can take shelter.

After taking written consent from her parents (to collect information for advocacy and awareness purposes), SHE interviewed the family for inclusion of this case report in the 'The Dead Don't Talk' advocacy film. The film was screened in Lohar Pada and attended by the victim's family. Soumya Sengupta and his team helped SHE organise an awareness puppet show in the neighbouring village of Bhor, which was attended by more than 200 people.

Outcome:

Sadly, the child did not survive.

This case report illustrates that the child died because of a lack of information that bites by kraits often occur to sleeping victims and that abdominal pain is a symptom of envenoming. It also illustrates that prevailing poverty can lead to families living in close proximity to snake-infested areas in houses that are ill-equipped to prevent snake entry, which places them in a particularly hazardous environment.

Current challenges and lessons learned from tackling snakebite in India

The general state of the medical infrastructure in rural and semi urban areas in India adds to the challenge of managing snakebite rapidly. Long distances and lack of ambulatory systems delay victims getting to a hospital equipped to effectively treat snakebite victims. This is especially dangerous for victims of neurotoxic envenoming because of the rapid onset of respiratory paralysis. Sadly, these patients often die on route to hospital.

Belief in faith healing and lack of knowledge are major barriers to reducing the medical and socioeconomic burden of snakebite. Faith healers enjoy tremendous followings and we have found that any awareness raised through them (and with the help of local political leaders, opinion builders and bureaucrats) is always well received by local communities. While this can be difficult and time consuming to accomplish, it can also be rewarding. Ideally, awareness programmes should be tailored to fit into already successfully run government campaigns, by securing the approval and support of local politicians and government officials to help promote the snakebite mitigation campaign.

Lack of accurate death and disability data adds to the apathy of health policy makers. Unless there are fully functional hospitals within 5 – 10 km radius of a snakebite victim, it will be difficult to bring down the mortality and disability numbers. The trial of keeping antivenom in ambulances in the states of Himachal Pradesh and Gujarat needs to be replicated in other states: victims call a toll-free number "108" and the call centre advises the paramedics collecting the victim whether to administer the antivenom while transporting them to the hospital.

Based on our experiences and learning from working with communities, our future objectives are:

- in places where the local population are heavily reliant upon faith healing, we will work with the healers to propagate awareness. This will be done with the help of the local administration and village heads and other respected members of the communities like teachers, religious leaders, community health workers, etc.
- we have learned that children are the most receptive audience. Students can be recruited to become community educators and drive change with the use of technology, social media, campaigns in their localities and by convincing their family and friends to believe in science and the medical treatment of snakebite victims.
- to align our projects with existing government plans and schemes is important. For example, the Swachh Bharat Scheme (cleanliness drive) to ban open garbage dumping (which attracts rodents) and build toilets in rural India are initiatives that will also help to reduce risk of snakebite.

- to continue working with the collector's office (government officer in charge of a district) to spread community awareness programmes in various districts and deliver capacity building and training of local medical officers, nursing staff and community health workers.

- to use IT solutions to advise doctors in rural areas in the management of complex snakebite cases in inadequate health facilities.

- to create more educational awareness videos to share on social media and WhatsApp groups and telecast in local cinema halls before the start of movies. We are also targeting state level Panchayats (rural governing bodies) to disperse educational posters and videos directly to the agrarian communities at greatest snakebite risk.

- to approach the National Social Service and National Cadet Corp in colleges to recruit volunteers to help conduct awareness drives in local communities. We are considering recruiting local auto rickshaws (tuktuk)/taxi operators as disseminators for our educational material and to recruit volunteers.

- to contact local radio stations to spread the snakebite awareness message as a two-minute audio clip in local languages. Their uptake would be greatly increased if we could recruit celebrities to talk about snakebite as a serious issue among the agrarian community (Message: Save people who grow food for the rest of the world).

- to approach the Education Department to add a chapter on snakebite and first aid in classes five to ten as a part of public health awareness, and request them to consider revising the medical college curriculum to add a comprehensive snakebite management protocol.

