

Snakebite crisis: Unresolved challenges and opportunities in the digital age

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FACULTY OF MEDICINE
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Image Source: [Jacques Van Niekerk](#)

A photograph of two women in a rice field. The woman on the left is wearing a white headscarf and a red sari, and is holding a bundle of rice stalks. The woman on the right is wearing a patterned headscarf and a red sari with a floral pattern. They are both looking down at the rice stalks. The background shows a lush green rice field with some trees in the distance.

+ 125,000
deaths

Image source: [CIAT](#)
Data Source: [WHO \(2018\)](#)



+ 400,000
amputations and disabilities

Image source: Dr. Gabriel Alcoba / MSF
Data Source: [WHO \(2018\)](#)

GLOBAL HEALTH

Africa braced for snakebite crisis

Health specialists warn that stocks of antivenom will run out in 2016.

BY QUIRIN SCHIERMEIER

Rural Africa is facing a resurgence of a persistent plague that rarely makes headlines: snakebite.

By June next year, stockpiles of the anti-venom that is most effective against Africa's vipers, mambas and cobras are expected to run out because the only company that makes the medicine has stopped production. With no adequate replacement in sight, the death toll from bites is set to rise, specialists warned at a tropical-medicine congress last week in Basel, Switzerland.

"We're dealing with a neglected health crisis that is turning into a tragedy for Africa," says Gabriel Alcoba, a medical adviser with the international humanitarian group Médecins Sans Frontières (MSF; also known as Doctors Without Borders).

Venomous snakes might seem an archaic menace in such a rapidly urbanizing world. Yet by cautious estimates, snakebites kill more than 100,000 people worldwide every year (see 'Death toll') — more, on average, than lose their lives in natural disasters. And survivors often experience permanent physical and mental disabilities.

In 2010, the French drug firm Sanofi Pasteur in Lyon ceased production of Fav-Afrique, an antibody serum that reduces the quantity of venom circulating in the blood of a snakebite victim. Made from the purified plasma of horses previously injected with small quantities of



The deadly carpet viper (*Echis ocellatus*).

snake venom, the serum neutralizes the venom of many of Africa's most dangerous snakes.

The antidote has saved many people from bites by deadly species such as the carpet viper (*Echis ocellatus*), common in West Africa, and the black mamba (*Dendroaspis polylepis*), found across the sub-Saharan region. But the high costs — US\$250–500 per person — and a supply shortage mean that only about 10% of snakebite victims in Africa get treatment, and the company says that producing the antidote is no longer profitable. Cheaper products by competitors have forced Sanofi Pasteur out of the African market, says Alain Bernal, a company

spokesman. Sanofi Pasteur is working to enable the transfer of know-how to companies willing to take over production of Fav-Afrique, he says.

Pharmaceutical companies in South Africa, India, Mexico and Costa Rica are among those marketing cheaper products — some of which work well against snakes in their host nations. But their safety and effectiveness against the large variety of species in Africa have not yet been established in clinical trials. To speed up the process, MSF is offering two of its hospitals in the Central African Republic (CAR) and South Sudan as study sites. But it will take at least two years to validate the products in development, and none is as broadly efficient as Fav-Afrique, Alcoba says.

NEGLECTED THREAT

Although just now becoming critical, Africa's snakebite problem has been smouldering for years, says tropical-medicine specialist David Warrell of the University of Oxford, UK, who consults for the World Health Organization (WHO). Snakebite fatalities have been rising over the past decade in the CAR, Ghana and Chad — in part owing to a failure to train enough medical staff, ignorance from health ministries and "unscrupulous marketing" of inappropriate antivenoms, he says. "War-torn countries have many other problems. But the millions of children, poor farmers and nomadic people at risk of snakebites just don't have the ear of politicians in capital cities."

And according to Warrell, the WHO has done little to help. To improve the safety and

PIRA, STAMATA/CCO/REUTERS



Snakebite envenoming

[Snakebite envenoming](#)[The disease](#)[Epidemiology](#)[Antivenoms](#)[Control and prevention strategies](#)[Treatment and rehabilitation](#)[Information resources](#)

Snakebite envenoming: Member States provide WHO with clear mandate for global action



24 May 2018 | Geneva -- The 71st World Health Assembly adopted a resolution formally providing the World Health Organization (WHO) with a strong mandate to develop a comprehensive plan to support countries in implementing measures for increased access to effective treatment to people who get bitten by venomous snakes. WHO is already working on a strategic plan to assess and address the global burden of snakebite envenoming. The plan is expected to be ready by the end of this year.

[Full story](#)[Read more on the prevalence](#)[Read more on antivenoms](#)[Answers on snakebite FAQ](#)

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Correction | Published: 05 October 2017

Snakebite envenoming

José María Gutiérrez, Juan J. Calvete, Abdulrazaq G. Habib, Robert A. Harrison, David J. Williams & David A. Warrell

Nature Reviews Disease Primers **3**, Article number: 17079 (2017) | [Download Citation](#) ↓

i The original article was published on 14 September 2017

Nature Reviews Disease Primers **3**, 17063 (2017)

In the original version of this article, it was incorrectly stated that tetanus toxoid boosts the immunity against snakebites (Table 2). This has now been corrected to ‘To boost immunity against tetanus toxin in all bite cases’



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WHO has added snakebite to the NTD list: these things need to happen next

15th Sep 2017 Snakebite Neglected tropical diseases 0 comments



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Image Source: [Jacques Van Niekerk](#)
Article: [The Lancet](#)



WHO Roadmap: Safe and effective antivenoms more widely available and accessible

Image Source: [Jacques Van Niekerk](#)

Antivenoms: Challenges





- Classic production methods (i.e. «hyper immune equine serum»)
- Side effects (anaphylaxis, pyrogenic, serum sickness)
- Taxa specific, not yet polyvalent (e.g. Pan African, Universal)
- Poor regulatory frameworks, absence of standards, lack of expertise and capacity within national drug control laboratories
- Low confidence in product safety and effectiveness



