Snake Envenomation: Initial Approach, Assessment and Management

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Eastern Diamondback Rattlesnake

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Snake envenomation

Time matters.

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VENOMOUS SNAKES OF ARIZONA

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Initial History Taking

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- Did you **see** the snake?
- Do you have a **picture** of the snake?
- What did the snake **look like**? (features of the snake…color, patterns, skinny, fat, approximate length, rattle present…)
- What were you **doing** when you encountered the suspected snake bite?
- Where on the **body** did the bite occur? Shoes, sandals, clothing present, wearing socks…
- **Where did this occur**? Near water, walking on a hike, cleaning out a barn…
- **When did the bite occur**? How long until you presented to health care?
- Did you pull the snake off your body or was it a quick strike?

Black tailed rattlesnake (Tucson, AZ)

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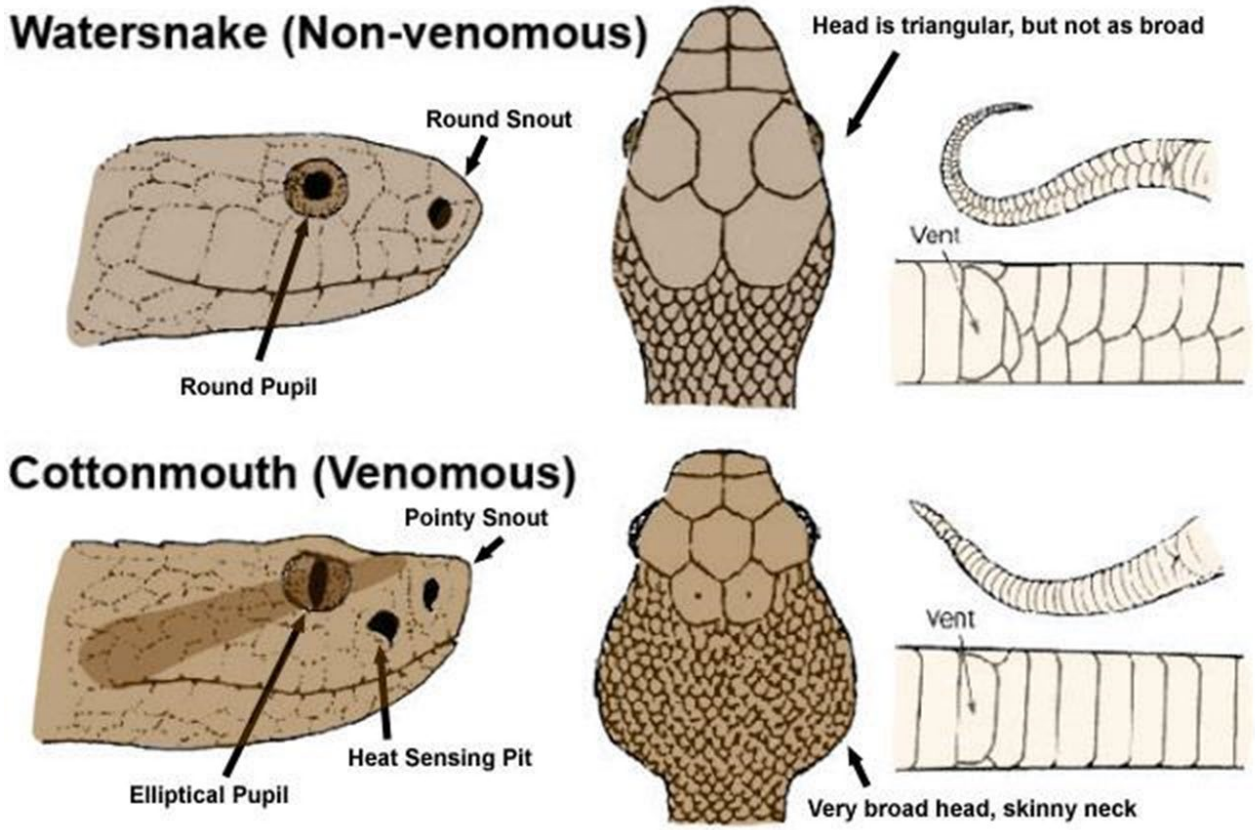
Rincon Mountains, Arizona

Rock Banded Rattlesnake

Common key features of native venomous snakes in US



- Broad, flattened, (often) arrow shaped head with skinny neck
- Elliptical pupil with most venomous snakes in the US
- Heat sensing pits “pit vipers” (Viperidae) which are located near the nostrils
- A rattle at the end of the tail

Pause! Takes three steps back and assess. There are always exceptions and unique features in some species.

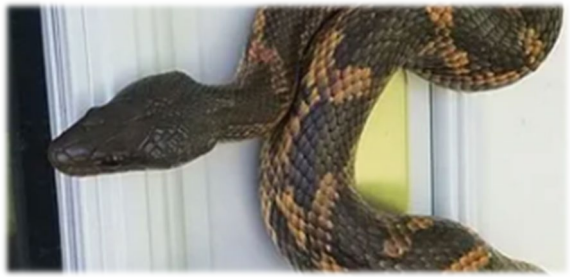
Exceptions to the “rules” should always be considered

Texas coralsnake (melanistic)

Eastern hog-nosed snake

Western gopher snake

Eastern diamondback



Western rat snake

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Arizona Coralsnake
(*micruroides euyxanthus*)

News from the Pit, Arizona Poison and Drug Information Center, 9/5/2023

Eastern Coralsnake
(Micrurus fulvius)

Photo credit: NL Beatty

- “red on yellow, kill a fellow…”
- Ring color will completely encircle the body
- Typically, the nose is black

Why are people bitten?

