The Academic
International Journal of Multidisciplinary Research

An Online Peer Reviewed / Refereed Journal
Volume 3 | Issue 6 | June 2025
ISSN: 2583-973X (Online)
Website: www.theacademic.in

Epidemiological Investigation of Snake Bite Incidents: A Quintessential 5-Year Observational Analysis at Goa Medical College

Purvi Ulhas Mishal*

Forensic Student, Goa Medical College and Hospital Bambolim Goa, India

*Corresponding Author Email: mishalpurvi07@gmail.com

Chetan Karekar

Assistant Lecturer, Department of Forensic Medicine and Toxicology,

Goa Medical College and Hospital Bambolim Goa, India

Email: drchetankarekar@gmail.com

DOI : https://doi.org/10.5281/zenodo.15845232

ARTICLE DETAILS

Research Paper

Accepted: 17-06-2025

Published: 10-07-2025

Keywords:

Epidemiology, Snake bite Envenomation, Venom toxicity, ASV-Anti snake venom; Treatment plans

ABSTRACT

Poisoning, a huge worldwide health burden, includes a variety of toxic exposures, including snakebite envenomation, which is still a critical medical emergency in endemic areas. Snakebite poisoning causes severe morbidity and mortality, with venom induced toxicity resulting in hematotoxic, neurotoxic, and cytotoxic symptoms. This study gives a complete five-year epidemiological analysis of snakebite cases at Goa Medical College (GMC), with a special emphasis on non-medico-legal cases (non-MLC) and their annual distribution. The statistical trends indicate the prevalence of snakebite envenomation, whilst the clinical assessment emphasises the importance of anti-snake venom (ASV) medication in patient management. Furthermore, the study assesses treatment outcomes and suggests theoretical approaches for improving intervention tactics. This study aims to increase clinical readiness for snakebite toxicity by analysing epidemiological patterns and treatment implications.

INTRODUCTION

Worldwide, snake bites pose a serious threat to public health, especially in rural and tropical areas where people frequently and closely contact with wildlife. The frequency of snake bites is still frighteningly high in places like Goa, where the environment is home to a wide variety of snake species. These occurrences can cause long-term consequences for people, including psychological stress and health issues, in addition to the immediate physical harm they cause. In-depth epidemiological studies are necessary to fully comprehend the scale and nature of this problem, as evidenced by the effects of venomous snake bites on healthcare systems, particularly with regard to treatment expenses, emergency care demands, and long-term rehabilitation.[13]

Snakebites are a major health risk in regions where poisonous species are common. Despite the lengthy history of antivenoms and advanced medical treatments, snakebites remain a leading cause of morbidity and mortality in rural and underserved communities. Clinical outcomes for snakebite victims are mostly determined by the snake's species, the victim's physiological characteristics, and the speed at which medical care was obtained. Therefore, in order to enhance patient outcomes and reduce death rates, it becomes imperative to understand all aspects of snakebite situations in hospital settings. Both venomous and non-venomous snake species can be found in tropical areas. Toxins injected by venomous snakes through their fangs can cause major health problems such paralysis, organ failure, and even death if treatment is delayed.[11]

Although there are more than 3,500 snake species in the world, only 250 of them are highly poisonous. India has 216 species, of which 53 are poisonous. According to the WHO, 2.5 million poisonous snakebites occur each year, killing over 1,25,000 people globally. Snake classification includes (A) Viperidae with hemotoxic venom (e.g., Russell's Viper, Saw-Scaled Viper); (B) Crotalidae (pit vipers) with heat-sensing pits (e.g., rattlesnakes, Malabar Pit Viper); (C) Elapidae with neurotoxic venom (e.g., King Cobra, Kraits, Coral Snakes); (D) Hydrophidae (sea snakes) as highly venomous marine species (e.g., Beaked Sea Snake); (E) Colubridae.[15]

Russell's viper (*Daboia russelii*), saw-scaled viper (*Echis carinatus*), and Indian cobra (*Naja naja*) are some of the most prominent poisonous animals in Goa. These snakes have strong hemotoxic or neurotoxic venom that can impact renal function, blood coagulation, and the neurological system. However, non-venomous species, such as rat snakes and pythons, usually have fewer serious health

effects and, because of their constriction, frequently produce minor wounds like bruising, swelling, or lacerations instead of venomous bites.[11]