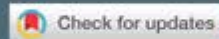
Image Source: [Jacques Van Niekerk](#)

ARTICLES | VOLUME 392, ISSUE 10148, P673-684, AUGUST 25, 2018

Vulnerability to snakebite envenoming: a global mapping of hotspots

Joshua Longbottom, MSc   • Freya M Shearer, BSc • Maria Devine, MSc • Gabriel Alcoba, MD •
Francois Chappuis, MD • Daniel J Weiss, PhD • Sarah E Ray, BS • Nicolas Ray, PhD • David A Warrell, FMedSci •
Rafael Ruiz de Castañeda, PhD • David J Williams, PhD • Prof Simon I Hay, FMedSci   • David M Pigott, DPhil •
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Open Access • Published: July 12, 2018 • DOI: [https://doi.org/10.1016/S0140-6736\(18\)31224-8](https://doi.org/10.1016/S0140-6736(18)31224-8) •



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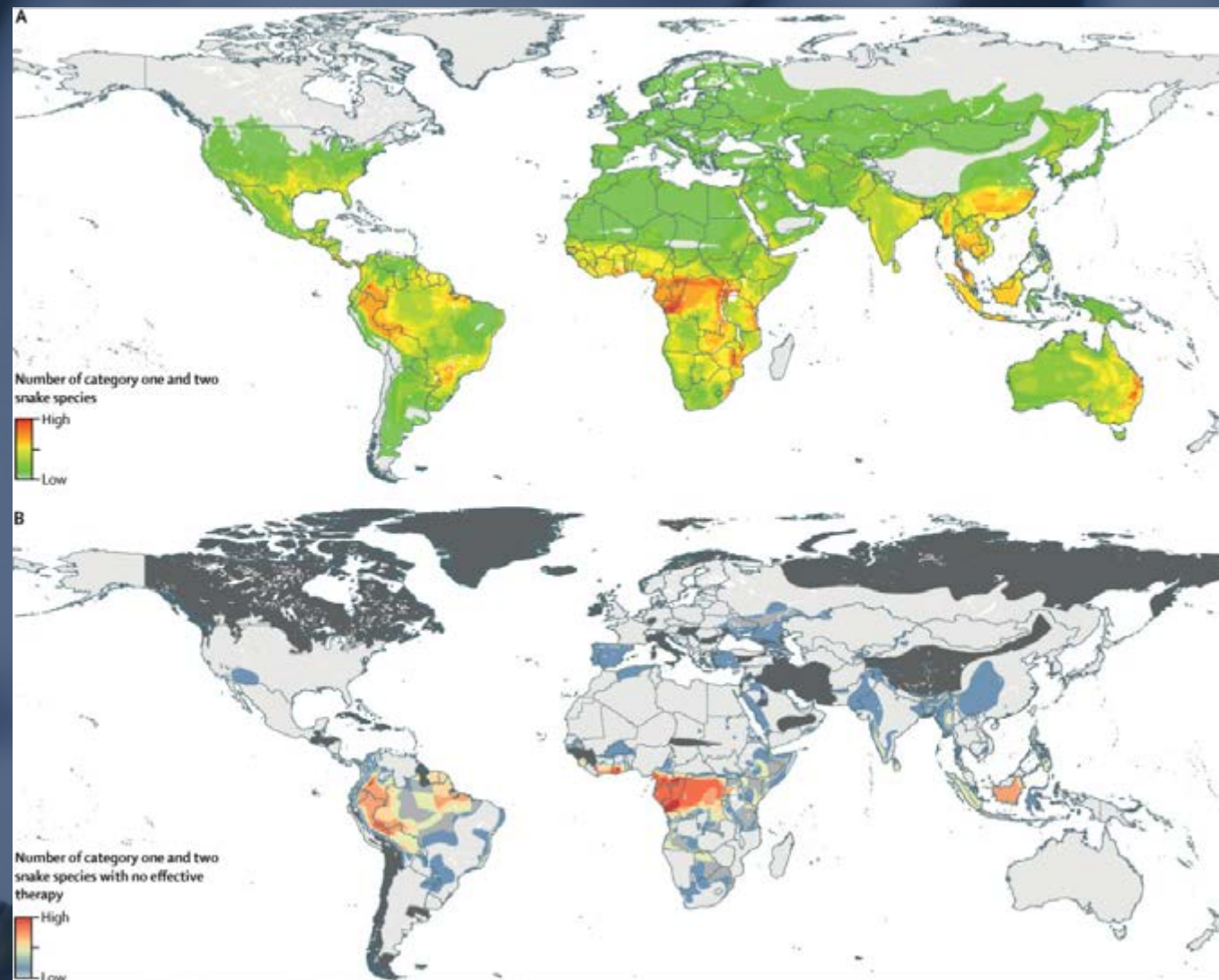
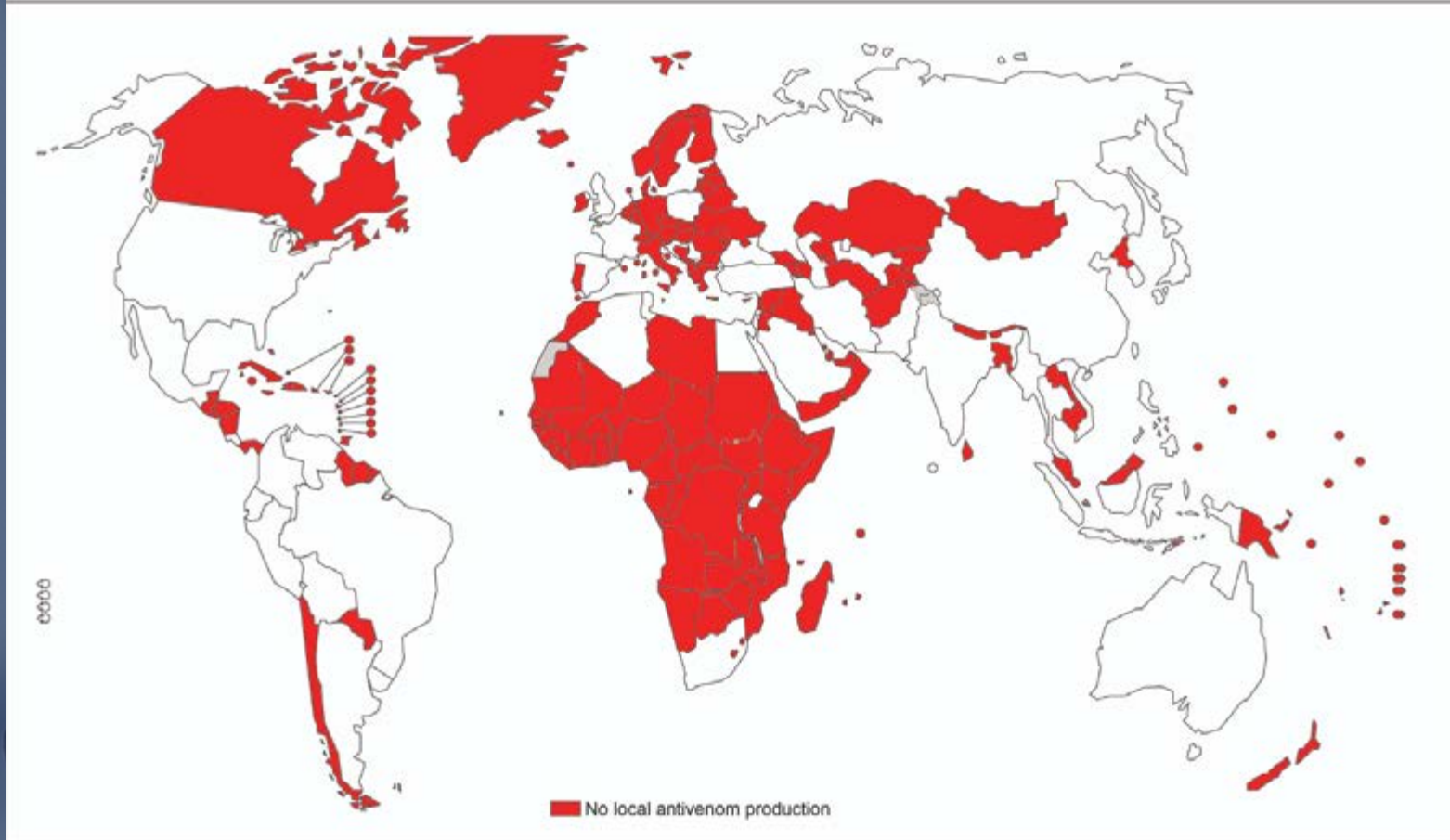