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- **Most of the time it is either**:
  - A person has grabbed or stepped on a snake on **accident**
  - They were **handling** and do not know how to handle a venomous snake
  - They were **trying to kill** it and were bitten
  - **Walking their dog** and were trying to protect their dog and were bitten

Pre-hospital clinical assessment

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- **Call 911!**
- **Key elements in a field setting (EMS):**
  - Get a safe distance from the snake and take a quick history
  - Did the person rip the snake off?
    - Fang could have broken off and important to convey at hospital
  - Have the person describe the snake
  - Take a picture of the snake but do not try to catch it!
- **Help the person remain call**
  - This will help prevent unnecessary tachycardia
  - Lie patient in a supine position if environment allows
- **Any puncture marks from fangs?**
  - One or two **puncture marks** can be seen (not always)
  - Distance between fang marks can help estimate size of snake
  - Other teeth can leave a linear marks
- **Mark the "line of demarcation" with pen and put time**

Cottonmouth envenomation
8 hrs post-bite at UF Health

Pre-hospital clinical assessment

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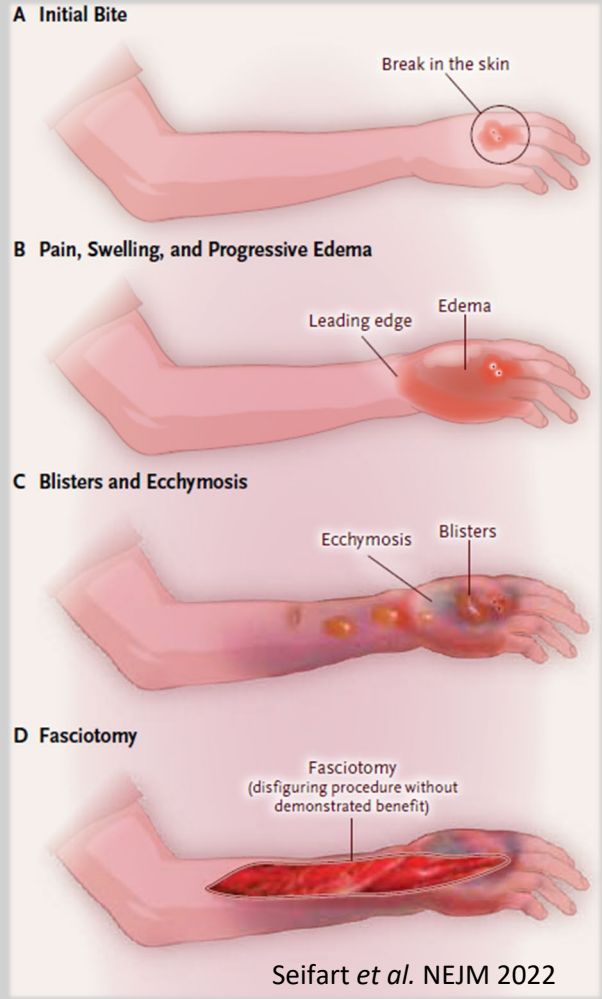
- **Children:**
  - May be difficult because they are unable to describe the snake or the encounter well
  - When in doubt, always bring to the hospital
- **En route to the hospital:**
  - Place the extremity in a heart-neutral position, lay patient flat in supine.
  - **Anticipate further swelling**…remove jewelry, rings, watches…
  - Vitals, ECG, supplemental oxygen as needed



Seifart *et al.* NEJM 2022

What methods are **NOT** recommended pre-hospital?

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- **"Cut and Suck"** → venom extractors have not been shown to be effective and delay care
- **Arterial/venous tourniquets** → can lead to accelerated tissue damage
- **Electrotherapy at bite site** → electricity is not known to disrupt venom and its properties
- **Heat at bite site** → does not alter venom properties and only damages tissues
- **Cryotherapy at bite site** → has not ben shown to be effective and may delay care
- **Pressure Immobilization Bandaging (PIB): (controversial)**
  - Broad elastic bandage to the entire bitten limb and immobilization
  - Technique that is not recommended for North American Crotaline bites
  - Utilized in regions in South-East Asia and has shown benefit
  - In North America it is likely not effective due to increasing local necrosis of tissue