Retrospective analysis provides a potent lens through which to examine how snake bite patterns have changed over time, especially when a whole five-year dataset is reviewed. Researchers can determine high-risk populations, spot patterns in the frequency of snake bites, and evaluate the efficacy of different treatment approaches by looking at historical data. This method makes it possible to comprehend the species that are most frequently encountered, the seasonal fluctuations in snake bite incidents, and the usual treatment results. Additionally, a retrospective study offers important information about the healthcare burden, such as the frequency of complications or fatality, the number of cases that necessitate hospitalisation, and the usage of antivenom.[8,9,14]

An essential tool for comprehending the larger epidemiological picture of snake bites in this area is the five-year dataset at Goa Medical College (GMC). This study intends to offer comprehensive insights into the trends of snake bite incidences and the ensuing clinical outcomes by reviewing the clinical records of snake bite patients treated at GMC. This analysis's retrospective design enables a comprehensive examination of the efficacy of treatments given over time and offers a clear picture of the historical management of snake bite cases, which will help guide future healthcare plans and preventative initiatives in Goa and other comparable areas.[14]

Venomous and non-venomous snake bites are distinguished from one another. In venomous bites, snakes inject toxins, including cytotoxic, hemotoxic, and neurotoxic venoms, which can result in a variety of serious symptoms, including tissue destruction, internal bleeding, and paralysis. The bites of venomous animals, such as cobras, vipers, and kraits, necessitate prompt medical attention. Non-venomous snake bites, such those from constrictor snakes like boas and pythons, typically result in less damage, such as localised pain, swelling, or bruising, although they can still cause injury or infection. Furthermore, certain poisonous snakes administer "dry bites" in which no venom is administered. The degree of envenomation varies from minor to severe, with severe cases having the potential to cause life-threatening complications.[7,12]

The species of snake, the quantity of venom injected, and the bite site can all have a substantial impact on the clinical presentation of a snake bite. Before moving on to systemic effects like disorientation, breathing difficulties, and shock, a poisonous bite may cause local symptoms like excruciating pain,

swelling, and redness. In extreme situations, venomous snake bites can result in permanent impairment from paralysis or renal failure, or even necessitate amputation[12].

Although non-venomous bites usually cause localised symptoms with few systemic effects, some people may still experience allergic reactions or illness. Emergency care plays a vital role in managing snake bites since prompt medical action is necessary to lessen the extent of symptoms and avoid potentially fatal consequences.[12]

I. **Neurotoxic Venom**: Neurotoxic venom prevents neuromuscular transmission by reducing acetylcholine release (presynaptic) or blocking nicotinic receptors (postsynaptic), resulting in flaccid paralysis and respiratory failure. Immediate antivenom and ventilatory assistance are critical to preventing death.Common in species like cobras and kraits.[7,15]

II. **Hemotoxic Venom**: Targets the circulatory system, Hemotoxic venom impairs coagulation and vascular integrity, resulting in excessive bleeding, blood clots and tissue necrosis. It causes shock and multiple organ failure, necessitating immediate antivenom and supportive care. Found in species like vipers and pit vipers.[7,15]

III. **Cytotoxic Venom**:Primarily causes local tissue damage, Cytotoxic venom causes cell membrane breakdown, vascular leakage, and inflammatory necrosis, resulting in extensive tissue death, haemorrhage, and oedema. Antivenom therapy, surgical debridement, and infection management may be required to treat progressive gangrenous necrosis. Found in species like the saw-scaled viper.[7,15]

IV. **Mixed Venom**: Some snakes have a combination of neurotoxic, hemotoxic, and cytotoxic effects in their venom. These bites can have more complex symptoms and are particularly dangerous.Examples include the king cobra.[7,15]