- to continue working with local health departments to ensure adequate supply of antivenoms and supportive drugs to state-owned hospitals.

- to train and establish snake rescue groups in every village.

- to build a snakebite management and mitigation app in collaboration with Dr Thomas Jhunghans and Dr Mauro Bodio, founders of www.vapaguide.info.

Implementing the above projects and aspirations requires funding. Support from corporations whose employees or products involve rural communities is vital if we are to help the WHO achieve its plan to halve snakebite mortality and morbidity by 2030. We remain self-funded in most of the projects we are undertaking.



Madras Crocodile Bank Trust

Romulus Whitaker, Allwin Jesudasan, Ajay Kartik and Gnaneswar Ch

madrascrocodilebank.org

We have been working in Tamil Nadu, India for decades and our aim is to relieve the tremendous socioeconomic burden snakebite places on rural communities. By empowering communities with the know-how to deal with snakebites, we not only address one of the pressing healthcare issues in India, but also contribute to the conservation of snakes by educating people on how they can safely co-exist with them instead of indiscriminately killing them.

India experiences the tragedy of the highest snakebite incidence on earth, with up to 50,000 men, women and children dying each year and tens of thousands of snakebite survivors permanently disabled and traumatised. A large part of this is down to the lack of knowledge of first aid and treatment of snakebite in rural regions.

As a majority of these bites are easily preventable, we believe that equipping people with the right knowledge about snakes and snakebite can help reduce snakebite deaths.

The project is run by the staff of the Centre for Herpetology at the Madras Crocodile Bank Trust. It is supervised by the joint director, project coordinator and assistant project coordinator. The project is currently operating in seven states with one or more non-governmental organisation (NGO) partners in each state. We have been operational since 2016 with donor support from several sources.

Our objectives are to:

- conduct extensive snakebite awareness programmes for various groups of stakeholders
- undertake research on geographical variation in venom
- maintain a database for snakebite mortality and reporting
- run technology-aided platforms related to snakebite
- establish a network of NGOs/volunteers/rescuers for conducting snakebite mitigation programmes
- interface with government in making policy level interventions.

Impacts and outcomes of the project

Case Report 8

Patient:

A 16-year-old boy (H) was bitten in the Keelperamanallur region of Kanchipuram at 17:30 on 10 October 2018.

Circumstance of bite:

H was bitten while gathering hay with his hands from a large harvest pile. He went home around 15 minutes later telling his parents about his slightly painful injury, which he believed was a thorn scratch. The site of the bite was on the middle finger of the right hand. His parents took him to a nearby PHC.



The boy was given a tetanus toxoid injection as a precaution and wasn't put under observation as this was not considered necessary for a thorn scratch. On returning home he began vomiting – the first symptom of envenoming he displayed. There was little/no local swelling nor excessive pain at the site of bite. The snake responsible remains unknown but we suspect a common krait.

H was then rushed to the nearby government hospital at 18:30 on a motorcycle and admitted at 19:30. After preliminary monitoring, he was referred by ambulance to a tertiary healthcare centre at about 20:00, for reasons unclear to the family.

He showed symptoms like breathlessness and muscular spasms in the ambulance, but was still capable of speaking. He was admitted to the tertiary healthcare centre at around 20:45. The boy was being continuously monitored in this hospital but died at about 15:00 on 11 October 2018.

What we did:

We were informed of the incident through a newspaper article. We visited the victim's home a week later to console his parents, offer advice and acquire details of the sequence of events. We noted all the crucial details and corresponded with the nearby PHC but were unable to gather any important information nor given access to the case sheet. We spoke to the family and encouraged them to get the post-mortem report in order to apply for compensation.

Outcome:

Unfortunately, H did not survive.

This case report illustrates that because the bite was first considered as innocuous and there was a delay in symptom development, the victim wasn't put under observation or given rapid treatment.

Case Report 9

Patient:

A 58-year-old man (J) bitten in Meyyur village, Kanchipuram at 09:10 on 29 October 2018.



