



# Toxicology in the news

**Skin manifestations occur after being bitten by venomous animals**

**"Some of these images contain patients' personal information and should not be further disseminated to respect patient privacy."**







# Local reaction



รูปภาพจาก case consultation ศูนย์พิษวิทยา รามา



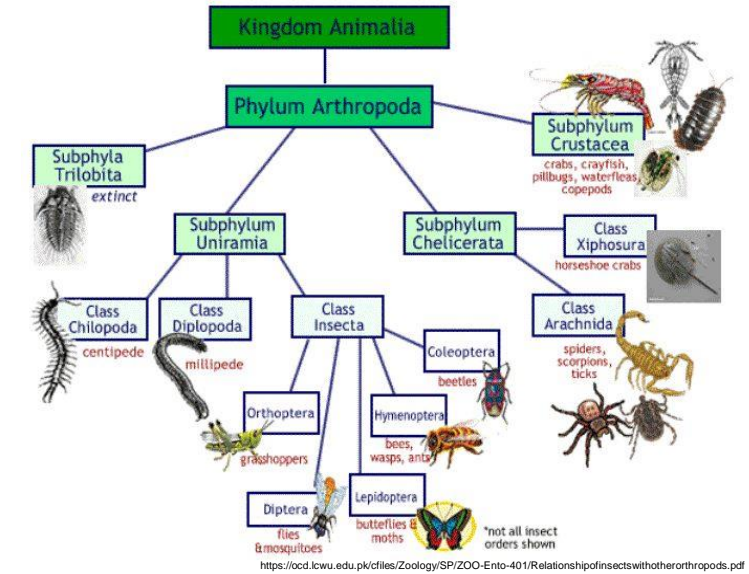


# Introduction

- WHO estimates that a million people in the United States got bitten by animals each year.
- **Animal bites are responsible for 1% of emergency hospital visits.**
  - In the United States, dogs and cats are responsible for 80-90% of animal bites cases.
  - 10–15% of animal bites cases are caused by snakes, while other animal bites, such as rabbits, hamsters, rats, insect, and monkeys, contribute to 1–2%.

# Introduction

- Although many tropical insects carry infectious diseases, cutaneous injury can occur by other mechanisms.
- Ants and insects can cause painful bites and stings.
- **Anaphylactic shock and death** can result from the venom of bees and wasps.
- **Common Paederus dermatitis**
  - Toxin called *paederin*





# Infectious Complications of Bite Injuries

- Skin and soft tissue infection is the **most frequent complication** following a bite injury.
- Polymicrobial and are caused by aerobic and anaerobic microorganisms comprising the oral flora of the perpetrator.
- **Management**
  - **Irrigation and debridement** are the mainstays of bite injury management.
  - Administration of preemptive antibiotic therapy is **controversial** and generally is recommended for high-risk injuries or injuries occurring in patients at high risk for infection.
  - The risk for tetanus and rabies transmission **should be considered in** patients sustaining an animal bite.

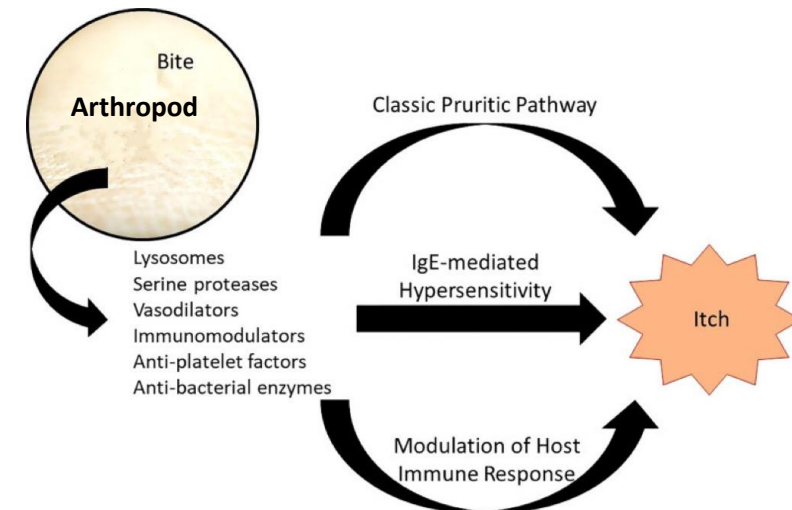
# Pathophysiology:

## Local reaction of arthropod bites and stings

- **Allergic responses to arthropod salivary antigens contribute to the development of localized and systemic rashes**
  - Erythematous and edematous eruptions along with other dermatological findings papules and urticaria represent the most common finding
- **Some arthropods can deliver toxic venom**
  - After histamine release from IgE-mediated hypersensitivity, in which IgE primed against saliva components crosslinks with mast cells, causing degranulation
  - Histamine also instigates local vasodilation and edema, causing wheal formation



<https://www.ausmed.com/learn/articles/rashes>





# Arthropods : Skin manifestations

- **Chilopoda: Centipedes**

- The primary components include histamine, serotonin, acid and alkaline phosphatase
- Two hemorrhagic punctures accompanied by surrounding erythema and swelling

- **Diplopoda: Millipedes**

- The primary components include hydrogen cyanide, cresols, phenol, benzoquinones, and hydroquinones
- The toxin produces a localized caustic-like effect accompanied by erythema and occasionally vesicle formation
- Development of a localized area of hyperpigmentation, usually brown or black, which may last for months

- **Insecta: Hymenoptera (bees, wasps, hornets and fire ants)**

- The primary components include bradykinin, acetylcholine, histamine and serotonin
- Localized swelling, blisters or bruising forms

- **Arachnids: spiders, scorpions, mites, and ticks**



**Fig 2.** Millipede. Diplopoda can cause lesions in humans with initial inflammation and marked pigmentation. Photograph courtesy of Vidal Haddad, Jr, MD.



**Fig 3.** Centipede. Envenomation by Chilopoda. Note the erythema and the small perforation. Photograph courtesy of Vidal Haddad, Jr, MD.

CLINICAL RESEARCH



## Patients with centipede bites presenting to a university hospital in Bangkok: a 10-year retrospective study

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### ABSTRACT

**Introduction:** Centipede envenomation occurs commonly in tropical and subtropical countries. In most cases, centipede envenomation causes benign clinical manifestations. Serious complications are reported occasionally. Clinical studies regarding centipede envenomation are limited to case reports and case series. This study aimed to determine the prevalence and clinical characteristics of centipede bites in Bangkok, Thailand.

**Methods:** This was a retrospective medical record review study. We included patients who were clearly envenomated by a centipede presenting to the emergency department of a tertiary university hospital in Bangkok from January 1, 2006, to December 31, 2015. Data were collected on demographics, details of the exposure, signs, symptoms, treatment, and complications of envenomation.

**Results:** A total of 245 cases were included. The prevalence of centipede bite was 0.0367%. The majority were female (56.7%). The median age was 34.6 years (range: 1 month to 90 years). The number of envenomations was highest from October through December. Feet (38.3%) and hands (19.1%) were the parts of the body most often envenomated. Local effects were common with 99.5% of patients having localized pain and 87% having local swelling at the bite site. In terms of systemic effects, urticarial rash (5.7%) and fever (4.1%) were most frequently observed. Twelve cases (5%) had clinical pictures compatible with anaphylaxis. For pain management, all patients who had pain received analgesic drugs, while 29.7% were injected with local anesthesia. Antibiotics, antihistamines, and steroids were prescribed in 53.9%, 20.4%, and 10.2% of cases, respectively. No deaths occurred in this study.

**Conclusions:** Even though the location of our hospital is in a metropolitan city in Thailand, there were centipede bites every month, especially during the last three months of each year. Nearly all patients had local effects. In contrast, serious complications such as anaphylaxis and systemic infection only occurred occasionally.