The kind, intensity, look, and location of a snake bite can all be used to categorise the markings left by the bite. Venomous snakes usually leave two different puncture marks after a bite, and they can bite with one or two fangs. From moderate bites that cause little pain or discomfort to severe bites that cause necrosis, swelling, and deep tissue injury, severity ranges. Slash marks from non-venomous constrictors, simple puncture wounds from venomous snakes, or widespread swelling and discolouration in cases of severe envenomation are all examples of bite marks. A bite can occur on the face, neck, or extremities; bites to the face or neck are riskier since they may cause breathing problems. Bite marks might also evolve into more serious symptoms over time or appear fresh right after the incident.[3,7,12]

Classification Type	Description
Type of Bite	Single Fang, Double Fang, Multiple Fang Marks
Severity	Mild, Moderate, Severe
Appearance of Bite Marks	Puncture Wounds, Slash Marks, Swelling/Discoloration
Region of Bite	Local (Extremities), Facial/Neck
Time Since Bite	Fresh Bite Marks, Developed Bite Marks

Table 1.: Classification of Snake bite

Snakebite marks differ depending on the species and envenomation kind. Venomous snakebites usually have two distinct fang marks and are accompanied by local oedema, discomfort, and systemic consequences. Non-venomous bites typically have several minor teeth marks without considerable envenomation. The toxicity of snake poisoning is determined by the type of venom used: neurotoxic venom (e.g., cobra, krait) causes paralysis and respiratory failure, hemotoxic venom (e.g., viper) causes coagulopathy and haemorrhage, and cytotoxic venom causes severe local tissue necrosis. Mixed venom effects may cause multi-organ malfunction, demanding immediate medical attention.[7,12]

Anti-Snake Venom (ASV) is an important treatment for snakebite envenomation, neutralising venom poisons with antibodies obtained from immunised animals. It is characterised as monovalent (for a single species) or polyvalent (for a group of species such as India's "Big Four"). When administered intravenously, ASV is critical for neurotoxic (paralysis, respiratory distress) and hemotoxic (coagulopathy, haemorrhage) envenomation. However, it carries hazards such as anaphylaxis and serum sickness, which necessitate close monitoring and supportive care. Despite its importance, issues with accessibility and timely use persist, particularly in rural India.[7,12]

METHODOLOGY AND OBSERVATIONS:

This study used a retrospective observational approach to analyse data on snake bites at Goa Medical College (GMC) from 2020 to 2024. It looked into patient medical records from inpatient wards, outpatient clinics, and emergency rooms. Seasonal patterns and trends over the five years are highlighted by the analysis, which concentrated on the monthly distribution of cases, the overall number of snake bite events, and the number of fatalities. The results sought to determine peak times, gauge the cost of healthcare, and determine how well treatments worked to lower mortality.

OBSERVATIONS:

MONTH	YEAR					
	2020	2021	2022	2023	2024	
JANUARY	28	38	23	25	32	TOTAL NUMBER OF CASES IN 5 YEAR SPAN
FEBRUARY	21	15	21	29	34	
MARCH	24	20	31	32	24	
APRIL	15	18	24	29	36	
MAY	27	20	39	22	22	
JUNE	26	32	35	36	25	
JULY	29	21	41	35	38	
AUGUST	20	34	25	28	26	
SEPTEMBER	25	18	24	33	31	
OCTOBER	33	31	34	40	23	
NOVEMBER	28	32	20	31	28	
DECEMBER	31	25	28	22	26	
TOTAL	307	304	345	362	345	1663

Table 2 :Cases reported at casualty, Goa Medical College

YEAR	NO.OF IPD DEATHS
2020	6
2021	6
2022	2
2023	5
2024	7
TOTAL	26

Table 3:Number of Non. M.L.C IPD deaths reported

DEMOGRAPHIC OBSERVATIONS:

PLACES	ESTIMATED CASES	%
North goa	299	18%
South goa	366	22%
Maharashtra	416	25%
Karnataka	333	20%
Others	249	15%
TOTAL	**1663**	**100%**

Table 4: Distribution according to locality

AGE	MALE	FEMALE	TOTAL	% OF TOTAL CASES
1-10	86	47	133	8%
11-20	162	87	249	15%
21-30	216	117	333	20%
31-40	194	105	299	18%
41-50	151	82	233	14%
51-60	108	58	166	10%
61-70	86	47	133	8%
70 above	75	42	117	7%
TOTAL	**1078**	**585**	**1663**	**100%**