Seifert et al. J Med Toxicol. 2011

Systemic symptoms

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- **Local swelling, erythema, and pain: 90 to 100 percent**.
- **Thrombocytopenia and/or coagulopathy**: Up to 40 percent.
- **Vomiting:** Up to 20 percent.
- **Bleeding** (typically not life-threatening): Up to 8 percent.
- **Neurotoxicity:** Up to 8 percent (primarily after rattlesnake bites, includes myokymia [rippling muscle movement, seen in the face]).
- **Tachycardia and/or hypotension**: Up to 6 percent
  - (primarily after rattlesnake bites).
- **Rhabdomyolysis**: <5 percent.
- **Angioedema** (allergic or anaphylactoid reaction): 1 to 2 percent.
- **Weakness, paralysis:** Rare for Crotalinae snakebites overall, but described in Mojave rattlesnake bites from southern California

Pygmy rattlesnake, 6hrs post-bite UF Health

Crotalinae envenomation

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- Monitor vital signs, continuous is needed if available (IMC or MICU)
- Remove any restrictive clothing from body; two large bore PIV placed
- Tdap should be updated; wound inspected for foreign body
- **Ultrasound or Xray the region for retained fangs**!
- Assess for the possibility of "**dry bite**" and can observe for 6-24hours.
- **CBC with diff, CMP, PT/INR, CRP, fibrinogen or fibrin split products , D-dimer, CK;** Labs every 6-8 hrs
- Give antivenom!!

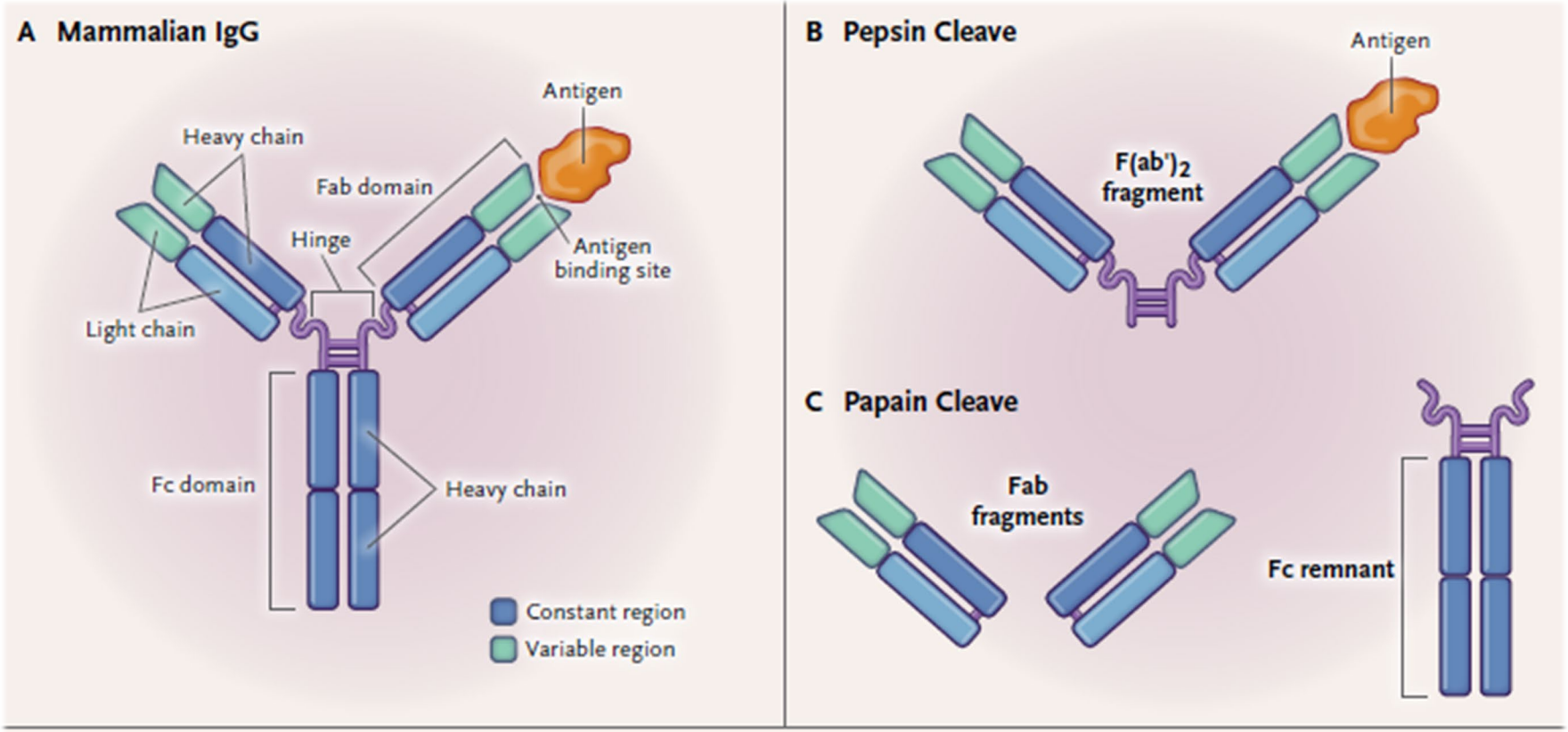

Figure 4. IgG and IgG Fragments Developed against Snake Venom Components.