Circumstance of bite:

J wasn't wearing any footwear and was bitten on the left foot by an unknown snake when he switched off the water pump in his farm. The snake was hidden in the slush next to the pump and he stepped on it. The snake fled after biting. The victim immediately alerted his nearby friends and walked 200m to reach his bike. From there he drove home along with two of his friends. He was very calm, mainly because he had experienced two previous bites by checkered keelback snakes, and because he didn't feel unwell. The snake responsible remains unknown but we suspect a common krait.

He went to his home to eat salt and green chilli to ponder whether there was any sort of venom in his body. He decided against visiting a PHC and didn't call for an ambulance but instead travelled directly to the tertiary healthcare centre. He was admitted at 09:50 and only 20 minutes later started showing severe symptoms and was moved to ICU. He was put on ventilation but died shortly after.

The total time from bite to death was 90 minutes.

What we did:

We were informed of the incident through a newspaper and a week later we visited the victim's home and spoke to his son and sibling regarding the progress of events. We noted all the crucial details and got to know that the victim was a very healthy man. The victim's son told us that antivenom wasn't administered at all. We were unable to gather any important information from the tertiary healthcare centre nor were we given access to the case sheet. We spoke to the family and encouraged them to get the post-mortem report in order to apply for compensation. The family did so and got the first instalment of compensation after three months.

Outcome:

Unfortunately, J did not survive.

This case report illustrates that even on reaching a tertiary healthcare centre within an hour, the victim still died. The victim's early mild symptoms delayed treatment and the onset of his severe symptoms were so rapid and life-threatening that he died before antivenom could be administered.

Case Report 10

Patient:

An 8-year-old boy (K) was bitten in Chittampur village, Kanchipuram at 09:15 on 26 January 2019.

Circumstance of bite:

K was returning home from school after Republic Day celebrations. The snake was on a sunshade of a building where he and his friend stopped to eat chocolates. Crows started pecking the snake, which fell on K's friend as it escaped. K's friend immediately brushed the snake off, but after it landed, it bit K's left ankle. He was weak as he hadn't had breakfast and collapsed shortly after. The snake was identified as a Russell's viper (*Daboia russelii*).



K was admitted to a PHC within 15 minutes of the bite. He displayed severe symptoms (initially droopy eyelids, frothing and low heartbeat progressing to severe fever and haematuria) and was given four vials of antivenom. K was transported by ambulance to the tertiary healthcare centre within two hours of the bite. He was quickly admitted to ICU under ventilation. He developed severe fever, bleeding from nose and haematuria. He suffered acute kidney failure the next day that required dialysis, but he passed away before dialysis was started.

What we did:

We were informed of the incident through a newspaper and visited the victim's home two weeks later. We spoke to his parents and recorded the crucial details and also visited the PHC. We were unable to gather any important information from the tertiary healthcare centre nor were we given access to the case sheet. We spoke to the family and advised them to them to acquire a copy of the post-mortem report in order to apply for compensation.

Outcome:

Unfortunately, K did not survive.

This victim case report illustrates that severe symptoms can develop very early. The doctors initially thought the bite was from a neurotoxic snake but confirmed it was Russell's viper when the specimen was brought to them.

Case Report 11

Patient:

A 45-year-old woman (L) was bitten in Cheyyur village, Kanchipuram at 13:00 on 6 December 2018.

Circumstance of bite:

L was bitten by a juvenile spectacled cobra when she was picking up bundles of paddy. The snake was hiding between the bundles and bit her on the left ankle. The snake was killed immediately and taken along with L to a nearby PHC and then transported to a secondary healthcare centre. Neither of these facilities administered antivenom.

She was later referred to a tertiary healthcare centre, admitted at 14:00 when she received antivenom treatment. She had mild swelling at the site of bite and local pain but no severe symptoms. On the next morning she started vomiting but became stable by that evening and was discharged the following day.