Image Source: [Jacques Van Niekerk](#)
Map: [Longbottom et al. \(2018\) The Lancet](#)

Countries with no local antivenom production



The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted lines on maps represent approximate border lines for which there may not yet be full agreement. © WHO 2017. All rights reserved.

Data Source: World Health Organization
Map Production: Control of Neglected
Tropical Diseases (NTD)
World Health Organization





Opportunities for **new approaches & digital innovation**

Image Source: [Jacques Van Niekerk](#)

A photograph of a snake, possibly a cobra, coiled around a dark branch. The image is heavily overlaid with a semi-transparent blue filter. The snake's head is visible, with its eyes and scales clearly defined against the blue background. The text "Snakebite: also a data crisis" is centered over the image in a white, sans-serif font.

Snakebite: also a data crisis

Image Source: [Jacques Van Niekerk](#)

Need for epidemiological data

- Very few national incidence studies (Sri Lanka, Bangladesh, India)
- Ongoing studies in Nigeria and Kenya (The African Snakebite Research Group: Prof. Habib, Dr. Harrison), and South Soudan (MSF) (but not nation-wide)



Image Source: [Jacques Van Niekerk](#)

SNAKE-BYTE Project

Tackling the second deadliest NTD: predicting and reducing the impact of snakebite on human and animal health through interdisciplinary analyses of hotspots and access to care

Started March 2018 for 4 years, Cameroun and Nepal



Image Source: Snake-Byte Project

Because snakebite is a data crisis:

- **Primary data collection at the household level: 24'000 households** in a national human-animal health integrated survey in Nepal and Cameroon
- Health and economic indicators (e.g. zDALY)



Image source: [Narayan G. Maharjan](#)



One Health approach
to snakebite in
rural agro-ecosystems

Source: [Narayan G. Maharjan](#)

One Health approach to Snakebite - Scoping review on Snakebite and domestic animals

- 143 relevant publications from 1956 to 2016
- 18 animal species affected but a focus on companion animals (e.g. dog, cat) vs livestock
- Death reported in all domestic animal species
- 34 different offending snake species identified (*Vipera*, *Notechis*, *Pseudonaja*, *Bothrops*, *Pseudechis*, *Naja*)



Modelling physical accessibility to treatment facilities to target population at risk taking into account:

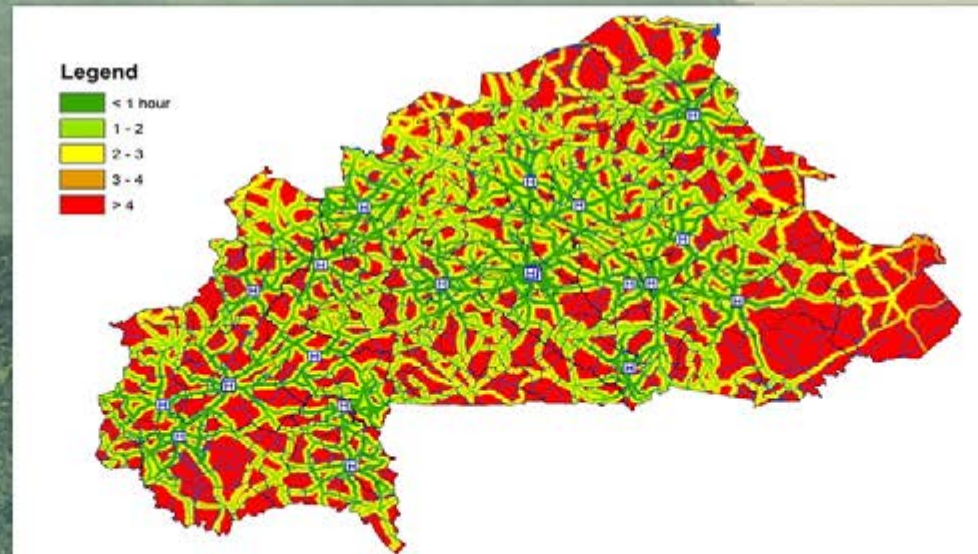
- barriers to movement
- road network
- walking and/or use of motorized vehicle
- population density

Free and open-source
WHO tool AccessMod

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AccessMod 5

Supporting Universal Health Coverage by modelling physical accessibility to health care



New data sources and participatory approaches



368 observations

CC

Mohave Rattlesnake
(*Crotalus scutulatus*)



309 observations

Prairie Rattlesnake
(*Crotalus viridis*)



309 observations

Red Diamond Rattlesnake
(*Crotalus durissus*)



309 observations

Texas Coralsnake
(*Micrurus tener*)



257 observations

CC

Sidewinder
(*Crotalus cerastes*)



227 observations

CC

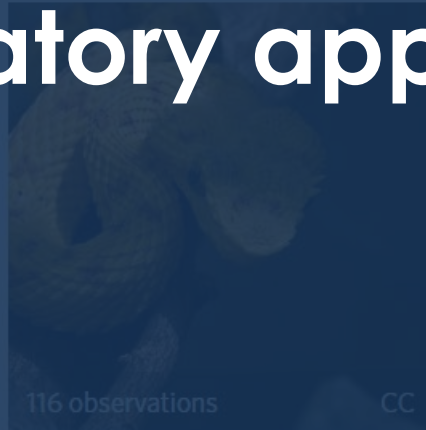
Speckled Rattlesnake
(*Crotalus mitchellii*)



142 observations

CC

Terciopelo
(*Bothrops asper*)



116 observations

CC

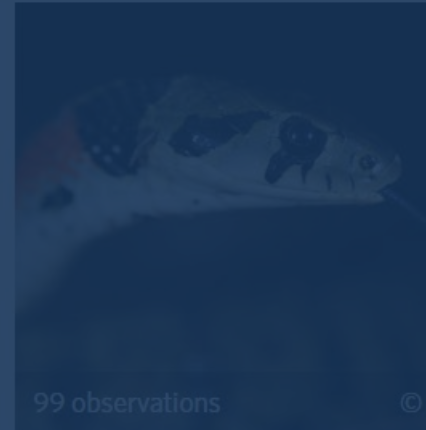
Eyelash Viper
(*Bothriechis schlegelii*)



111 observations

CC

Western Massasauga
(*Sistrurus tergeminus*)



99 observations

©

Tiger Keelback
(*Rhabdonhis tigrinus*)

VIEWPOINTS

Participatory approaches and open data on venomous snakes: A neglected opportunity in the global snakebite crisis?

Lester Darryl Geneviève¹, Nicolas Ray², François Chappuis³, Gabriel Alcoba^{3,4}, Maria Rosa Mondardini⁵, Isabelle Bolon¹, Rafael Ruiz de Castañeda^{1*}

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3 Division of Tropical and Humanitarian Medicine, University Hospitals of Geneva, Geneva, Switzerland,
4 Médecins Sans Frontières, Geneva, Switzerland, **5** Citizen Cyberlab, CERN-UNITAR-University of Geneva, Geneva, Switzerland



**citizen
cyberlab**



Medically Important Venomous Snakes

Add observations to this pr

Stats

Totals

10396

Observations »

202

Species »

2882

People »

