# ANTIVENOM; SCIENCE & TECHNOLOGY

**NEWS:** *Why are antivenoms not easily accessible in India?*

## WHAT'S IN THE NEWS?

India faces a significant snakebite crisis with an estimated 58,000 deaths annually, highlighting the urgent need for accessible antivenoms, innovative treatments, and strengthened healthcare infrastructure, especially in rural areas.

## 1. What Are Antivenoms?

- **Definition:**
  - Antivenoms (or antivenins) are life-saving medicines designed to neutralize venom toxins after a snakebite.
- **Production Process:**
  - **Step 1:** Small doses of venom are injected into animals (typically horses) to stimulate their immune response.
  - **Step 2:** Animals produce antibodies to neutralize the toxins.
  - **Step 3:** Blood is collected from the immunized animals, and the antibodies (immunoglobulins) are extracted and purified.
- **Historical Development:**
  - Developed by Albert Calmette, a French physician, in the 1890s.

## 2. Understanding Snake Venom:

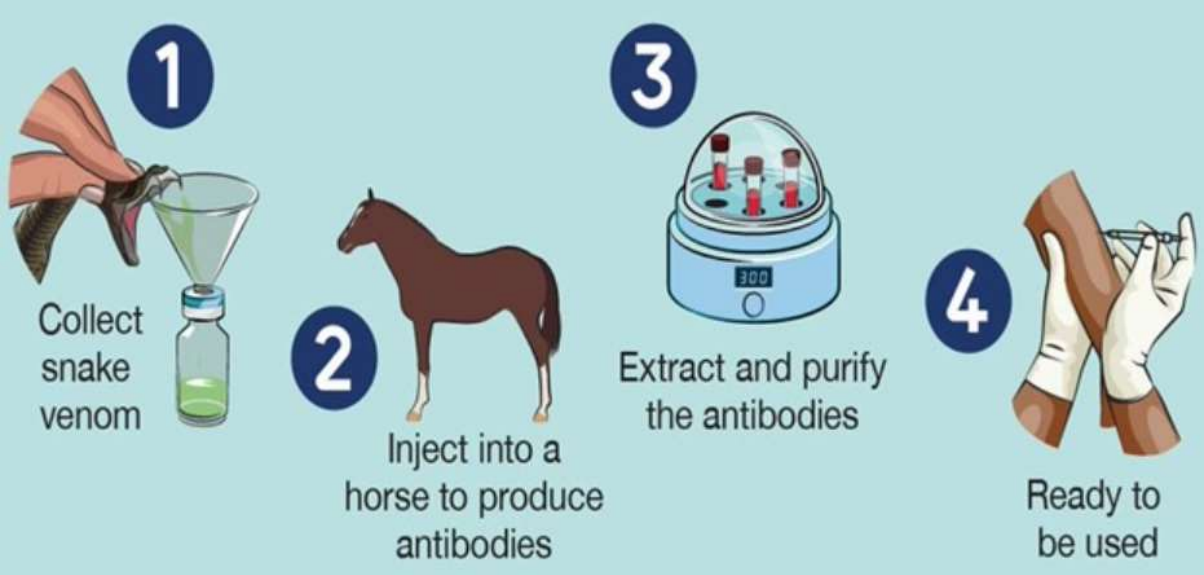
- **Nature of Venom:**
  - Snake venom is a complex cocktail of proteins and enzymes evolved for immobilizing prey and self-defense.
- **Types of Toxins in Venom:**
  - **Hemotoxins:** Destroy red blood cells, disrupt blood clotting, and lead to internal bleeding.
  - **Neurotoxins:** Block nerve signals, causing paralysis and potentially fatal respiratory failure.
  - **Cytotoxins:** Dissolve and damage tissues at the bite site, leading to necrosis.
- **Role of Antivenoms:** Bind to venom toxins and neutralize them until the body eliminates the harmful substances.

## 3. Polyvalent Antivenoms (PVAs):

- **Definition:**
  - PVAs are designed to neutralize venoms from multiple snake species simultaneously.
- **Why Are They Important in India?**
  - India has high snake species diversity, and identifying the exact species responsible for a bite is often challenging.
- **Production Process:**

- **Step 1:** Venom is extracted from multiple snake species known to cause significant envenomation in the region.
- **Step 2:** Animals are immunized with incremental doses of these venoms to develop antibodies.
- **Step 3:** Blood is collected from the immunized animals, and the antibodies are processed into polyvalent antivenoms.

- **Advantages of PVAs:**
  - Effective in treating bites when the snake species cannot be identified.
  - More practical than producing individual monovalent antivenoms for each species.
- **Challenges:**
  - PVAs are ineffective against venoms from some species, such as king cobras, hump-nosed vipers, and pit vipers, which remain outside their coverage.