Table 5: Distribution according to age

OCCUPATION	ESTIMATED CASES	%
Farmers	658	39.58%
Students	388	23.34%
Proffessionals	128	7.70%
Others	489	29.38%
TOTAL	**1663**	**100%**

Table 6: Distribution according to the occupations

REGION OF BITE	ESTIMATED CASES	%
Lower limbs	998	60%
Hands and fingers	416	25%
Forearms and wrists	166	10%
Face and neck	83	5%
TOTAL	**1663**	**100%**

Table 7: Distribution according to region of bite

SURVIVAL PERIOD	ESTIMATED SURVIVORS	DEATHS	TOTAL	%
Less than 6 hrs	196	16	212	12.75%
7-24hrs	295	8	303	18.22%
1-3 days	410	0	410	24.66%
4-7 days	361	0	361	21.71%
More than 7 days	375	2	377	22.66%
Total	**1637**	**26**	**1663**	**100%**

Table 8: Distribution according to survival period

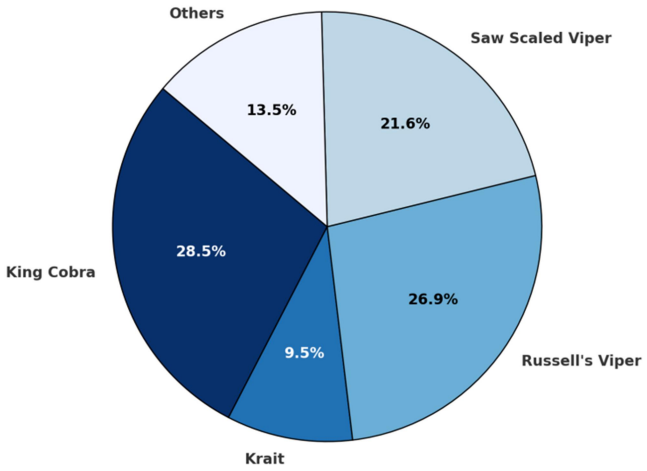

Fig 1: Distribution according to type of snake

TYPE OF VENOM	ESTIMATED CASES	%
Neurotoxic Venom	499	30%
Hemotoxic Venom	582	35%
Cytotoxic Venom	333	20%

Mixed Venom	249	15%
TOTAL	**1663**	**100%**

Table 9: Distribution according to the type of venom

RESULTS AND DISCUSSION

The information presented in (Table 2 and Fig 1) shows the yearly pattern of snakebite cases that were reported to Goa Medical College's casualty department between 2020 and 2024. With a peak of 362 cases in 2023 and a total number of 304 cases in 2021, there is a clear pattern of varying case incidence. The number of cases increased overall between 2020 and 2023, with a notable increase in 2022 (345 cases) and another surge in 2023 (362 cases), according to a year-over-year comparison. However, 345 cases are reported in 2024, which is comparable to 2022 numbers but slightly lower than the prior year. Monthly distributions reveal significant variances, with certain months showing a persistently larger number of instances. Monthly distributions show significant variances, with certain months having consistently higher cases. For example, July, a peak monsoon month, has one of the highest case counts, with 41 cases in 2022, 35 in 2023, and 38 in 2024. Similarly, October 2023 (40 cases) is identified as a high-risk timeframe. Conversely, February and April, which normally report fewer instances, show a significant increase in 2023 and 2024, indicating a shift in seasonal trends or higher reporting efficiency. These tendencies deserve further investigation to discover the underlying environmental or behavioural reasons that are causing the observed variances.