### ARTICLE HISTORY

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### KEYWORDS

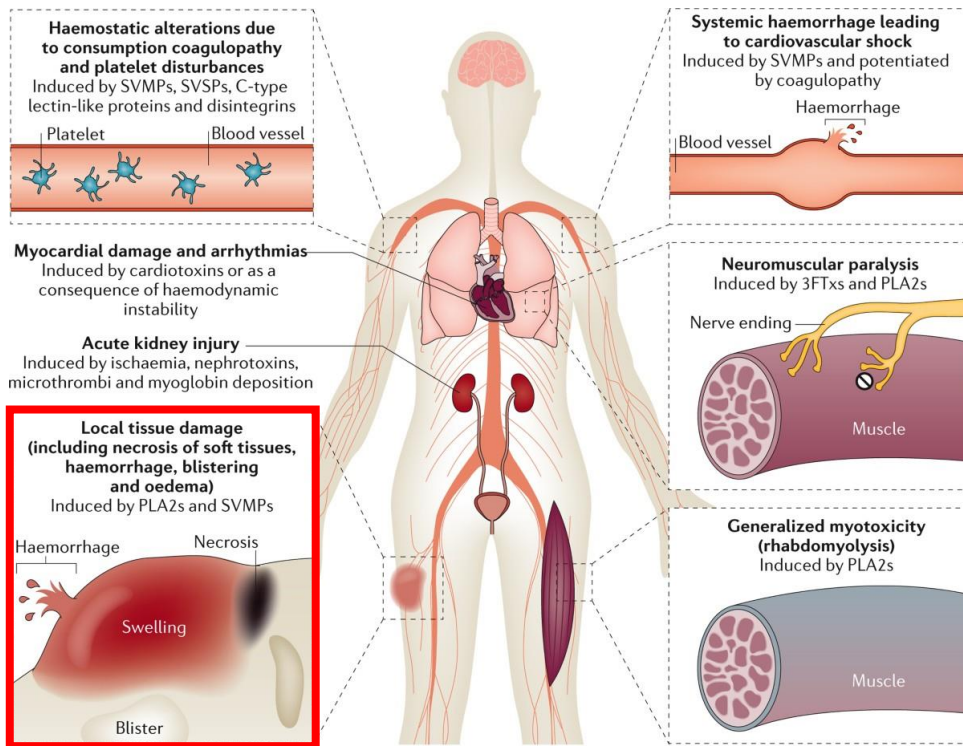
Centipede envenomation;  
scolopendra; systemic  
effects; anaphylaxis;  
infection



**Table I.** Management of injuries from Diplopoda, Chilopoda, and Arachnida

Arthropod class	Injurious components in venom/ mechanism of injury	Signs and symptoms	Management
Chilopoda (centipedes)	Metalloproteases (bite)	Erythema, edema, and pain	Wash site, cold compresses, and analgesics
Diplopoda (millipedes)	Cyanide and quinones (contact)	Erythema, pigmentation, and blindness	Wash site and topical alcohol
Arachnida (spiders)	Brown recluse— sphingomyelinase D (bite); tarantula—activation of capsaicin receptor (bite), allergic response (contact)	Brown recluse—ischemia, marble plaque, bullae, necrosis, eschar, and ulcer; tarantula—dermatitis, conjunctivitis, pain, and pruritus	Brown recluse—antivenom and sulfone; tarantula—topical corticosteroids and oral antihistamines
Arachnida (scorpions)	Tityustoxin, hemicalcin, and a complex mixture of basic proteins (sting)	Erythema, purpura, bullae, necrosis, ulcers, pain, nausea, vomiting, coughing, wheezing, heart failure, pulmonary edema, tremors, shock, and death	Local anesthetics, antiserum, and cardiopulmonary life support
Arachnida (mites and ticks)	Antigen activation of immunoglobulin E—driven T <sub>H</sub> 2 response (contact)	Erythema, edema, papules, pruritus, and secondary bacterial infection	Topical corticosteroids, oral antihistamines, and antibiotics for infections

# Pathophysiology : Local reaction of snake venom



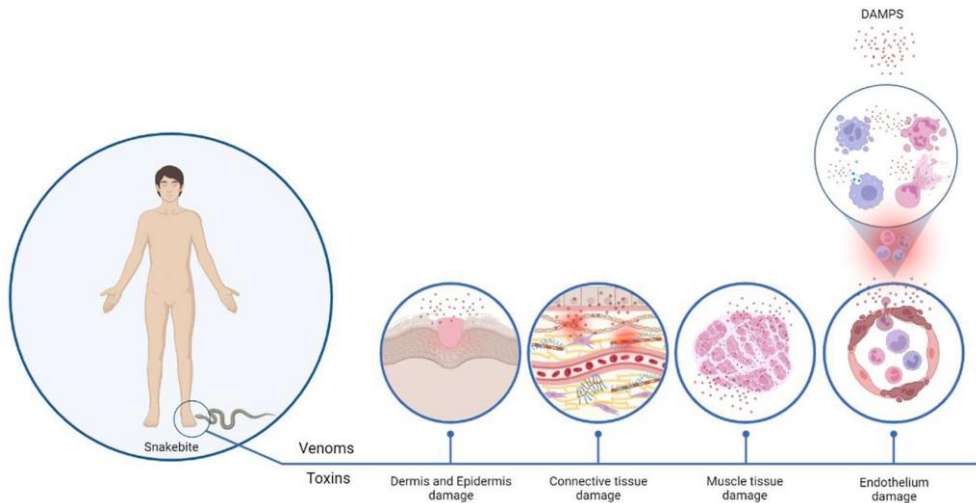
Nature Reviews | Disease Primers

- **Snake envenomation, venom components**
  - Phospholipases A2
  - Metalloproteases (SVMP), directly contribute to local and systemic inflammatory responses.
  - Hyaluronidase
  - Serine proteinases (SVSP)
  - L-amino acid oxidases (LAAO)
  - Lectins
  - 3-finger toxins (3-FTX)
- **Extensive local inflammatory process were both tissue and cells can release endogenous alarmins, that are chemotactic immune-activating**
  - Local tissue edema, blistering, and tissue necrosis and promotes the spread of venom through tissues and proteolytic enzymes will increase vascular permeability which causes oedema, blistering, bruising and necrosis at the site of the bite



# Pathophysiology :

## Local reaction of snake venom



- **Phospholipase A2 is a common component of snake venom and causes local tissue damage** acts as a direct vasodilator by acting on smooth muscle to cause dilation of blood vessel
  - Leukotriene B4 (LTB4)
  - Prostaglandins E2 (PGE2)
- The defense against tissue damage start from keratinocytes and mast cells, which are present in nearly all vascularized tissues
- Mast cells can degranulate and secrete histamine and trigger synthesis of cytokines, chemokines, and eicosanoids/lipid mediators, which attract and activate other effector immune cells.
- Histamine is a mediator of inflammation that strongly increases vascular permeability and contributes to the release of other mediators to induce edema formation
- Mast cell degranulation and the release of mediators such as histamine with the involvement of H1, H2, H3/H4 receptors, prostaglandins, and leukotrienes play a role in this venom-induced edema, which is then downregulated by nitric oxide (NO).





# Venomous Animals











**Mosquito ??**

**1.YES**

**2.NO**

# **Black fly fever**

- Fever, leukocytosis, lymphadenitis, papular lesions



A 45-year-old man was admitted because of acute edema involving the right hand.

The patient complained of severe pain, fever (38.4°C), and general malaise.

**Snake ??**

**1.YES**

**2.NO**



**A****B**







## **Ig E mediated allergic reaction**

- *Sco m 5*

## **Pain**

- TRPV1

The first pair of legs has been modified into 2 sharp stinging structures connected to muscular venom glands



The patient presented with severe chest wall pain and diaphoresis of the left arm following an **unknown animal bite**.





**A**

**VS**



**B**

# *Latrodectus*





- The typical black widow bite consists of a blanched circular patch with a surrounding red perimeter and a central punctum.
- **Target lesion** may be seen in up to 50 percent of cases.
- **Local diaphoresis** and lymphadenopathy may also be present.

Black widow bites do **not become necrotic** and secondary infection with cellulitis or abscess is also rare.