The mammalian IgG molecule (Panel A) consists of an Fc (heavy) chain, a hinge, and two Fab (light) chains. The light chains have constant and variable regions, which allow the IgG to bind to certain antigens (Ag), such as venom components. When the IgG is treated with pepsin, the IgG molecule is cleaved below the hinge (comprising two disulfide bridges), and an $F(ab')_2$ fragment is produced (Panel B). When the IgG is treated with papain, the cleavage occurs above the hinge, and two Fab fragments are produced (Panel C). The Fc remnant or chain, which is more immunogenic than the Fab chains, can be removed from the remaining solution by means of various purification techniques.

Seifart *et al.* NEJM 2022

Antivenom

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- Should be started with confirmation or high concern for envenomation (this is often a clinical diagnosis)
- **CROFab** and **ANAVIP** are both approved by the FDA for Crotinlinae snake envenomation
- Both have similar efficacy
- **Contraindications** – allergy to papain, papaya, or previous known allergy

CROFab
crotalidae polyvalent immune fab (ovine)

ANAVIP
crotalidae immune F(ab')$_2$ (equine)

Antivenom

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	Antivenom	
	Crotalidae immune equine F(ab')2 (Fab2AV, Anavip)	**Polyvalent Crotalinae ovine immune Fab (FabAV, CroFab)**
Initial dose*	▪ 10 vials; repeat dose if initial control of local and systemic venom effects not achieved ▪ Call physician expert if initial control not achieved after 2 loading doses¶	▪ 4 to 6 vials; repeat dose if initial control of local and systemic venom effects not achieved ▪ 8 to 12 vials if patient in shock or with serious active bleeding ▪ Call physician expert if initial control not achieved after 2 loading doses¶
Maintenance doses?	**No:** Patient should be observed for an additional 18 hours after control achieved	**Yes:** 2 vials every 6 hours for 3 doses
As-needed doses for recurrent venom effects	4 vials	2 vials
Timeline for reassessment of platelets and fibrinogen	▪ 5 to 7 days after last antivenom dose; continue to monitor if trend toward abnormal ▪ Reassess sooner if risks for bleeding present ▪ Patients who received **both** FabAV and Fab2AV: 2 to 3 days **and** 5 to 7 days after last antivenom dose; continue to monitor if trend toward abnormal	▪ 2 to 3 days **and** 5 to 7 days after last antivenom dose; continue to monitor if trend toward abnormal ▪ Reassess sooner if risks for bleeding present ▪ Patients who received **both** FabAV and Fab2AV: 2 to 3 days **and** 5 to 7 days after last antivenom dose; continue to monitor if trend toward abnormal

CROFab
crotalidae polyvalent immune fab (ovine)

ANAVIP
crotalidae immune F(ab')2 (equine)

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Hospital Supportive care

- **Pain control is important** – usually require opioid management (morphine or dilaudid)
- **Intravenous fluids as bolus and continuous infusion** – helps with potential rhabdomyolysis
- **Fresh frozen plasma and platelets** – should only be given in life threatening bleeding and with antivenom administration; Crotalinae venom will de-activate products given
- Monitor for compression syndrome and fasciotomy; less common in Crotalinae bites but does occur and especially in eastern diamondback rattlesnake.

Western diamondback rattlesnake (Oro Valley, AZ)

Snake Envenomation in the State of Florida, USA – A 20 Year Retrospective Analysis of the Epidemiology and Clinical Outcomes at a Tertiary Medical Center