What we did:

We were informed of the incident through a hospital visit. We briefly interviewed the victim and her husband when she was receiving treatment. After she was discharged, we visited her home and donated her a pair of gumboots. Initially she was reluctant to wear them but after persevering, she found them to be comfortable. She realised that if only she had worn the boots the bite could have been prevented. She said that she would wear these to work in the future and also encourage her neighbours to wear gumboots.

Outcome:

L fully recovered and has adopted behaviours that help reduce her, and her friends', risk of future bites.



This case report illustrates that gumboots can be accepted for agricultural work because of the understanding that they reduce the risk of snakebite. This case was a major stimulus for distribution of the Madras Crocodile Bank Trust snakebite prevention kit.



Current challenges and lessons learned from tackling snakebite in India



We currently have educational programmes running in seven different states but to scale up our efforts nationwide presents a unique set of problems. Finding suitable partners/volunteers, getting permissions, making region specific programmes and funding constraints are some of the many challenges we face.

The project currently has eight NGO partners and several volunteers who conduct outreach and education workshops for rural communities in some of the most snakebite prone regions of India. So far, we have conducted over 300 programmes in seven different states. The workshops are audience-specific and are always thoroughly documented.

We have reached more than 700,000 people through our workshops and concise educational materials, including posters and short films in regional languages concerned that regional variation in venom protein composition may affect antivenom efficacy, we have partnered with Dr Kartik Sunagar of the Evolutionary Venomics laboratory, Indian Institute of Science to systematically study this, and we anticipate publishing this important work shortly we established the Irula tribal Snake-catchers Cooperative in 1978 to supply venoms for the production of antivenom for India. We are modernising venom production, so it meets WHO standards in collaboration with Dr David Williams, Australian Venom Research Unit, University of Melbourne and CEO, Global Snakebite Initiative we continue our dialogue and work with India's five antivenom producers with regards to increasing antivenom effectiveness and reducing adverse reactions we are partnering together with the National Health Mission, Tamil Nadu State to collect epidemiological data and establish a State Snakebite Registry, that we hope will be

replicated nationwide we are working with the government's Indian Council for Medical Research, Ministry of Health and Department of Biotechnology toward standardising a snakebite treatment protocol, guaranteeing adequate supply of antivenom, free to the rural poor where it is needed most, training of rural clinicians and adding snakebite to the syllabus of MBBS physicians.

One of our major challenges is to scale-up our efforts and conduct our workshops nationwide – a challenge in a country as large as India. That said, our model of 'training trainers' in partnership with regional NGOs has been effective thus far and will be the way to augment our reach to a wider part of the country. The folklore and myths surrounding snakes and treatment of their bites are strongly ingrained in the minds of rural Indians and changing their thought process is always a challenge, but we've seen that people become more open through sustained engagement with the community.

Our future objectives include:

- scale-up the education programmes to cover the whole country
- upgrade the currently existing technology aided platforms, including mapping of hospitals and snakes
- distribute and analyse efficacy of snakebite prevention tools like torchlights, mosquito nets and gumboots
- interface with government in making policy level changes leading to an improvement in healthcare.





Remote Envenomation Consultancy Services (RECS Philippines)

Patrick Joseph Tiglao, John David Commandante, Emelia Santamaria and Marvin Jay Sarmiento

mstoxinology.blogspot.com/p/recs.html

The 'Reaching Out to Communities through Education and Training' mission of RECS Philippines is coordinated and implemented by Dr Patrick Joseph Tiglao, Dr John David Commandante, Dr Emelia Santamaria and Mr Marvin Jay Sarmiento.