Target appearance

### Lyme disease: erythema migrans

This resource had been produced to support NICE's guideline on Lyme disease [www.nice.org.uk/guidance/NG95](http://www.nice.org.uk/guidance/NG95)



Figure 1. Small erythema migrans lesion on arm with a central clearing and 'bull's eye' (© LDA)



Figure 2. Large erythema migrans lesion on leg with a central clearing and 'bull's eye' (© LDA)



Figure 3. Large erythema migrans lesion on leg with faint 'bull's eye' (© LDA)



Figure 4. Large erythema migrans lesion under the arm without a central clearing (© LDA)



Figure 5. Large erythema migrans lesion on child's leg without a 'bull's eye' (© LDA)



Figure 6. Multiple erythema migrans lesions on back (© PCDS)

## **$\alpha$ -Latrotoxin**

- Stimulates neurotransmitter and hormone release from secretory cells
- $\text{Ca}^{2+}$  -independent secretion
  - Glutamate, GABA and acetylcholine
- $\text{Ca}^{2+}$  -dependent secretion
  - Catecholamines



	<i>Latrodectus hasselti</i>	<i>Latrodectus mactans</i>	<i>Latrodectus curacaviensis</i>	<i>Latrodectus indistinctis</i>	<i>Latrodectus geometricus</i>	<i>Latrodectus mactans</i>	<i>Latrodectus tredecimguttatus</i>
Number of bites	68	163	77	30	15	89	56
Study design	Pr, PIC	R, ED	R	R	R	R	Pr, ED
Positive identification	100%	72%	75%	20%	67%	..	..
Pain							
Local pain*	100%	38%	56%	67%	93%	91%	90%
Radiating pain to limb	38%	18%	41%	57%	7%	..	..
Abdominal pain	9%	17%	17%	67%	27%	53%	35%
Chest pain, constriction	6%	4%	10%	30%	0%	..	14%
Back pain	..	56%	..	47%	7%	..	45%
Diaphoresis	34%	22%	28%	70%	..	70%	55%
Systemic effects							
Nausea	24%	11%	..	17%	0%	..	12%
Vomiting	4%	11%	5%	17%	0%	..	..
Headache	10%	9%	8%	21%	0%	..	12%
Abdominal rigidity	..	..	..	70%	7%	45%	..
Hypertension	1%	29%	4%	..	0%	17%	..
Agitation, irritation	..	..	14%	50%	13%	44%	..

Pr=prospective study. R=retrospective study. ED=emergency department study. PIC=Poisson centre study. \*In most studies, local pain seems to refer to persistent or severe pain only, rather than any discomfort of the bite (initial or persistent), which differs from the prospective study in Australia.<sup>29</sup>

**Table: Summary of clinical effects of widow spider bites from different regions of the world<sup>29,31-35</sup>**



# “Latroductus facies” or “facies latroductismica.”

Grimacing  
Masseter trismus  
Rhinitis  
Conjunctivitis  
Sweating





Do we have **black widow spiders** in Thailand?

**1. YES**

**2.NO**



A 45-year-old man with no medical history was bitten by unknown animal at his left lower limb.

**What type of animal bit the patient?**



A 45-year-old man, living in a rural area, was sleeping at night and felt an itching and burning sensation in his lower lip