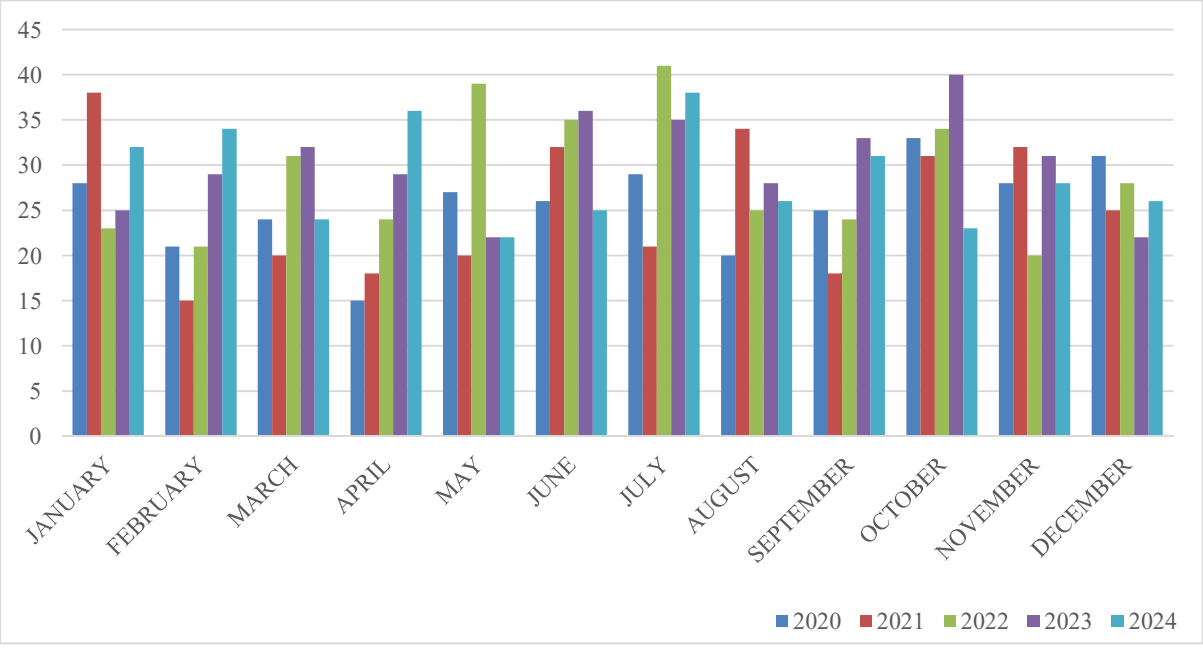

Fig 2: Graphical representation for number of cases reported

The annual variance in non-M.L.C. IPD deaths at Goa Medical College from snakebite is seen in (Table 3 and Fig 2), where the fatality rate ranges from 2 to 7 cases between 2020 and 2024. While 2020 and 2021 had a constant fatality count of 6 cases each, a significant reduction to 2 deaths in 2022 shows possible improvements in clinical care. However, mortality increased in 2023 (5 cases) and peaked in 2024 (7 cases), indicating possible delays in intervention, increased envenomation severity, or treatment challenges. These results underline the importance of increased surveillance, early antivenom administration, and optimised treatment techniques in reducing snakebite fatalities.