We started this volunteer initiative in 2017 in response to the perceived need to improve clinical management of snakebite in district-level hospitals that admit most victims. Lack of base-line snakebite research, and dependency upon hospital-based data that cannot include data on community-based incidence, mortality and morbidity, means that we don't know the scale of the problem in the Philippines. However, the little data we have illustrates that snakebite primarily affects male agricultural farmers and workers, who are mostly the breadwinners of their families. Thus, a report⁷ from a Research Institute of Tropical Medicine resident physician in 2016 described that of the 79 envenomed patients admitted from 1995 – 2000, 50% were 18 – 28 years of age, with a 9:1 male-to-female ratio and 95% of the bites were to hands and feet. While the majority of patients (97.5%) were discharged in good health, 2.5% of patients died, with shortage of antivenom being the likely cause.¹

Another 2011 – 2015 study⁸ based from the Bicol Medical Center described that of the 153 admitted snakebite patients, 78.4% were male, 73% were adult, 51% were single and 41.8% were farmers and 73% were bitten on the lower extremities. 95% of surviving patients stayed in hospital for less than 48 hours. There were notable year-year differences in admission and survival rates. 52.9% of the envenomed patients were given antivenom two to six hours after the bite. A range of five to ten vials of antivenom were given to 47.1% of patients and ventilator support was given to 17.6% of patients. A total of 136 patients (88.9%) did not have local bite site complications. The highest probability of survival was attributed to being female, shortest hospital stay and living in the 5th district of Camarines Sur. This study illustrates that prompt medical treatment with the requisite ventilatory and associated support improves survival from snakebite.

We were aware that the latter was urgently needed in more rural, remote hospitals, particularly training in envenomation first aid for snakebite and marine animal envenoming. At this point in time, we are still raising funds to support the planned activities of RECS Philippines and hopefully we can do more relevant outreach to more places in the country.

Impact and outcomes of the project

Case Report 12

Patient:

A 15-year-old boy (M) was bitten in an unknown location at 09:00 in May 2016.

Circumstance of bite:

M was walking along the roadside in sunny, humid weather when he was bitten on the left leg. He was admitted to the district hospital with signs of neurotoxic envenoming: slurred speech, dizziness and difficulty in breathing.

What we did:

We were contacted by the district hospital. We provided oversight of immobilisation of the bitten left leg and intubation of the patient. Antivenom was not available and supportive treatment was given, the most critical being early mechanical ventilation.

Outcome:

The patient survived.

This case report illustrates that supportive treatment, especially ventilatory support for victims suffering respiratory paralysis, can be effective even in the absence of antivenom. It also illustrates the scarcity of critically needed antivenom in district hospitals.

Case Report 13

Patient:

A 36-year-old pregnant (16 weeks of gestation) woman (N) was bitten at noon on 24 April 2018.

Circumstance of bite:

N was seated, cracking coconuts for a meal when she was bitten on her back by the snake. She was admitted to the local hospital with symptoms of neurotoxic paralysis.

What we did:

We were contacted for advice and ensured that the obstetrics and gynaecology service was involved in her treatment. The patient was given antivenom almost every hour, with a total of nine vials administered over the first 24 hours. Neurologic improvement was noted six hours after the first seven vials of antivenom infusion.

Outcome:

N and her unborn child survived.

This case report illustrates that prompt administration of adequate doses of antivenom and appropriate supportive care delivers rapidly effective recovery. It also demonstrates that pregnant snakebite victims can be given antivenom.

Case Report 14

Patient:

A 15-year-old girl (O) was bitten at about 18:00 on 5 May 2015.



The left image shows darkening of O's ankle indicating the onset of tissue necrosis; the right image shows her ankle post-surgery.

Circumstance of bite:

O was collecting laundry from the backyard clothes-line when she suddenly felt excruciating pain on her right foot. The snake was not seen nor caught/killed.

The patient felt pain and weakness of the affected limb, which prompted the family to immediately take her to a traditional 'Albularyo' healer. The Albularyo performed the 'tandok' ritual, applied an oil on the bite site and gave the patient mefenamic acid and amoxicillin. Because of their daughter's worsening weakness in her leg, dizziness and inability to converse, her parents decided to transport her by motorcycle to the local district hospital. Noting the patient's severe general weakness and associated light-headedness and restlessness, she was transferred to a tertiary healthcare centre, where RECS was consulted.