**Snake ??**

**1.YES**

**2.NO**

Five days after the accident



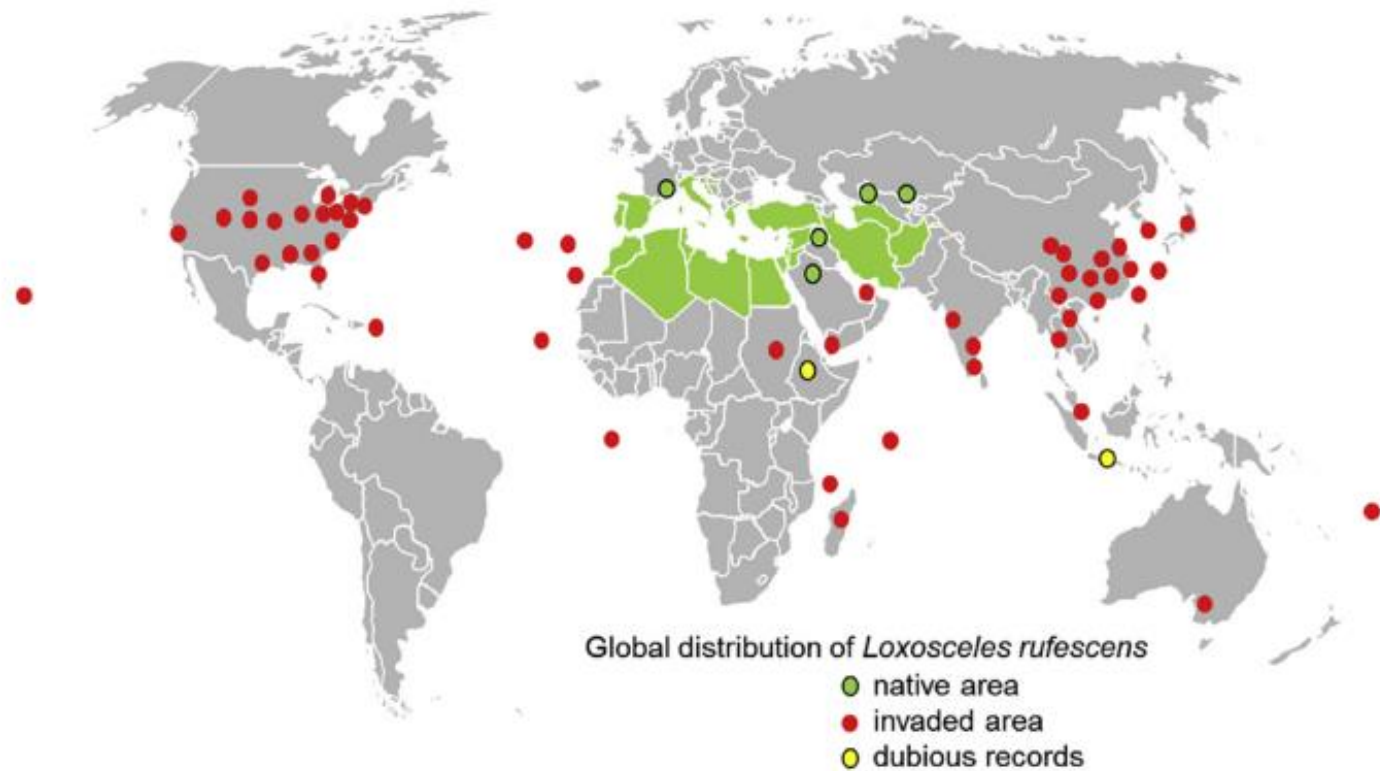


*Loxosceles*



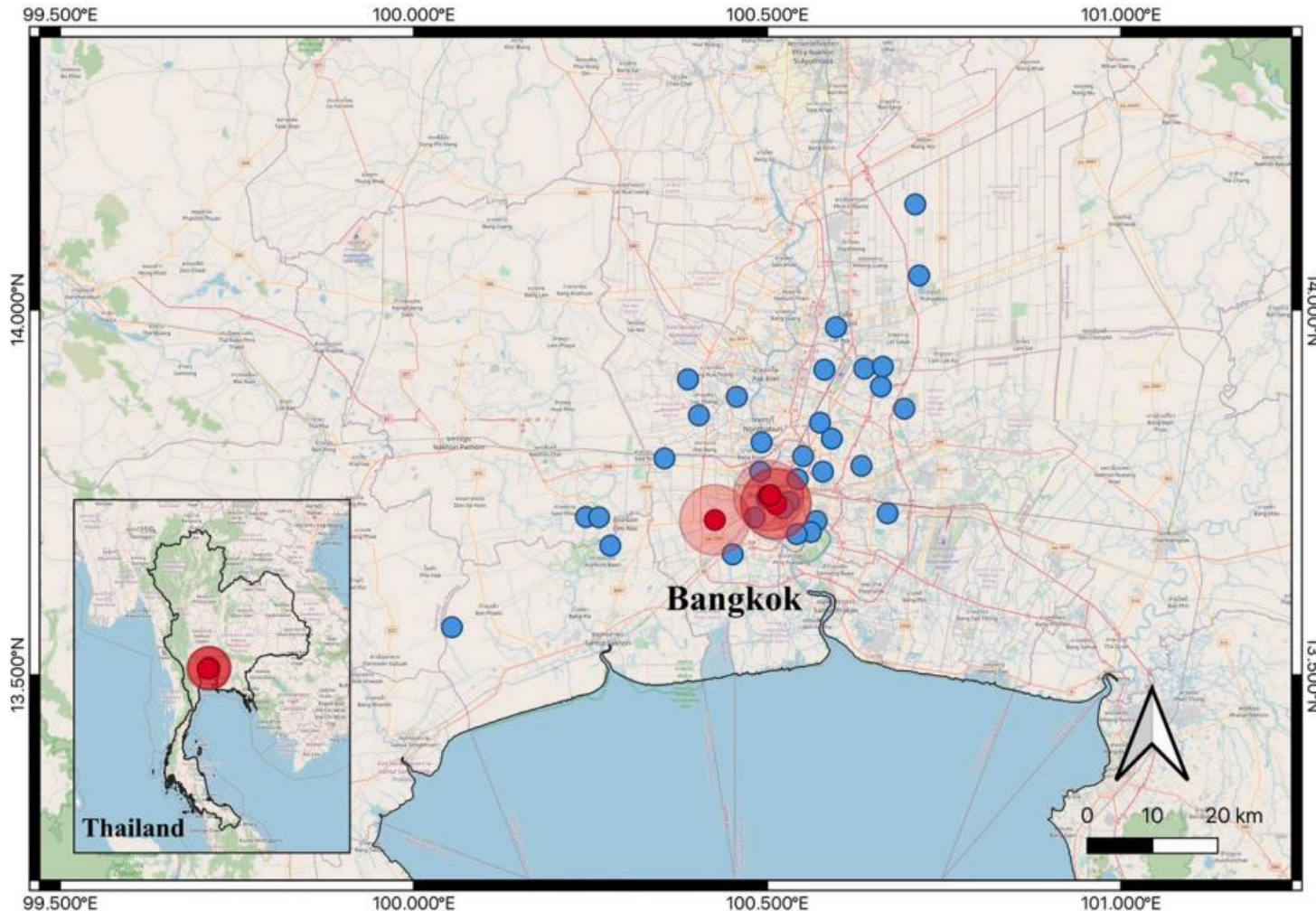
### Non-verified deadly *L. rufescens* bites

- In 2014, a man in Thailand reported to have been bitten by a spider (**first identified as *L. reclusa***), died three weeks later (Bangkok Post, 2014).
- In the Thai media, Choomphuphuang mentioned the “**deadly Mediterranean recluse spider**” for the first time recorded for Thailand (Chiangrai Times, 2016) which was occasionally condensed to *L. rufescens* being responsible for one fatality in Thailand.
- The Mediterranean *L. rufescens* has been recently recorded for one location in a **cave in a remote part of southwestern Thailand**.



# Phylogenetics and species delimitation of the recluse spider, *Loxosceles rufescens* (Araneae: Sicariidae) populations invading Bangkok, Thailand

Narin Chomphuphuang<sup>a,b,\*</sup>, Chalermkiat Leamyongyai<sup>b</sup>, Chaowalit Songsangchote<sup>a,b</sup>, Kanyakorn Piraonapicha<sup>c</sup>, Nirun Pojprasat<sup>b</sup>, Paveen Piyatrakulchai<sup>b,d</sup>



The highest density was recorded in a storage house on **Yaowarat Road**, located in the heart of Bangkok's Chinatown, where 315 individuals were found, including adults, juveniles, and spiderlings.





## **Loxtox - phospholipase D**

- Dermonecrosis and hemolysis

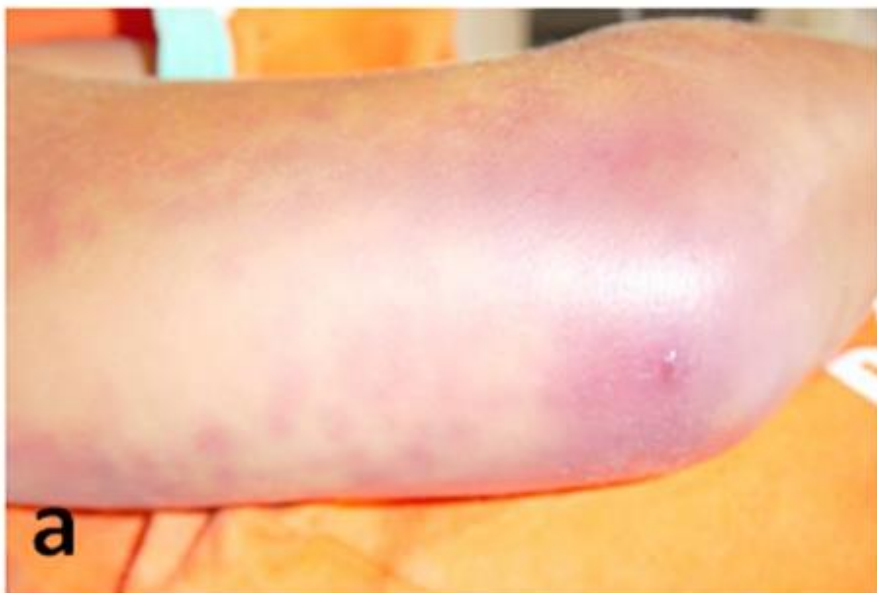
## **Metalloproteases**

- Cellular apoptosis

## **Sphingomyelinase D**

- Lipid hydrolysis, paralysis of the prey

- Brown spider bites - a classical well-known picture of necrotic skin lesions with **gravitational spreading** that is the hallmark of envenomation.
- **2-8 h.** - the initial bite is relatively painless
- **12-24 h.** - appearance of a bleb or blister surrounded by a halo of ischemic tissue and the bleb may become hemorrhagic.
- **> 24h.** - the necrotized lesions become a fixed dull blue-violet color, with a characteristic gravitational spread and, consequently, the blue area increases and eschar formation.



**a** White, red, blue sign 21 h after the accident.

**b** Blisters with hemorrhagic content 68 h after the accident.

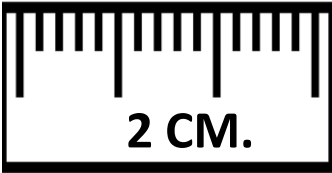
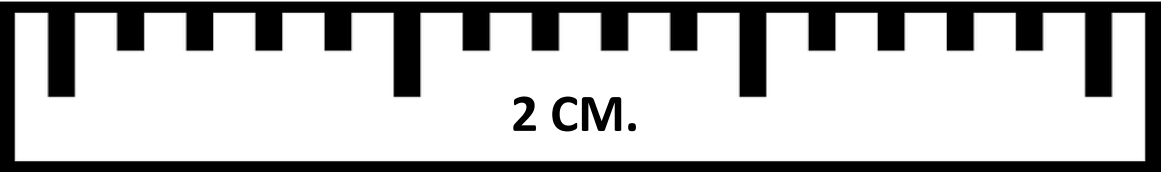
**c** Leakage of blister content; hyperemic and hemorrhagic area 96 h after the accident.

**d** Necrotic lesion 7 days after the accident.



Small puncta

A



B



# NOT RECLUSE—A Mnemonic Device to Avoid False Diagnoses of Brown Recluse Spider Bites

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Department of Dermatology, University of Missouri Health Sciences Center, Columbia.

**The notoriety** of the brown recluse spider, *Loxosceles reclusa*, has resulted in many dermatological conditions being misdiagnosed as the bite of this arachnid. These misdiagnoses occur throughout North America and are of concern especially in American states and Canadian provinces where no brown recluse populations are known to exist.

About 40 medical conditions have been or could be misdiagnosed as recluse bites. A sampling of these misdiagnoses includes infections caused by *Staphylococcus aureus*, *Bacillus anthracis*, *Borrelia burgdorferi*, *Sporothrix schenckii*, the herpes zoster virus, and even lymphoproliferative conditions such as lymphomatoid papulosis.<sup>1</sup> Because past medical reports of loxoscelism often did not adhere to the principles of evidence-based medicine, these erroneous reports artificially increased the list of signs associated with loxoscelism, decreasing diagnostic accuracy.

As most patients cannot find an offending spider, and a diagnostic recluse venom test is only recently available, loxoscelism is typically diagnosed clinically. Considering the abundance of recluse bite misdiagnoses still being reported, the medical community would benefit

## T - Timing

Credible bites outside the April to October recluse activity season in North America are unlikely.<sup>3</sup> Uncommonly, recluses may be encountered when disturbing secluded areas during the winter holiday season.