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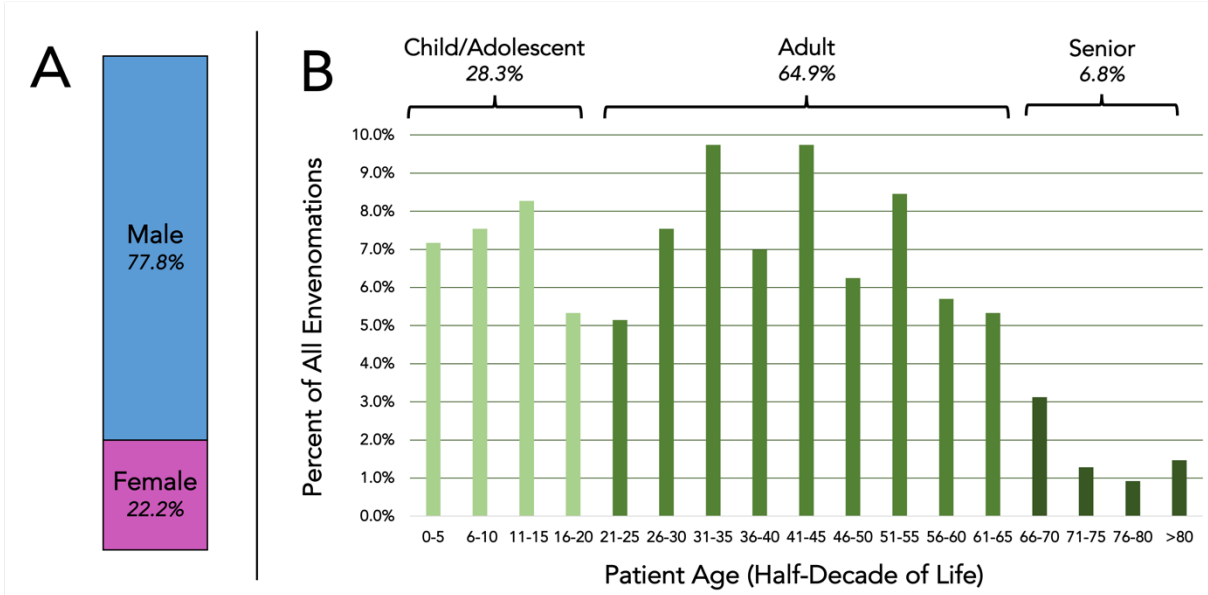
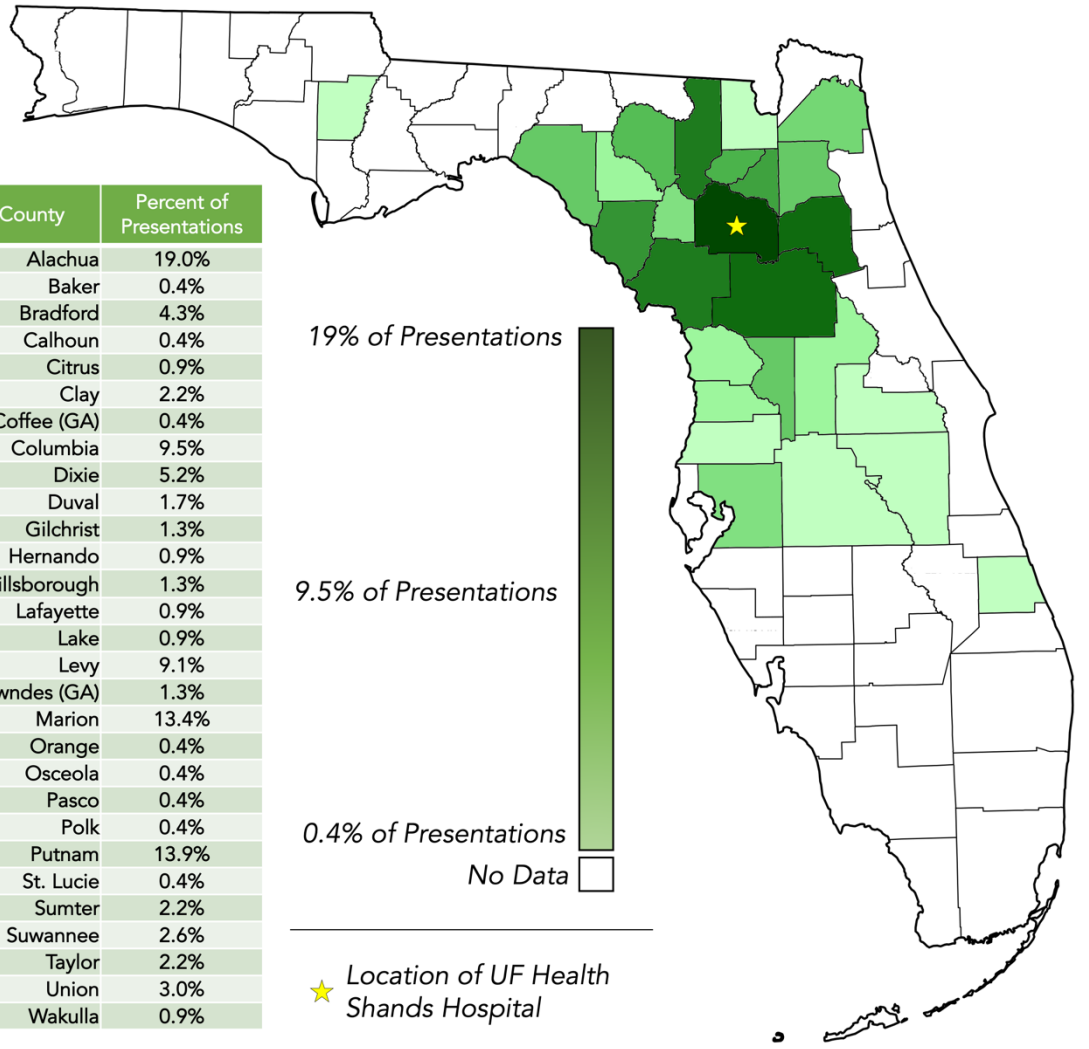
Total snake envenomation encounters: **n=829**



County	Percent of Presentations
Alachua	19.0%
Baker	0.4%
Bradford	4.3%
Calhoun	0.4%
Citrus	0.9%
Clay	2.2%
Coffee (GA)	0.4%
Columbia	9.5%
Dixie	5.2%
Duval	1.7%
Gilchrist	1.3%
Hernando	0.9%
Hillsborough	1.3%
Lafayette	0.9%
Lake	0.9%
Levy	9.1%
Lowndes (GA)	1.3%
Marion	13.4%
Orange	0.4%
Osceola	0.4%
Pasco	0.4%
Polk	0.4%
Putnam	13.9%
St. Lucie	0.4%
Sumter	2.2%
Suwannee	2.6%
Taylor	2.2%
Union	3.0%
Wakulla	0.9%