What we did:

O was admitted and referred to the toxicology service for co-management. We provided advice throughout and noted improvement in her condition two hours after infusion of two vials of antivenom in 500ml of PNSS. She was transferred to the paediatric ICU where she was administered tetanus prophylaxis and intravenous antibiotics.

O was noted to have tissue necrosis 72 hours post-bite and was referred to a general surgery service for debridement and wound care.

Outcome:

O was discharged and had several outpatient and surgery department follow-up consultations, serial debridement and regular wound dressing over the following three – four week period.

This case report illustrates the value of antivenom to reverse neurotoxic envenoming, and the value of co-management by toxicology and general surgery experts. It also evidences the delay incurred by visiting nearby faith healers.

It has also spearheaded the start of an advocacy campaign to encourage every physician in the region to count, record and report snakebite admissions, so that appropriate antivenom allocations can be implemented.

This case also highlighted the psychological effect that snakebites can have. O previously excelled in her studies and was a Valedictorian when she graduated from elementary school. However, when she graduated from Secondary school, 11 months after the snakebite, she was the 5th Honourable Mention. This was a very significant setback for this hardworking student. The pain, stigma of the open scars and repeated hospital visits all detracted from her normal life, wellbeing and scholastic performance. This case therefore emphasises that in addition to medical and surgical services, snakebite victims would greatly benefit from psychological counselling and support to better cope with their trauma and to deal with any long-term disfigurement.

Case Report 15

Patient:

A 17-year-old boy (P) was bitten at about 08:00 on 20 May 2019.

Circumstance of bite:

P was getting water from a nearby well when he was bitten on his left ankle. P was initially brought to a local traditional healer; however, he was taken to the local district hospital when he collapsed after experiencing increasing dizziness and numbness.

He was admitted unresponsive and with a Glasgow Coma Score of 3, immediately intubated and ventilated but eventually transferred to a tertiary regional hospital around 13:00. One of the attending nurses (who had attended our Snakes and Snakebite Envenomation Management training course) called RECS Philippines for advice.

What we did:

We provided clinical oversight of the immediate administration of five vials of antivenom infusion and admission to the paediatric ICU ward. Here he was subsequently administered anti-tetanus vaccination (tetanus toxoid 40U/0.5ml IM) and immunoglobulin therapy (HTIG 250 iu IM).

A total of 15 vials of antivenom was administered before the patient showed signs of improvement and eventually noted to have a GCS of 15.

Outcome:

P was discharged well from the hospital on 29 May 2019.

This case report illustrates that the availability of antivenom and supportive airway and medical management is of utmost importance. This is a good example of having everything in place to successfully manage a critically endangered snakebite victim.

Current challenges and lessons learned of tackling snakebite in the Philippine archipelago

The medical and humanitarian benefits of RECS Philippines justify our approach but also highlight the challenge we face. This is because our nation's archipelago geography requires our delivery of training to numerous, hard to reach island communities, which is time consuming and expensive, all without compromising our day jobs.

We have also learned that inadequate production and supply of antivenom to hospitals in these remote locations restricts what can be done for snakebite victims. One of our goals is to ensure that these emergency drugs and associated ventilation equipment is part of the emergency cart in all these remote hospital facilities.

We have therefore needed to add advocacy activities to our portfolio to improve political will and increase the national budget prioritisation for snakebite management, including equitable supply of antivenom for those communities in need. Accurate, nationally representative data on the socioeconomic burden of snakebite would greatly assist this effort.

We continue trying to raise funds to support our current and future plans to geographically expand our RECS Philippines training and clinical advice interventions. We seek productive engagement with all national stakeholders, including with antivenom production facilities like the Research Institute for Tropical Medicine and local government units. RECS Philippines is also strategising towards creating global partnerships through research and enticing more advocates for our projects.