Most Observations



skystevens
214 observations



catenatus
209 observations



swanson
206 observations



agua_dulce_snake_guy
194 observations



sandboa
171 observations

Most Species



sullivanrabbit
28 species



eligarciapadilla
19 species



herpguy
19 species



sandboa
17 species



matthieberroneau
17 species

Most Observed Species



Western Diamondback
1960 observations



Western Rattlesnake
1707 observations



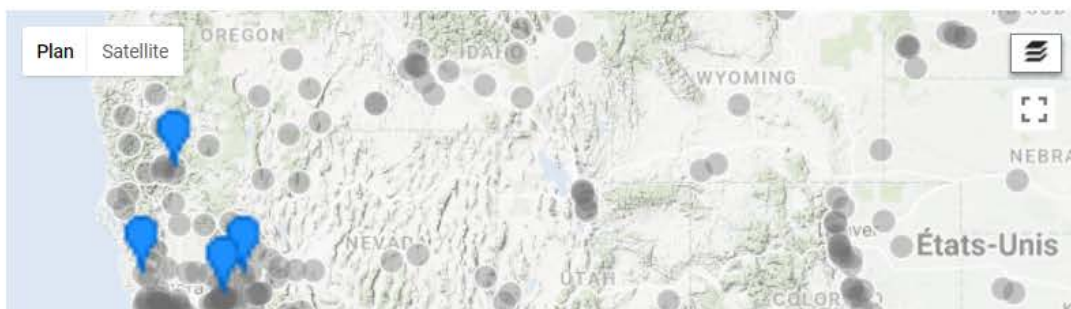
Copperhead
1205 observations



Cottonmouth
1174 observations



Timber Rattlesnake
389 observations



» Members



35 me

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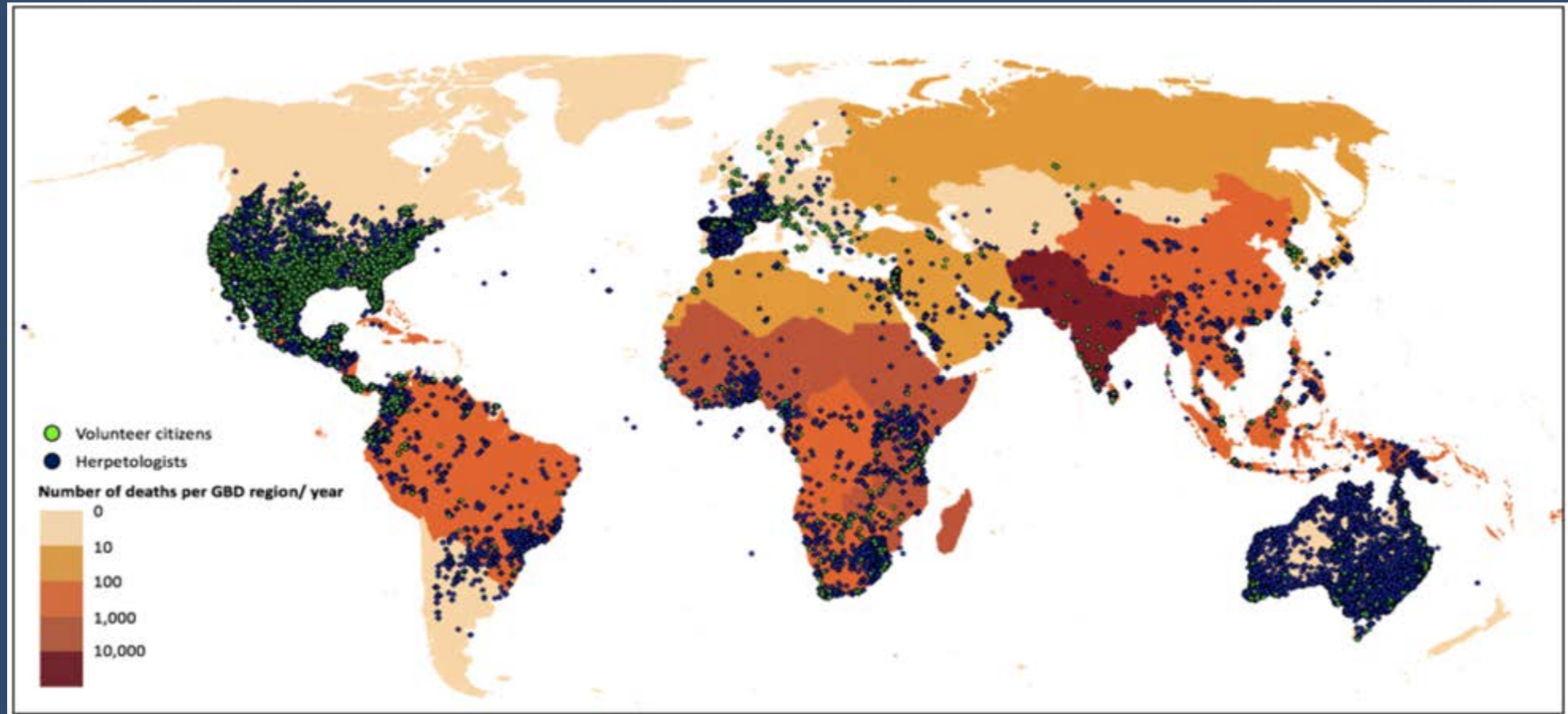
Open participatory
platforms on animal
biodiversity such as
iNaturalist

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First global map of venomous snake distribution based on open data:





Medically Important Venomous Snakes

Add observations to this pr

Stats

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Most Observations



skystevens
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matthieuberroneau
17 species

Most Observed Species



Western Diamondback
1960 observations



Western Rattlesnake
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Atom



KML



CSV

Open participatory
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Brown Vine Snake (*Oxybelis aeneus*)

Records Today: 20

Last 7 Days: 710

Last 30 Days: 3,146

Total Records: 235,878





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from snake bites every year**

Updates From the Field



India's largest digital snake database



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FoodHack Geneva 201...

* Be respectful * No shaming * No negative emoticons * No guessing * Dead snakes allowed * Limit discussion that isn't ID related

CLICK HERE TO READ THE *FULL* RULES
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We have a great group with a friendly, *professional* atmosphere; it's up to *YOU* to keep it that way!

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Christopher E. Smith shared a link.

April 8, 2015

RULES (Updated: 3 July 2017)

TinyURL: <https://tinyurl.com/SnakeIdentification>

Read these rules in full. Any violation of these rules will result in the deletion of your post and possibly your permanent removal from this group. There are plenty of experts here to help identify snakes, we will not miss a few. ...

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DESCRIPTION

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Source: [Facebook](#)



Map: A. Durso, Institute of Global Health, UNIGE

Largest global and dynamic open dataset of snake photos

368 observations

CC

Mohave Rattlesnake
(*Crotalus scutulatus*)

309 observations

CC

Prairie Rattlesnake
(*Crotalus viridis*)

329 observations

CC

Red Diamond Rattlesnake
(*Crotalus ruber*)

229 observations

©

Scarlet King Snake
(*Lampropeltis elaps*)

257 observations

CC

Sidewinder
(*Crotalus cerastes*)

227 observations

CC

Speckled Rattlesnake
(*Crotalus mitchellii*)

142 observations

CC

Terciopelo
(*Bothrops asper*)

116 observations

CC

Eyelash Viper
(*Bothriopsis schlegelii*)

111 observations

CC

Western Massasauga
(*Sistrurus tergeminus*)

99 observations

©

Tiger Keelback
(*Rhabdonhis tigrinus*)

What is the biting snake?,
is it venomous?, what type of
venom and what clinical
manifestations to anticipate?