## R - Red Center

Recluse venom causes immediate destruction of the capillary bed with resulting ischemia. Thus, the central area of a recluse bite will be pale, blue-white, or purple and only rarely, with mild bites, will be red. (Peripherally, erythema due to cytokine response<sup>4</sup> is routinely observed.) Differential diagnoses: a lesion with an inflamed red central area is more likely another arthropod bite or sting, streptococcal cellulitis, or even an uncommon bacterial infection such as anthrax.

## E - Elevated

Recluse bites are flat or slightly sunken. A central lesion area raised more than 1 cm above the normal skin is not a recluse bite; any elevation makes a recluse bite unlikely. Differential diagnoses: a raised area is more likely

Figure. *Staphylococcus* Infection Misdiagnosed as Loxoscelism by a General Practitioner



Elevated, crusted ulcer with rapid onset and exudative pus.

## E - Exudative

Recluse bites are not initially exudative,<sup>2</sup> moist, or purulent (exceptions: bites on eyelids and toes); although, at the bite site, a small blister filled with clear or reddish fluid may manifest. Pus formation indicates bacterial infection and is the first negative sign excluding a loxoscelism diagnosis.<sup>3</sup> Additionally, it has been strongly argued that spiders do not vector bacteria.<sup>7</sup> Differential diagnoses: if a wound exudes pus, then bacterial infection, particularly *S aureus* (Figure), should be considered with a nonspider etiology. If a weeping wound extends deep to the subcutaneous fat, pyoderma gangrenosum can be suspected, especially on lower extremities.

If 2 or more of the NOT RECLUSE signs are present, a recluse bite is even less likely. As Philip Anderson, MD, noted after studying over 1000 loxoscelism cases, "None are nodular or red in the center like wasp stings."<sup>2</sup> Another common combination is red and exudative; previously, we remarked upon seeing infection diagnosed as loxoscelism in Canada that it was "too red, too wet" (Richard S. Vetter, MS, oral communication, 2004) to be a recluse spider bite. In our experience, the most common condition misdiagnosed as a recluse spider bite is *S aureus* infection which may show multiple NOT RECLUSE signs such as the crusted, purulent, elevated lesion in Figure.

## Summary

Alternate diagnoses for recluse bites include critical, urgent dis-

## VIEWPOINT

# NOT RECLUSE—A Mnemonic Device to Avoid False Diagnoses of Brown Recluse Spider Bites

## N - Numbness

A typical recluse bite often results from a defensive response when a spider is compressed or crushed. Occasionally 2 bites may occur. Contemporaneous widely separated dermonecrotic lesions are a highly unlikely result of recluse bites. Differential diagnoses: multiple lesions indicate contagious bacterial infection, herpes zoster, pyoderma gangrenosum, poison ivy or poison oak, and arthropod bites (eg, fleas, bedbugs, and various mites).

## O - Occurrence

The most common circumstance surrounding occurrence of a recluse bite involves disturbance of a secluded recluse spider. Often it may be hiding in a box in a closet, attic or garage, or in clothing long unused or left on the floor. Alternately, the recluse may have crawled into a bed; upon awakening, the sleeper notices the lesion. Differential diagnoses: lesions occurring after gardening suggest sporotrichosis.

## L - Large

The most dynamic recluse bites typically do not exceed 10 cm.<sup>5</sup> Although peripheral erythema may extend several times this distance from the injury, there is no credible documentation of very large areas of necrosis. Recluse venom appears to cause a deeper and more severe reaction in morbidly obese people, likely due to circulatory insufficiency in adipose tissue. Differential diagnoses: a wound more than 10 cm wide suggests pyoderma gangrenosum.

## U - Ulcerates Too Early

Recluse bites do not typically ulcerate until 7 to 14 days postenvenomation. Differential diagnoses: if ulceration (or crusting) occurs within 7 days, consider infection or pyoderma gangrenosum for ulceration, or anthrax for crusting.

Dr. Vetter provides expert testimony and has authored spider books and online medical pages for which he receives royalties. Dr. Dyer has received research support from SpiderTek.

## REFERENCES

- Swanson DL, Vetter RS. Bites of brown recluse spiders and suspected necrotic arachnidism. *N Engl J Med*. 2005;352(7):700-707.

cytokine-driven pain. *JAMA Dermatol*. 2014;150(11):1205-1208.

- Sams HH, Heath SB, Long LL, Wilson DC, Sanders DH, King LE Jr. Nineteen documented

Do spiders vector bacteria during bites? the evidence indicates otherwise. *Toxicon*. 2015;93:171-174.

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ล้สสุด

**Is this a wound from spider bite?**

**1.YES**

**2.NO**



# PAIN

Loxosceles



**A**



**B**

Cutaneous Anthrax

# SWELLING



ลุ่มทราวจี๋เออแอนแอทรกั๋  
เผื่อะวังเสียงทั้งจำบด!!







A 45-year-old woman was admitted because of acute edema involving the left leg.

**What type of snake bit the patient?**

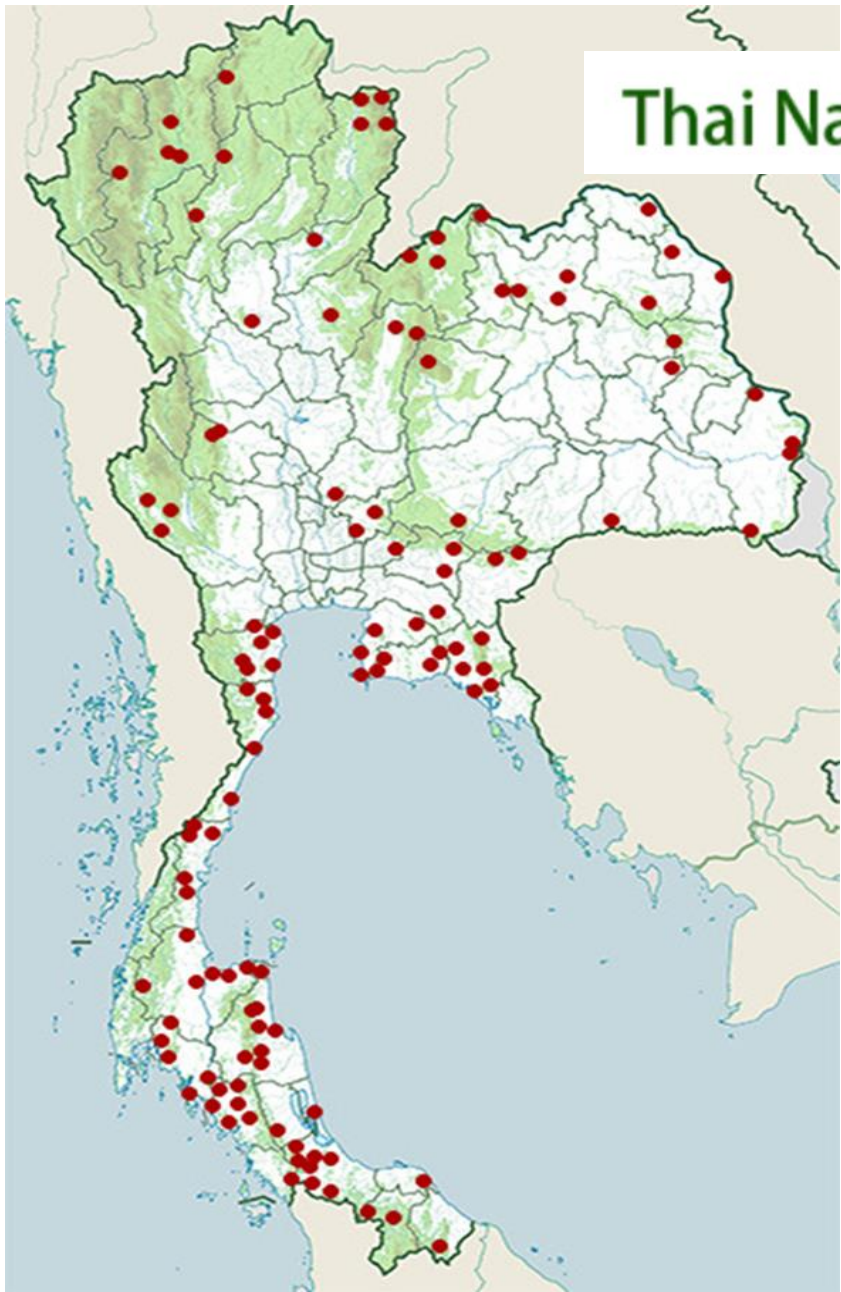


**What type of snake bit  
the patient?**

**Geographic distribution**







Thai National Parks 

2.NO

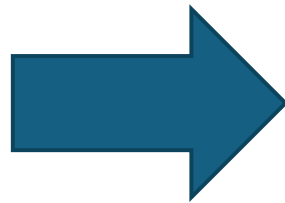
Range map of *Calloselasma rhodostoma* in Thailand



**Which type of antivenom should be used in this patient?**



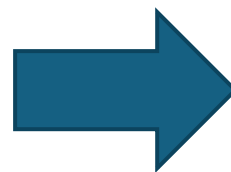
แผลแรกเริ่ม 14.20น.