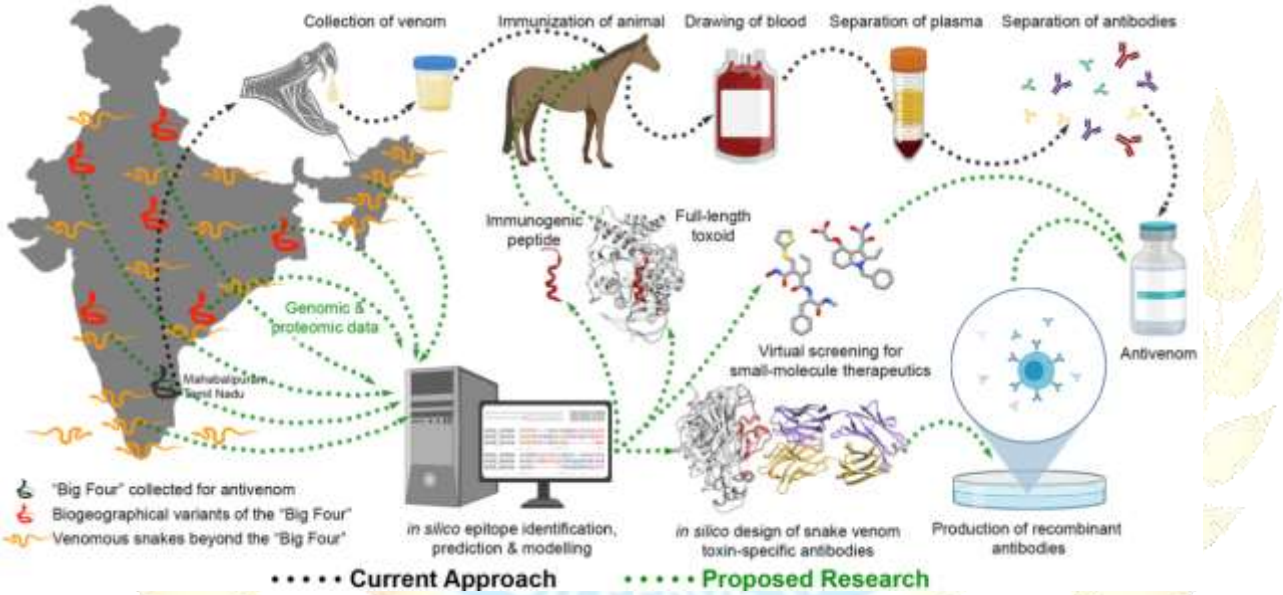



## 4. India's Snakebite Crisis:

- **Snake Diversity:**
  - India is home to over 300 snake species, of which more than 60 are venomous.
- **The Big Four:**
  - Indian cobra (Naja naja), common krait (Bungarus caeruleus), Russell's viper (Daboia russelii), and saw-scaled viper (Echis species) cause the majority of snakebite deaths.
- **Impact:**
  - A 2020 study estimated that 1.2 million deaths and three times as many disabilities occurred between 2001 and 2014 due to snakebites in India.
  - Rural populations in agricultural areas are the most affected.
- **Healthcare Challenges:**
  - Limited availability of antivenoms in remote areas.
  - Lack of training among healthcare workers for effective snakebite management.

## 5. Advancements in Antivenom Technology:

- **Synthetic Antivenoms:**
  - Developed using recombinant DNA technology, eliminating the need for animal-derived components.
  - Potential for greater safety and efficacy.
- **AI-Driven Research:**
  - A team led by Nobel laureate David Baker used artificial intelligence (AI) to design synthetic antivenoms with improved properties.
- **Indian Contributions:**
  - Researchers at IISc Bengaluru are mapping venom compositions to create region-specific antivenoms tailored to local snake populations.
- **Rapid Diagnostic Tools:**
  - Technologies are being developed to quickly identify the type of venom, enabling precise and timely treatment.




## 6. Profiles of the Big Four Snakes:

1. **Indian Cobra (Naja naja):**
   - **Features:** Distinctive hood mark, often resembling spectacles.
   - **Venom Type:** Primarily neurotoxic; affects the nervous system, potentially leading to respiratory failure.
   - **Behavior:** Generally shy but raises its hood when threatened.
   - **Habitat:** Found across forests, plains, and urban areas in India.
2. **Common Krait (Bungarus caeruleus):**
   - **Features:** Glossy black or blue-black body with thin white bands.
   - **Venom Type:** Highly potent neurotoxins causing muscle paralysis; bites are often painless, leading to delayed treatment.
   - **Behavior:** Nocturnal; more dangerous at night.

- **Habitat:** Prefers fields, scrublands, and human dwellings.

3. **Russell's Viper (Daboia russelii):**
    - **Features:** Stout body with dark brown spots bordered by white or yellow.
    - **Venom Type:** Hemotoxic; leads to blood clotting disorders, internal bleeding, and kidney damage.
    - **Behavior:** Quick-tempered; hisses loudly when threatened.
    - **Habitat:** Found in grasslands, bushlands, and agricultural fields.
4. **Saw-Scaled Viper (Echis carinatus):**
    - **Features:** Small, stocky snake with keeled scales producing a rasping sound when rubbed together.
    - **Venom Type:** Hemotoxic; causes coagulopathy, leading to internal bleeding.
    - **Behavior:** Highly irritable; assumes a side-winding motion and produces a characteristic 'sizzling' sound when agitated.
    - **Habitat:** Arid regions, scrublands, and rocky terrains.

**Source:** https://www.thehindu.com/sci-tech/energy-and-environment/why-are-antivenoms-not-easily-accessible-in-india/article69123152.ece