Grace *et al*. Unpublished data, 2024

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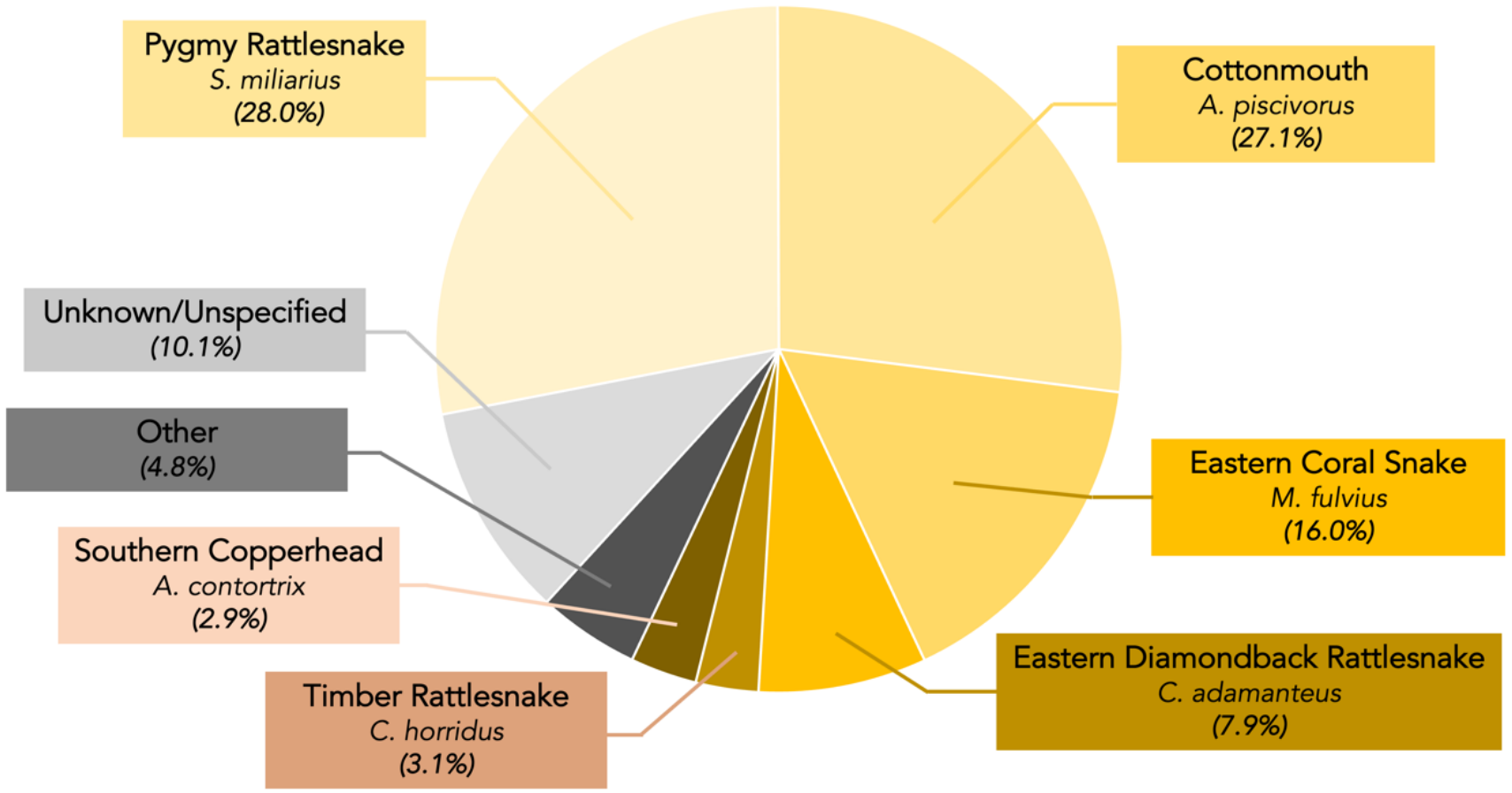