- Snake identification is key for **adequate clinical management**
- Snake identification is **complex** and health professionals are **not herpetologists**



WHO:

“Out of more than **3000 species of snakes** in the world, some **600 are venomous** and over **200 are considered to be medically important**”

368 observations

Mohave Rattlesnake
(*Crotalus scutulatus*)

369 observations

Prairie Rattlesnake

283 observations

Red Diamond Rattlesnake

279 observations

Texas Coral Snake

257 observations

Sidewinder
(*Crotalus cerastes*)

227 observations

Speckled Rattlesnake
(*Crotalus mitchellii*)

142 observations

Terciopelo

(*Bothrops asper*)

116 observations

Eyelash Viper

(*Bothriopsis schlegelii*)

111 observations

Western Massasauga

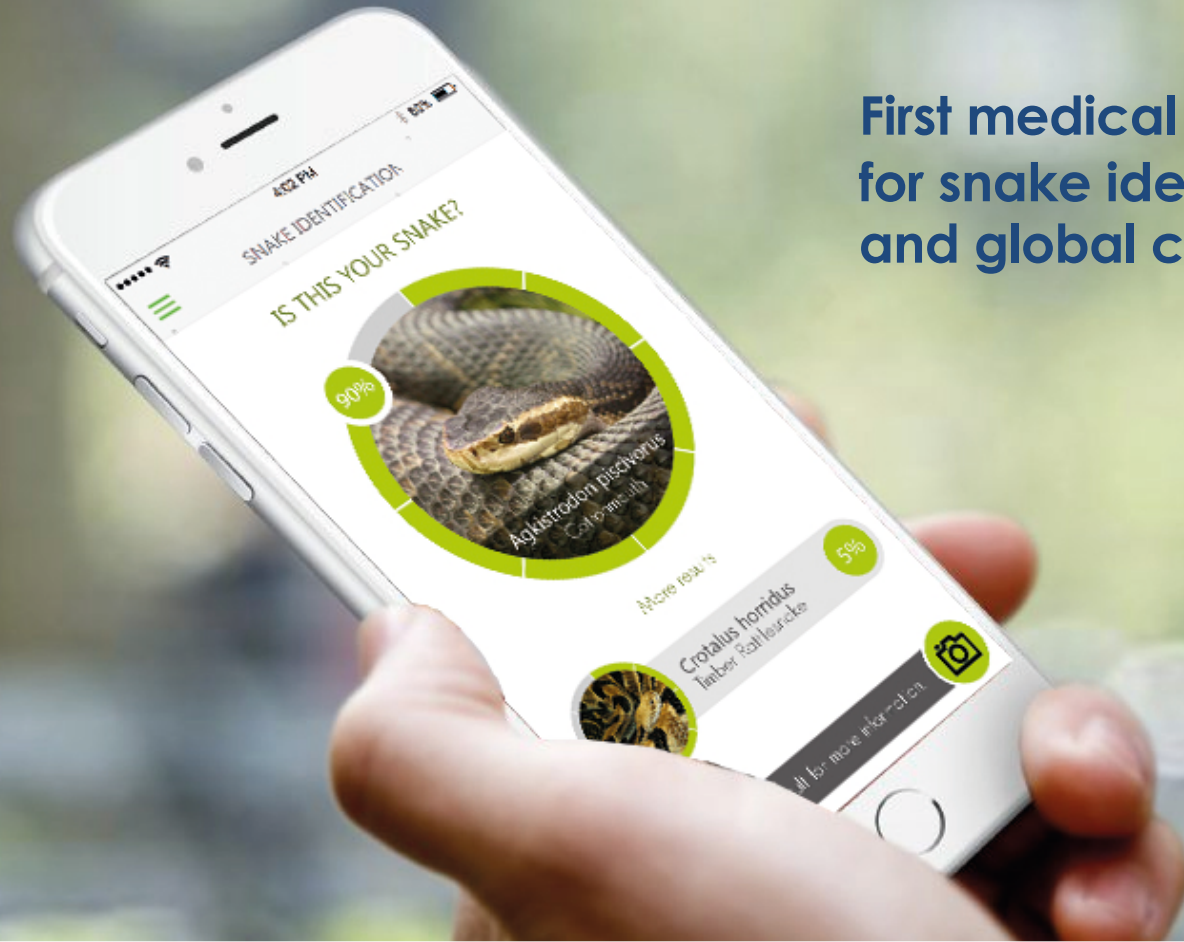
(*Sistrurus termonius*)