แผลหลังงูกัด 6hr (20.00น.)



20/5/67 20.40



21/5/67 ~05.00

## Rhodostoxin

- Local necrosis

## Hemorrhagic metalloproteinases

- Local hemorrhage

The incidence of tissue necrosis was high (**95% prospective, 94% retrospective**), but severe necrosis was less common.






**Which type of antivenom should be used in this patient?**

**1.Cobra**

**2.MPV**

Article

# A Retrospective Cohort Study of Cobra Envenomation: Clinical Characteristics, Treatments, and Outcomes

Phantakan Tansuwannarat <sup>1,2</sup>, Achara Tongpoo <sup>2</sup>, Suraphong Phongsawad <sup>1</sup>, Charuwan Sriapha <sup>2</sup> ,  
Winai Wananukul <sup>2,3</sup> and Satariya Trakulsrichai <sup>2,4,\*</sup>

**Local swelling (68.0%), local necrosis (21.04%), skin necrosis (33.8%), Necrotizing fasciitis (9.7%), Cellulitis (54.7%).**

**Onset of Neurotoxicity:** The median time from bite to onset of neurological symptoms was 1 hour (range: 10 minutes to 24 hours).



## Taiwan Cobra (***Naja atra***)

- *Enterococcus faecalis* and *Morganella morganii*

## Vietnam (***Naja atra***, ***Naja kaouthia***, and ***Naja siemensis***)

- *Morganella morganii* and *Enterococcus faecalis*





**Is this a wound from snake bite?**

**1.YES**

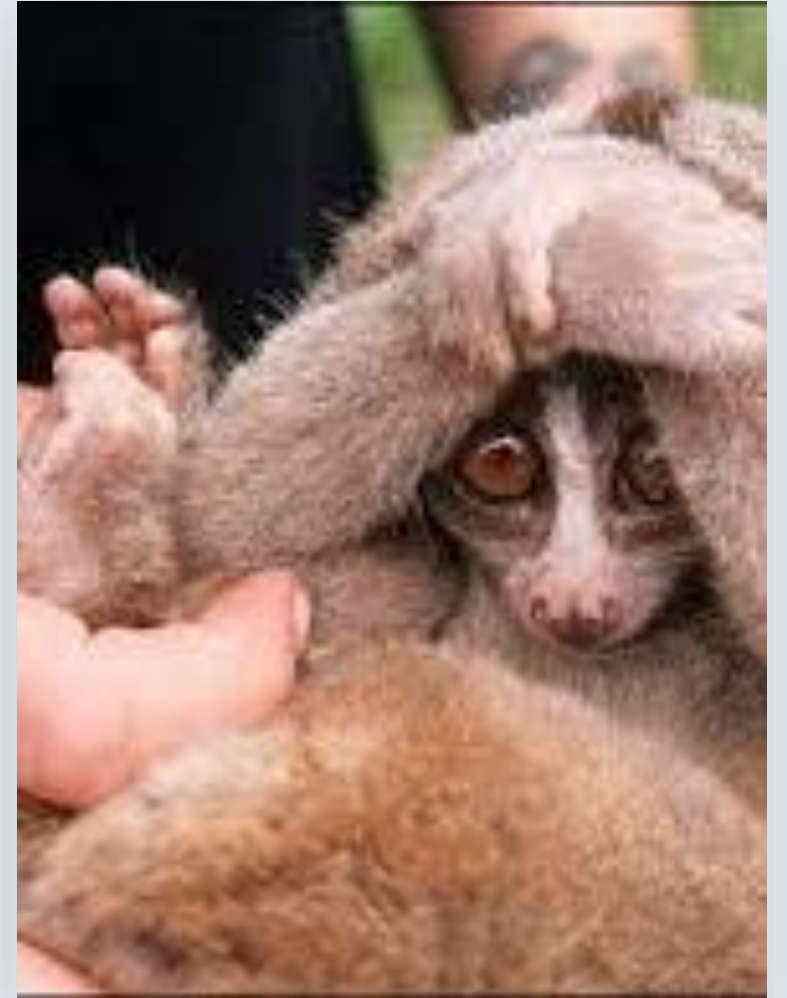
**2.NO**







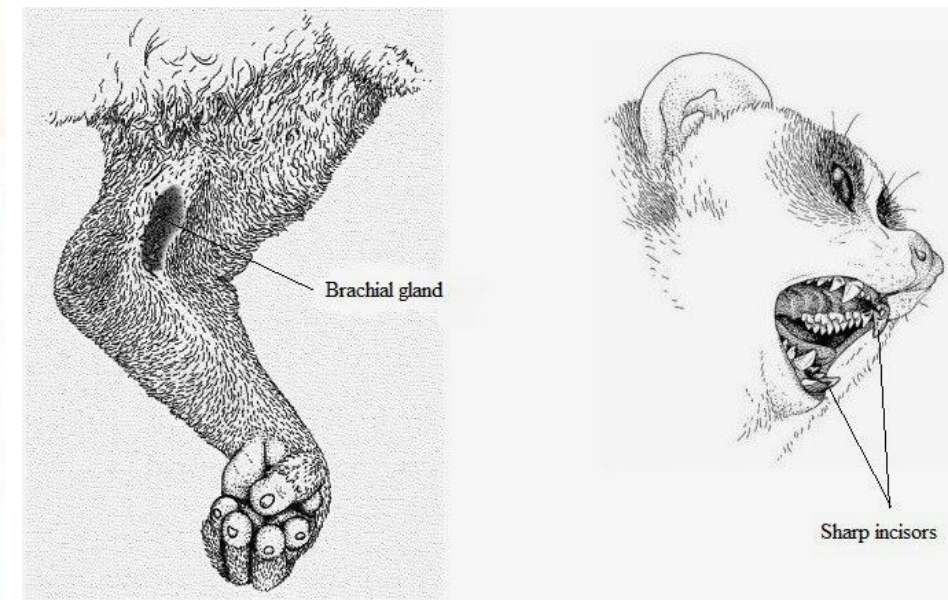
## Slow loris (*Nycticebus spp.*)







## Brachial gland exudate -Fel-d1 protein



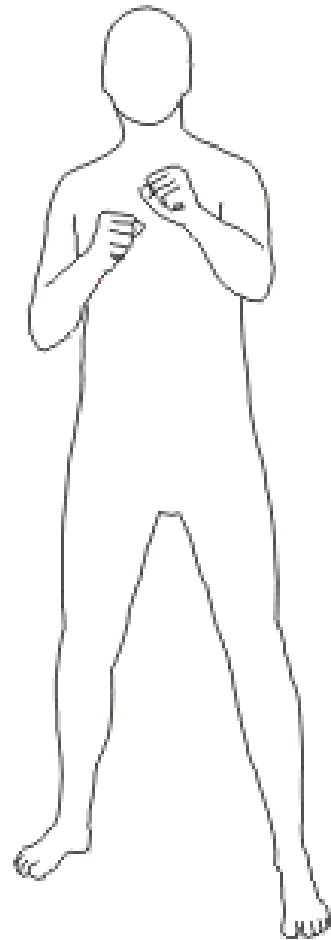
Toxins (Basel). 2023 Aug 22;15(9):514.