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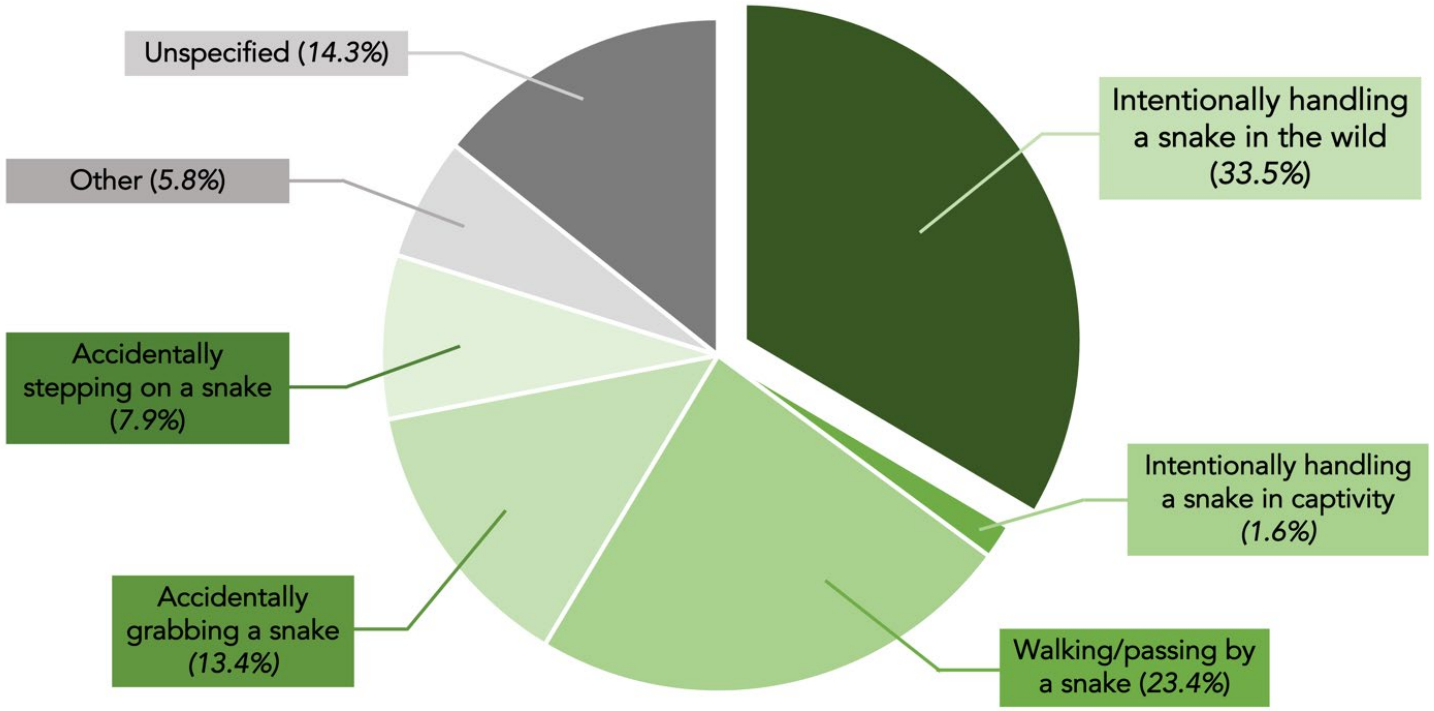

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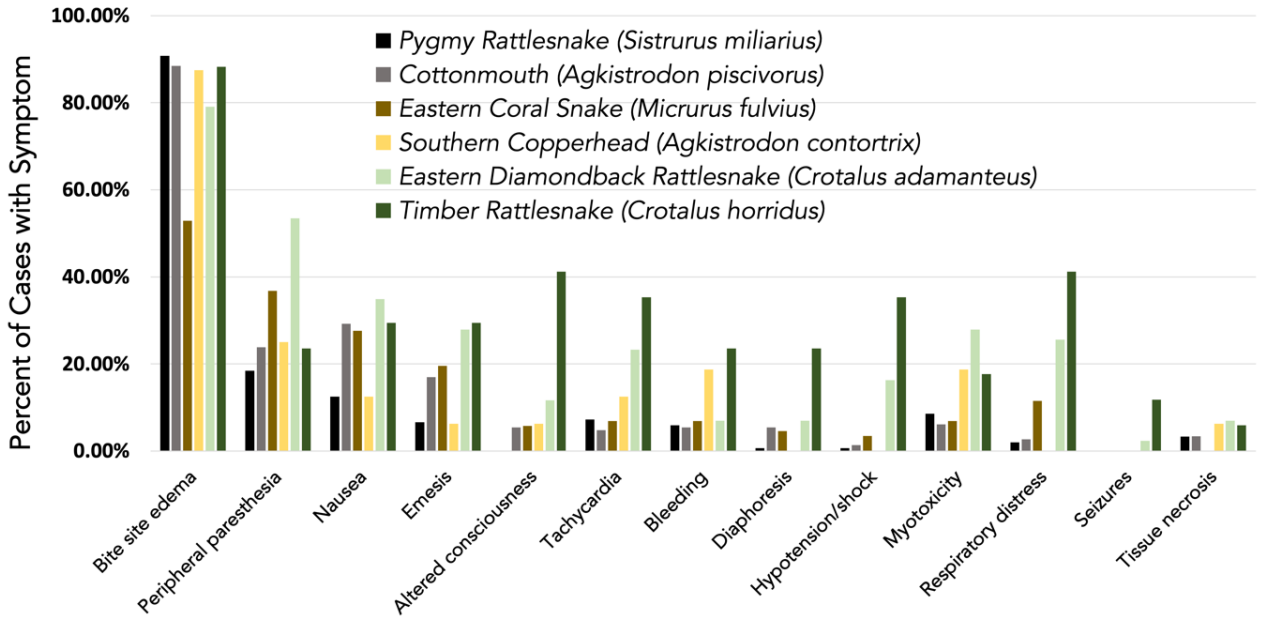