99 observations

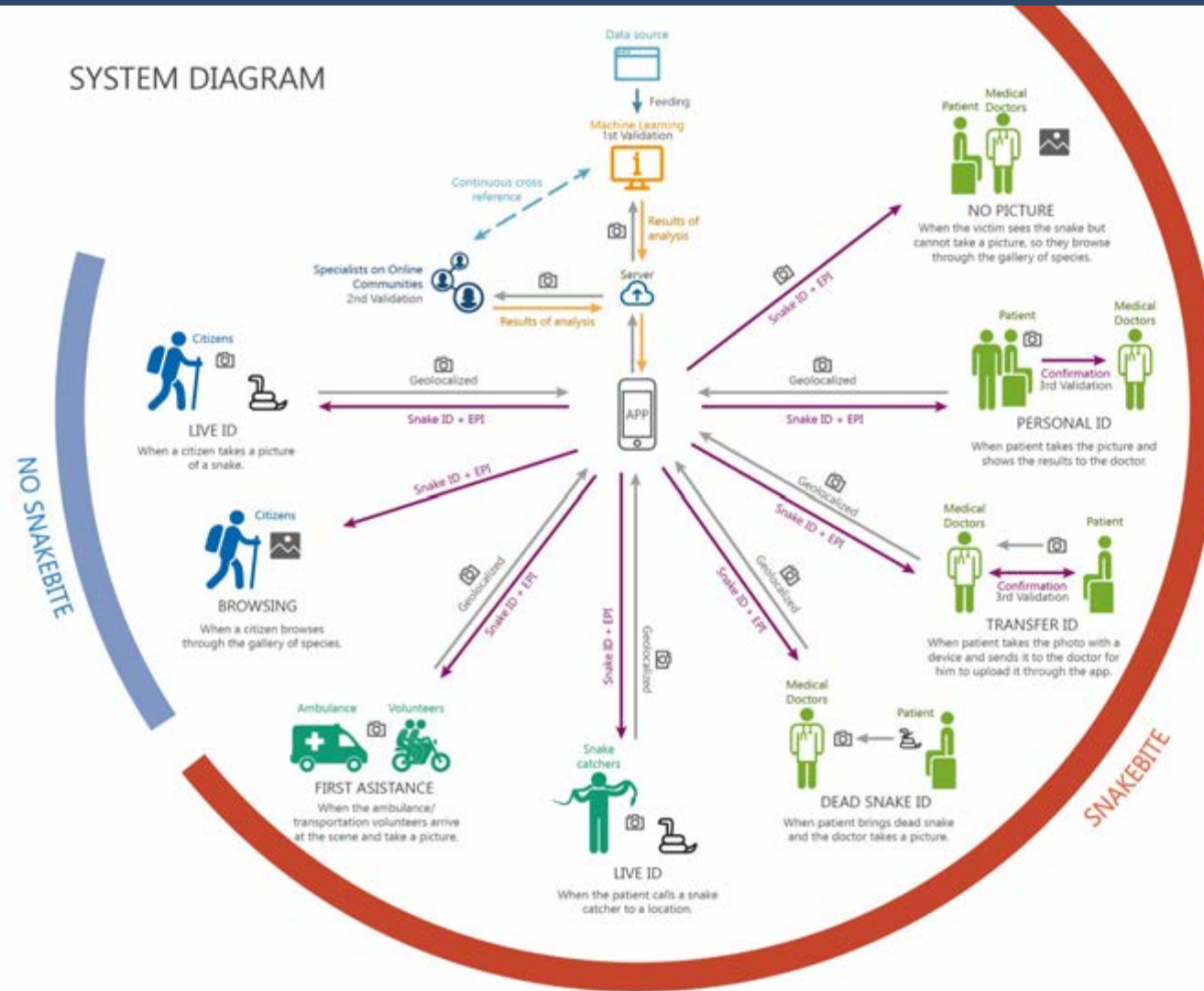
Tiger Keelback

(*Rhabdophis tigrinus*)

First medical decision-support tool
for snake identification based on AI
and global collaborative expertise



SYSTEM DIAGRAM

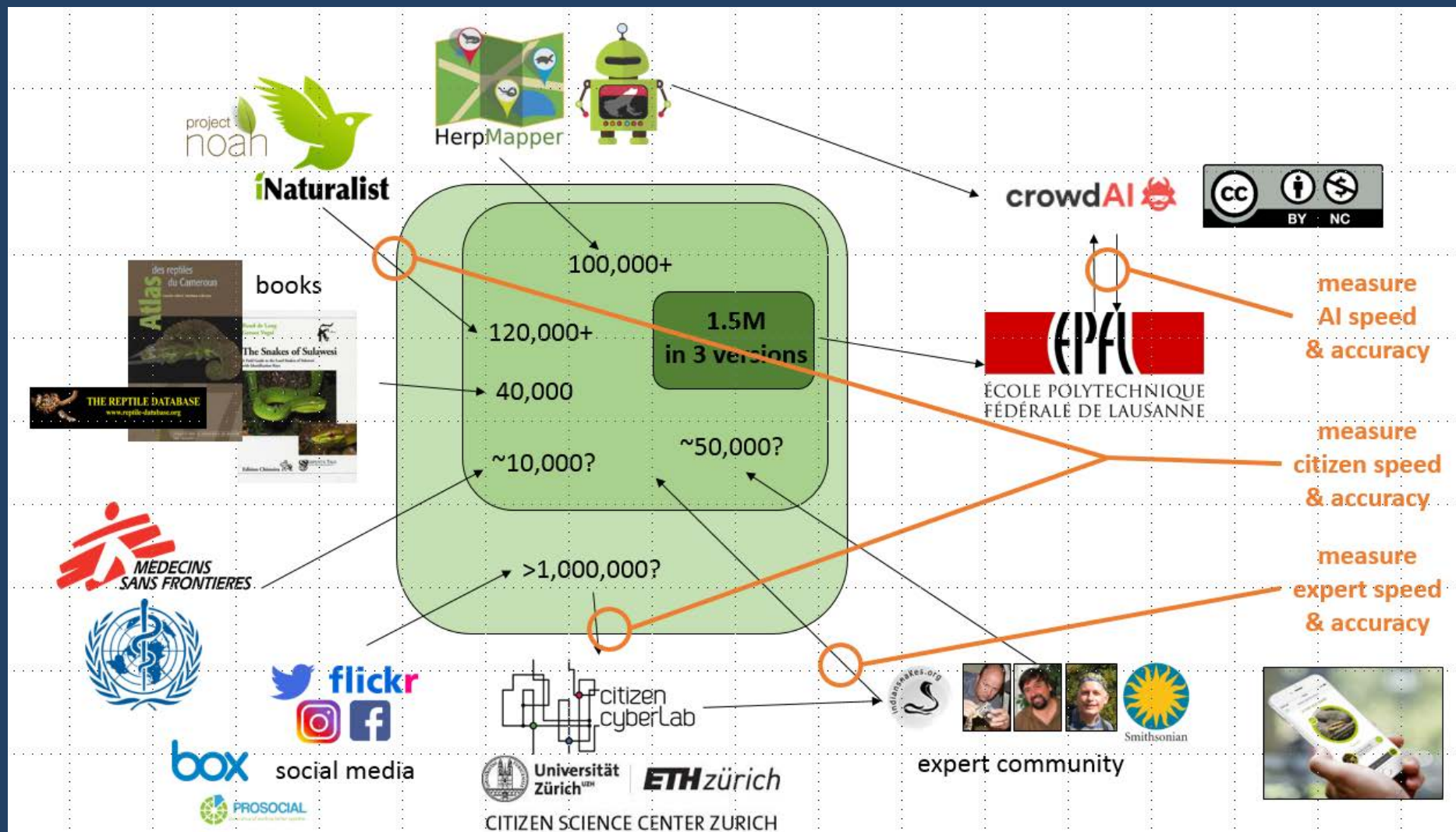


Source: Snapp team – SDG Summer School 2017, Geneva-Tsinghua Initiative



Diversity of possible scenarios:

- Field and clinical scenarios identified with experts and to be tested
- Although not recommended, killing the biting snake and carrying to the health centre is a common practice in many areas of the world (e.g. Myanmar over 60% of snakebite)



Source: Andrew Durso

Crowdsourcing AI to solve real-world problems

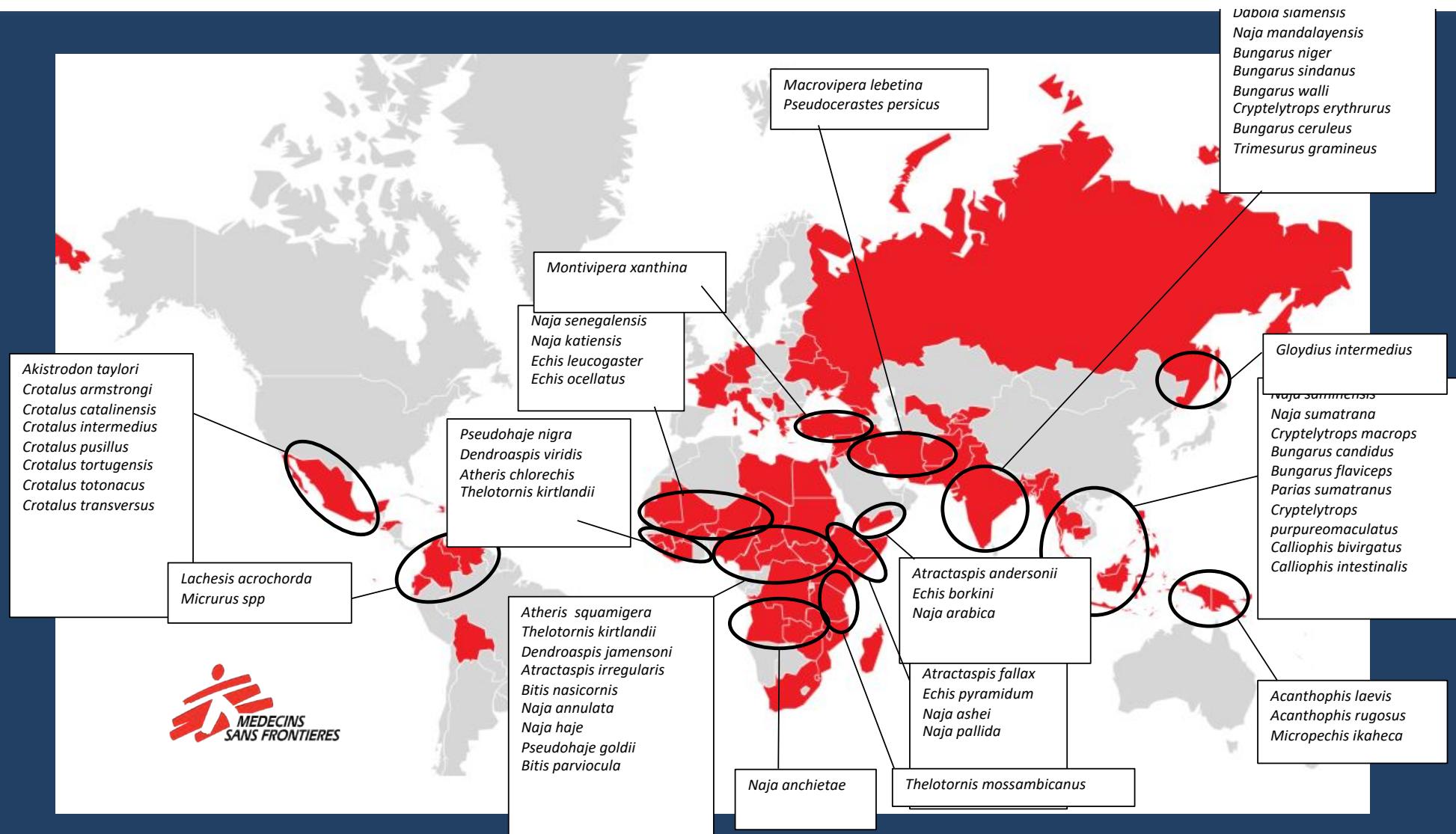
crowdAI enables data science experts and enthusiasts to collaboratively solve real-world problems, through challenges.

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Map: Dr. Gabriel Alcoba

Thank you! Danke!

Acknowledgements: Dr. Isabelle Bolon, Dr. A. Durso, Dr. Gabriel Alcoba, Dr. A. Tamrat, Mrs. H. Eptsein, Dr. Nicolas Ray, Prof. François Chappuis, Prof. David Williams, Mr. Jose Louies, Prof. François Grey, Dr. Rosy Mondardini, Dr. Jose Luis Fernandez, Prof. Brian Lohse, Mr. Mohanty Sharada, Ms Camille Montalcini, Prof. Marcel Salathé, Dr. Sanjib Sharma, Mr. Mamit Rai, Dr. Franck Wanda, Dr. Armand Nkwesch, Prof. Antoine Flahault.

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