J Venom Anim Toxins Incl Trop Dis. 2013 Sep 27;19(1):21.



# Fighting Stance

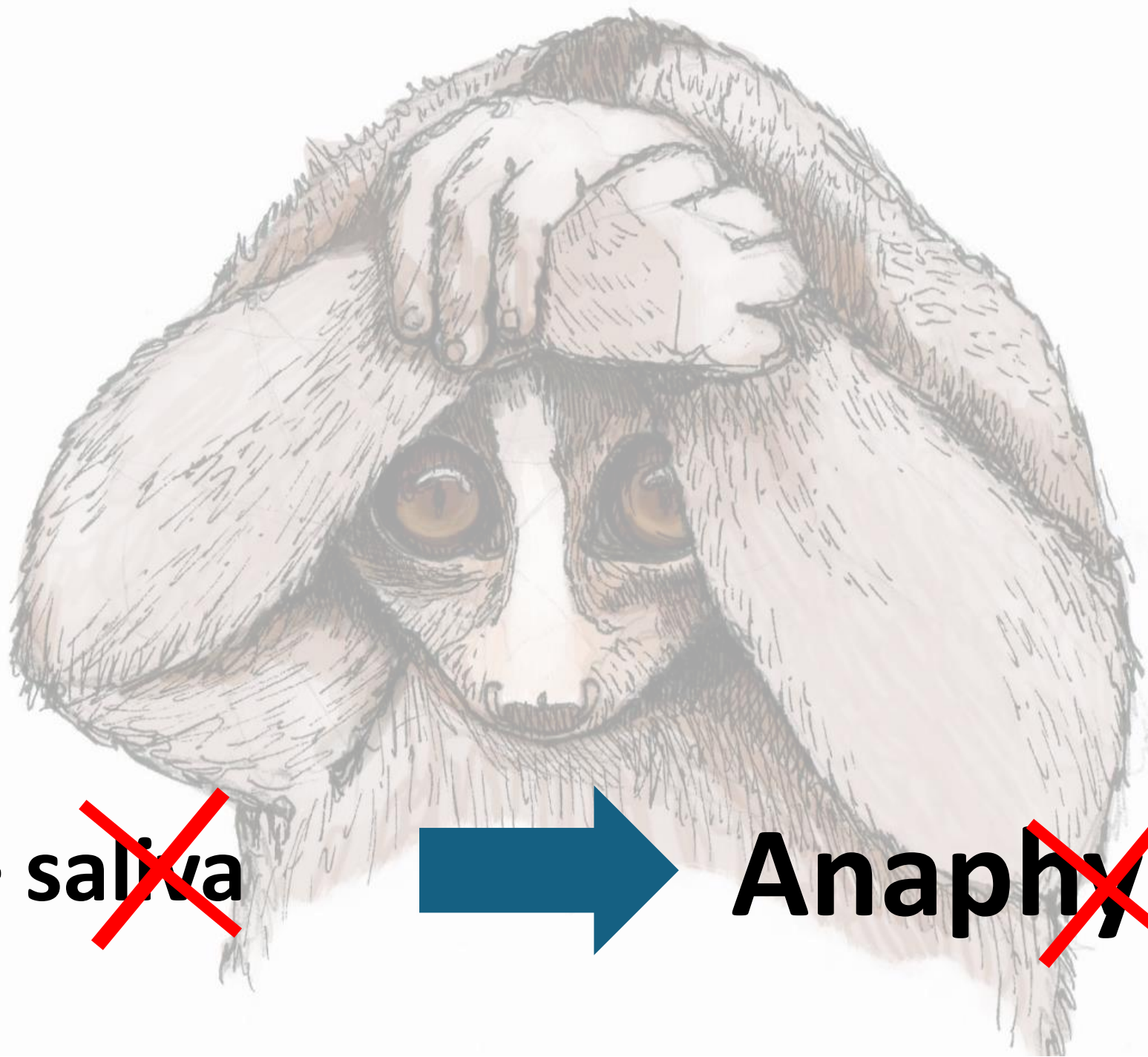
Front View



Side View







**BGE + saliva**



**Anaphylaxis**

???



Start research

✦

I've completed your research. Feel free to ask me follow-up questions or request changes.

🔍

Venomous Animal Species Count

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🔍 Venomous Animal Species Count			<a href="#">Export to Docs</a>		
Cone Snails	~800	All species are venomous; some are deadly to humans.			
Cephalopods	Many (all octopuses, squids, cuttlefish)	All species are thought to be venomous, with varying potency.			
Jellyfish	Many (~100 pose risk to humans)	Out of ~10,000 species, a significant number are venomous.			
Sea Urchins	Several species	Venomous spines for defense.			
Bloodworms	Several species (Family Glyceridae)	Venomous jaws for predation.			
Fish	≥ 1,200	Includes stonefish, lionfish, stingrays, catfish, and many others.			
Snakes	~600	Approximately 15% of all snake species are venomous.			
Lizards	Few	Notable examples include Gila monster, Mexican beaded lizard, and some monitor lizards.			
Amphibians	Relatively few	Examples include certain frogs, salamanders, and caecilians. Most amphibians rely on poison rather than venom.			
Mammals	Very few	Examples include platypus, solenodons, shrews, European mole, vampire bats, and slow lorises.			
Estimated Total	> ~46,300	This is a rough estimate and likely an underestimation due to the broad definition of venomous and the many groups where precise numbers are			

Approximately **15% of all animal species** are venomous.

Global Estimates of Venomous Animal Species

I. Introduction

The natural world teems with a remarkable diversity of life, and among its many fascinating adaptations, the ability to produce and deliver toxins, known as venom, stands out as a potent force in ecological interactions and a subject of considerable scientific interest. The question of how many species of venomous animals inhabit our planet is a seemingly straightforward inquiry, yet it delves into the complexities of biological classification, the ever-evolving understanding of toxins, and the sheer vastness of undiscovered biodiversity. To address this question accurately, it is essential to first establish a clear understanding of what defines a venomous animal and to appreciate the scale of animal life on Earth. Furthermore, recognizing the distinctions between venomous and poisonous organisms is crucial to avoid common misconceptions and to provide a scientifically sound response.<sup>1</sup>

II. Defining Venom and Venomous Animals

In biological terms, a venomous animal is characterized by its capacity to produce toxins, known as venom, within specialized glands and to actively deliver these toxins into another organism through a wound. This delivery is typically facilitated by a specialized anatomical structure such as fangs, stingers, spines, or other apparatus designed for injecting the venom.<sup>1</sup> The process by which venom is injected is termed envenomation.<sup>2</sup> This active injection is the key differentiator between venomous and poisonous organisms. Poisonous animals, in contrast, possess toxins that are passively delivered, typically through ingestion, inhalation, or absorption through the skin.<sup>1</sup> It is important to note that while the term "poisonous snake" is often used in popular language, it is technically incorrect as most dangerous snakes inject their toxins; they are venomous.<sup>1</sup> However, some animals, like the Asian Tiger snake and the Blue-ringed Octopus, exhibit both venomous and poisonous characteristics.<sup>2</sup> The purpose of venom can vary widely, serving in prey capture, defense against predators, or even in competition with other members of the same species.<sup>2</sup> While some classifications of venomous animals might focus on species whose venom is medically significant to humans, a broader scientific perspective includes all animals that utilize venom for any purpose.<sup>1</sup>

toxins.<sup>2</sup> Certain caterpillars also possess urticating hairs for defense.<sup>1</sup> Examples of medically important venomous insects include fire ants, bullet ants, and various species of bees and wasps, whose stings can cause significant pain and potentially fatal allergic reactions.<sup>2</sup> Many species of centipedes also employ venom to subdue their prey, using modified legs called forcipules to inject toxins.<sup>2</sup> The giant centipede is one example known for delivering a painful bite.<sup>2</sup>