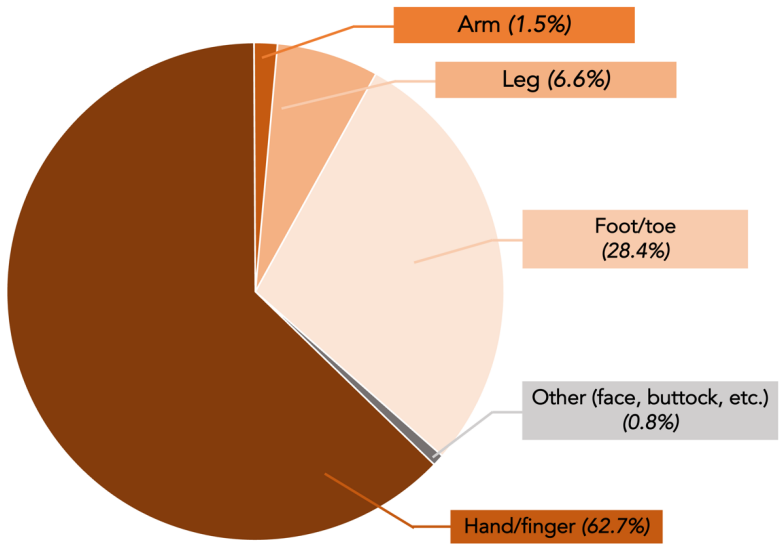

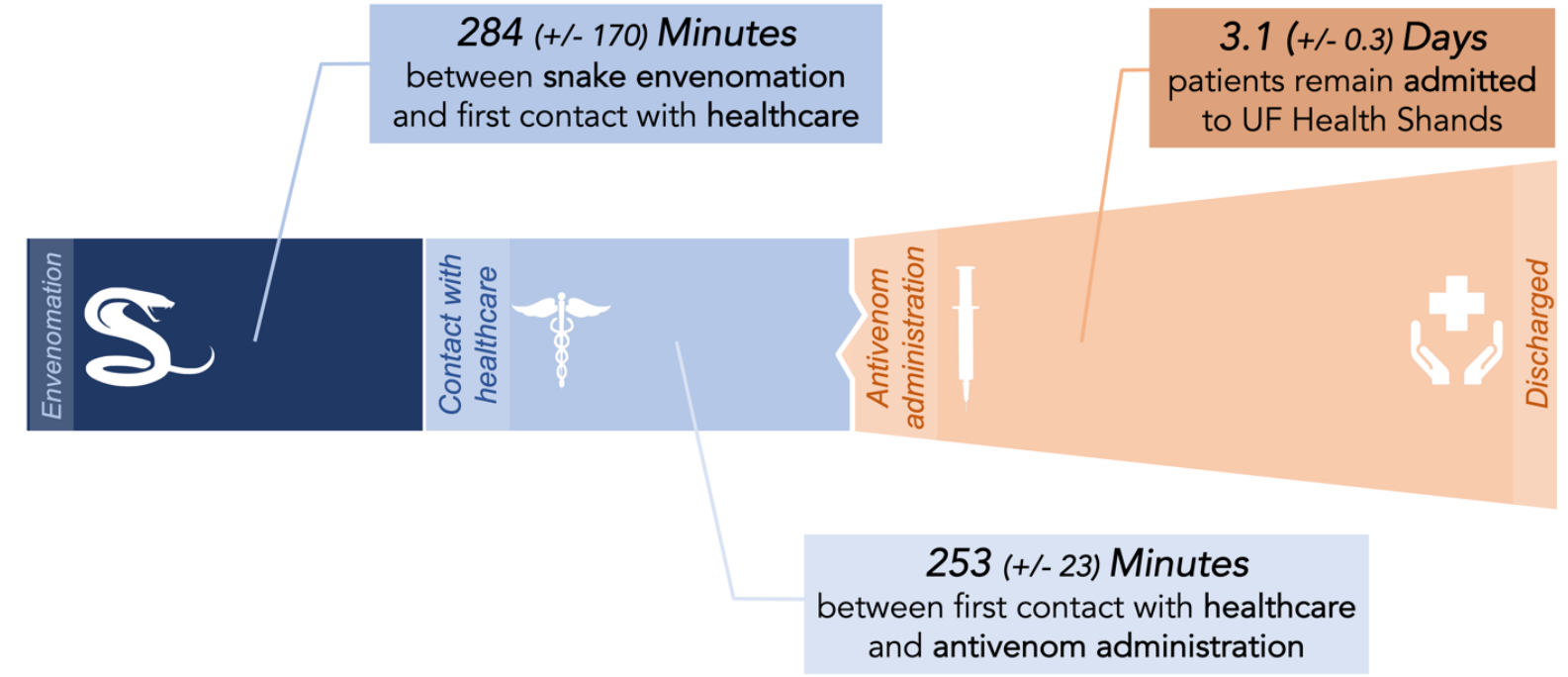

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- **Three patients who died from snake encounter or treatment:**
  - 2 patients bitten by Eastern diamondback despite antivenom
    - One sustained **shock and cardiac arrest**
      - Handling the snake in the wild
    - One developed **cerebral edema and herniation**
      - Moving the snake from across the road
  - 1 patient died from anaphylaxis after being given antivenom; developed shock and cardiac arrest

- **Anaphylaxis or anaphylactoid reaction: 3.86% of participants**

Grace *et al*. Unpublished data, 2024

Questions?

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***Juvenile Florida Cottonmouth** (Agkistordon conanti)*