Concluding remarks

These case reports from across the world testify to several common challenges that need to be overcome if snakebite victims can fully recover from their bites. Delay to treatment because of long distances or difficult geographies, lack of ambulance systems, traditional healer consultations and multiple hospital referrals are key common factors. Addressing this challenge is vital to improving survival of victims suffering rapid respiratory paralysis after neurotoxic envenoming. The non-availability of antivenom and associated life-support systems in hospitals serving these communities is clearly part of that challenge. There seems to be a common perception that more lives would be saved by simply increasing the dose of antivenom. While understandable and supported by some of the case reports, this perception needs to be viewed with some caution because the drivers of antivenom effectiveness include factors other than just dose: there is an urgent need for clinical antivenom efficacy research that better defines the pathophysiological consequences and time course of envenoming by the most medically-important snakes in each region, and the required characteristics, and doses, of antivenom to neutralise these variant pathologies. Ideally this should be allied to development of effective symptomatic treatment protocols. Similarly, the value of antivenom in treating venom-induced necrosis, and the most effective surgical, psychological and physiotherapy support is another clinical research priority.

The case reports also demonstrate the extraordinary humanitarian contributions donated by these community groups. We know of several similar groups elsewhere in sub-Saharan Africa and Asia that face equally demanding medical, logistic and advocacy challenges, and there will surely exist many community groups that we don't know about.

It is a sad truth that the many benefits all these groups donate to their communities is fragilely dependent upon the voluntary services of key individuals operating on equally fragile charity budgets. Loss of either risks loss of both – and cessation of their lifesaving help to remote community snakebite victims. For the WHO strategy to benefit these snakebite victims, it will be necessary that the aims, activities, approaches and reach of these community groups are inculcated into local and central government health operations. Ideally perhaps, this should be undertaken in collaboration with more securely funded civil society and other stakeholder groups to ease the transition of snakebite management from charity to state responsibility.

References

1. Harrison RA, Casewell NR, Ainsworth SA, Lalloo DG. The time is now: a call for action to translate recent momentum on tackling tropical snakebite into sustained benefit for victims. *Trans R Soc Trop Med and Hygiene* 2019;doi: 10.1093/trstmh/try134.
2. World Health Organization. WHO launches global strategy for prevention and control of snakebite envenoming. Geneva: WHO, 2019. www.who.int/news-room/detail/23-05-2019-who-launches-global-strategy-for-prevention-and-control-of-snakebite-envenoming [Accessed 30 July 2019].
3. Williams DJ, Faiz MA, Abela-Ridder B et al. Strategy for a globally coordinated response to a priority neglected tropical disease: Snakebite envenoming. *PLoS Negl Trop Dis* 2019;13(2):e0007059.
4. Wellcome Trust. Snakebites – it's time to solve the world's biggest hidden health crisis. London: Wellcome Trust, 2019. <https://wellcome.ac.uk/press-release/snakebites--its-time-solve-worlds-biggest-hidden-health-crisis> [Accessed 30 July 2019].
5. Hodel K. Scientists pursue universal snakebite cure using HIV antibody techniques. London: The Guardian, 2019. www.theguardian.com/global-development/2019/may/24/scientists-pursue-universal-snakebite-cure-using-hiv-antibody-techniques [Accessed 2 August 2019].
6. Freeman C, Nuki P. Snakebite: the race to find a universal antivenom. London: The Telegraph, 2019. www.telegraph.co.uk/news/snakebite-and-antivenom/ [Accessed 2 August 2019].
7. Rutchell A, Simene MD. The Serpent's Curse. Interdepartmental Case Report, 2019.
8. Belleza R, Ranola JoM III. Epidemiology and Clinical Outcomes of Snakebite Patients at the Bicol Medical Center January 2011 to December 2015. Naga City: Bicol Medical Center.



Transactions of the Royal Society of Tropical Medicine & Hygiene

Submit your snakebite research!

We are pleased to announce *Transactions of the Royal Society of Tropical Medicine & Hygiene* will publish a special issue on the topic of snakebite. According to the World Health Organization, there are approximately 5.4 million snake bites each year, resulting in 81,410–137,880 deaths and around three times as many amputations and other permanent disabilities. Raising awareness and further research will help reduce the morbidity and mortality of this neglected tropical disease.

We welcome research submissions on all areas of snakebite.

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