**B. Mollusks:** The phylum Mollusca also includes a significant number of venomous species. All cone snails, comprising around 800 species, are venomous predators that use a specialized tooth to inject potent venom into their prey.<sup>2</sup> Some cone snail species possess venom capable of causing serious harm or even death to humans.<sup>1b</sup> Furthermore, many species of octopus, squid, and cuttlefish, collectively known as cephalopods (excluding the nautilus), utilize venom to hunt and kill their prey.<sup>1c</sup> Notably, all species of blue-ringed octopuses are venomous and contain a powerful neurotoxin that is highly dangerous to humans.<sup>2</sup>

**C. Cnidarians:** This phylum includes jellyfish, corals, and sea anemones, many of which are venomous. These animals possess specialized stinging cells called nematocysts, which they use to inject venom into prey or as a defense mechanism.<sup>2</sup> The box jellyfish is renowned for being one of the most venomous animals on Earth, with some species capable of causing rapid paralysis and death in humans.<sup>2</sup> While there are approximately 10,000 jellyfish species worldwide, about 100 of them are considered to pose a risk to humans.<sup>1c</sup> The Portuguese Man o' War is another venomous cnidarian that can deliver a painful sting.<sup>2</sup>

**D. Echinoderms:** Several species within the phylum Echinodermata, which includes sea urchins, are venomous. These animals typically use their spines to deliver toxins, primarily for defense against predators.<sup>2</sup>

**E. Annelids:** The phylum Annelida includes segmented worms, and within this group, the family Glyceridae, commonly known as bloodworms, contains venomous species. These worms possess an eversible proboscis equipped with jaws connected to venom glands, which they use to kill the invertebrates they feed on.<sup>2</sup>

		deaths).
Scorpions	>1,000 (all possess venom)	Only a few dozen have venom dangerous to humans.
Insects	Many	Includes bees, wasps, some ants, and certain caterpillars. Exact number not specified, but likely thousands of species with varying degrees of venom potency.
Centipedes	Many	Numerous venomous species.
Cone Snails	~800	All species are venomous; some are deadly to humans.
Cephalopods	Many (all octopuses, squids, cuttlefish)	All species are thought to be venomous, with varying potency.
Jellyfish	Many (~100 pose risk to humans)	Out of ~10,000 species, a significant number are venomous.
Sea Urchins	Several species	Venomous spines for defense.
Bloodworms	Several species (Family Glyceridae)	Venomous jaws for predation.
Fish	≥ 1,200	Includes stonefish, lionfish, stingrays, catfish, and many others.
Snakes	~600	Approximately 15% of all snake species are venomous.

and the ecological roles their venom plays.<sup>1a,4</sup>

VII. Conclusion

In conclusion, while a precise figure remains elusive due to the inherent complexities and ongoing nature of scientific discovery, current estimates suggest that there are over 200,000 known venomous animal species across the globe.<sup>1f</sup> This substantial number highlights the widespread evolutionary success of venom as a biological adaptation for predation, defense, and other ecological interactions. It is important to recognize that this figure is an approximation and is likely to be refined as our understanding of animal diversity and the definition of venom continues to evolve. Continued research in taxonomy, ecology, and toxinology will undoubtedly uncover new venomous species and provide further insights into the fascinating world of animal toxins. The ecological significance and complexity of venomous animals underscore the importance of ongoing efforts to explore and understand this remarkable aspect of natural history.

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remains undiscovered. The ongoing nature of taxonomic research means that these figures are subject to revision as new species are identified and classification methods improve.<sup>19</sup>

IV. The Proportion of Venomous Animals

Given the estimated total number of animal species, understanding the proportion that are venomous is key to answering the user's query. Research suggests that approximately 15% of all animal species are venomous.<sup>21</sup> Furthermore, venomous representatives are found across a remarkable 57.5% of all animal lineages, indicating that the evolution of venom has occurred independently in many different groups.<sup>17</sup> This convergent evolution of venom across diverse animal lineages highlights its significant adaptive advantages for survival.<sup>17</sup>

V. Venomous Species Across Different Animal Groups

The distribution of venomous species varies significantly across different animal groups.

**A. Arthropods:** This incredibly diverse phylum includes arachnids (spiders and scorpions), insects, and other arthropods like centipedes. Strictly speaking, all spiders, numbering over 43,000 known species, possess venom, which they deliver through fangs.<sup>2</sup> However, the vast majority of spider venom is adapted for subduing insect prey and poses little threat to humans. Only around 100 spider species have venom considered detrimental to humans, and fewer than 30 have been responsible for human deaths.<sup>1c</sup> Examples of medically significant spiders include Australian funnel-web spiders, Brazilian wandering spiders, widow spiders, and recluse spiders.<sup>2</sup> Similarly, all scorpions, of which there are over a thousand known species, possess venom delivered through a stinger at the end of their tail.<sup>2</sup> While most scorpion stings are painful but not life-threatening, only a few dozen species have venom that is dangerous to humans, notably bark scorpions and the deathstalker.<sup>2</sup> Among insects, venom is found in some bees, wasps, and ants, which use stingers or bites to inject

venom. Spiders, scorpions, and snakes are some examples of highly venomous snakes include the inland taipan, king cobra, black mamba, and various species of vipers.<sup>2</sup> Venomous snakes are responsible for a significant number of human deaths globally each year.<sup>8</sup> In contrast to snakes, relatively few lizards are venomous. Notable examples include the Gila monster, the Mexican beaded lizard, and some members of the monitor lizard genus *Varanus*, such as the Komodo dragon, parentie, and lace monitor.<sup>2</sup> The potency of lizard venom can vary considerably.<sup>8</sup>

**H. Amphibians:** While many amphibians are poisonous, true venom delivery mechanisms are relatively rare in this group.<sup>2</sup> However, some exceptions exist, including Bruno's casque-headed frog and Greening's frog, which possess spines on their snouts used to deliver venom.<sup>2</sup> Certain salamanders, such as the fire salamander and the Iberian ribbed newt, are also venomous.<sup>2</sup> Additionally, some species of caecilians, a group of limbless amphibians, are known to be venomous.<sup>3</sup>

**I. Mammals:** Venom is a relatively uncommon trait among mammals. Only a few modern mammal species are venomous.<sup>2</sup> These include the male platypus, which possesses venomous spurs on its hind legs<sup>2</sup>, solenodons and some species of shrews, which have venomous saliva<sup>2</sup>, the European mole<sup>2</sup>, vampire bats, whose saliva contains anticoagulants<sup>2</sup>, and slow lorises, which have a venomous bite.<sup>2</sup> It is thought that venom production might have been more prevalent in the evolutionary history of mammals.<sup>2</sup>

Table 1: Estimated Number of Venomous Species in Major Animal Groups

Animal Group	Estimated Number of Venomous Species	Notes
Spiders	~43,000 (all possess venom)	Only a small percentage are dangerous to humans (~100 species with detrimental venom, <30 responsible for

		lorises.
Estimated Total	> ~46,300	This is a rough estimate and likely an underestimation due to the broad definition of venomous and the many groups where precise numbers are unavailable. It also doesn't account for potential overlap.

VI. Challenges in Estimating the Number of Venomous Species

Obtaining a precise count of venomous animal species is fraught with challenges. The very definition of "venomous" can be interpreted broadly, leading to inconsistencies in classification across different studies and animal groups.<sup>2</sup> The vast number of undescribed species means that many venomous animals likely remain unknown to science, contributing to an underestimation of the total.<sup>1b</sup> Furthermore, the medical significance of venom can influence which species are considered "venomous" in certain contexts, potentially excluding species whose venom is not harmful to humans but serves important ecological roles.<sup>2</sup> Recent research has also expanded our understanding of toxins, suggesting that venom-like mechanisms may exist in non-animal organisms such as plants, fungi, bacteria, and viruses<sup>1d</sup>, which could significantly broaden the definition and the estimated number of venomous organisms in the future. Studying venomous animals, particularly those that are small or not medically significant, can be logistically difficult, leading to gaps in our knowledge.<sup>1a</sup> The common confusion between venomous and poisonous species can also lead to inaccuracies in reporting and counting.<sup>2</sup> The lack of comprehensive and mandated reporting for envenomations in many parts of the world further complicates efforts to accurately assess the impact and prevalence of venomous animals.<sup>1b</sup> The traditional focus of venom research on species posing a direct threat to human health has likely resulted in less attention being paid to the broader diversity of venomous organisms



**Thank You**