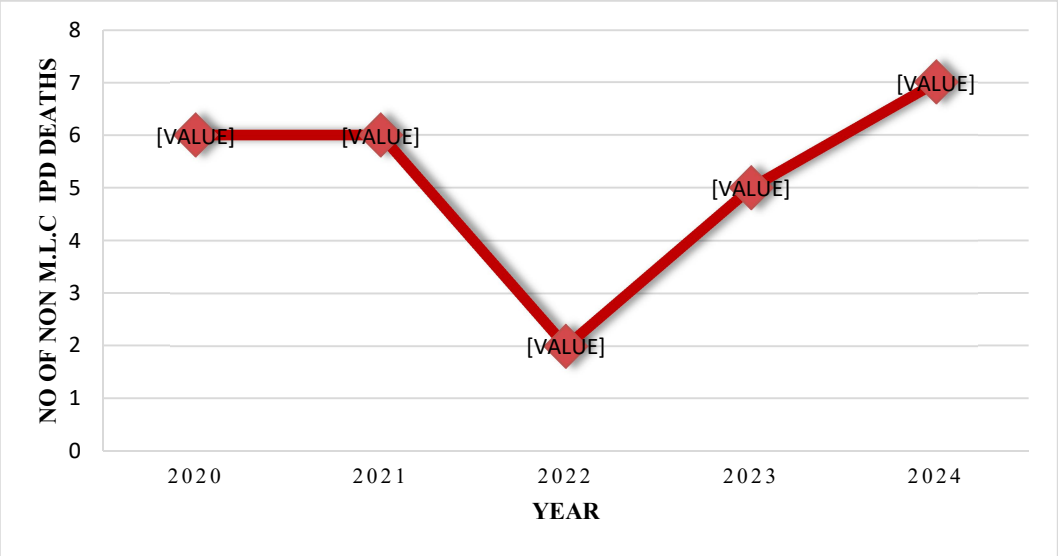

Fig 3: No. of non M.L.C cases at GMC

A stated epidemiological study of 1663 snakebite cases was done. The data was broken down by type of venom, snake species, length of survival, demographic factors, anatomical bite sites, and region of prevalence. The most common type of envenomation was hemotoxic (35%), followed by neurotoxic (30%), cytotoxic (20%), and mixed (15%). This shows that snakebites can have a wide range of effects on the body. King Cobra had the highest case burden, outnumbering Russell's Viper, Krait, and Saw Scaled Viper, highlighting its clinical significance. Survival analysis revealed that over 60% of patients continued for more than three days, with 26 fatalities occurring primarily during the first 24 hours, emphasising the importance of prompt antivenom medication and critical care assistance. Males and people aged 21 to 30 were disproportionately impacted, with instances concentrating in North Goa, South Goa, Maharashtra, Karnataka, and the adjacent areas. Bite site analysis revealed a prevalence of lower

limb envenomation, followed by hand and forearm involvement, which is consistent with occupational and environmental exposure patterns.

To address the increasing number of snakebite cases and changing mortality at Goa Medical College, a diversified approach is required. Early response, including immediate detection, prompt administration of antivenom, and standardised treatment methods, can greatly reduce mortality. Prioritise community awareness initiatives about first-aid measures, avoidance methods, and the significance of early hospital visits. Furthermore, establishing a reliable antivenom supply chain, training healthcare providers in envenomation management, and adopting real-time surveillance systems for snakebite patients can improve patient outcomes. Collaboration among healthcare institutions, public health authorities, and local communities is critical for reducing the burden of snakebite-related morbidity and mortality.

DISCUSSION

The World Health Organisation estimates that India accounts for nearly half of the global snakebite mortality, with yearly fatalities ranging from 81,000 to 138,000. According to other estimates, over 58,000 people die from snake bites in the country each year. This disparity emphasises the problem of underreporting and the necessity for more precise data gathering. The bulk of these instances occur in rural areas, affecting largely agricultural workers and children, who are more vulnerable due to their lesser body mass.

The data from Goa Medical College is consistent with national trends, highlighting the crucial need for improved snakebite management practices.[11] The observed changes in case numbers and mortality rates highlight the significance of prompt medical response, access to effective antivenoms, and comprehensive public health programs. Implementing targeted education initiatives, expanding access to healthcare facilities, and assuring the availability of high-quality antivenoms are all critical measures towards lowering the burden of snakebite envenoming in India. The investigation of snakebite incidences at Goa Medical College between 2020 and 2024 demonstrates a shifting pattern in both instances and death.

The overall number of cases varied from 304 in 2021 to a high of 362 in 2023, with fatality rates ranging from 2 to 7 deaths per year. Notably, the number of fatalities fell significantly to two in 2022, implying that clinical treatment or early intervention measures may have improved. However, the ensuing increase

in deaths to 5 in 2023 and 7 in 2024 highlights persistent issues in snakebite care. In comparison, India has a significant weight of snakebite incidences and fatalities.

A distinctive and unusual case for discussion.:

The case study demonstrates the deadly course of cobra envenomation in a paediatric patient, despite early ASV treatment and intensive care. On day six, the kid experienced multi-organ dysfunction, coagulopathy, heart failure (EF 25-30%), and systemic toxicity, all of which led to cardiorespiratory arrest. Localised observations included oedema, brittle nails, and gangrene, all of which indicated serious vascular injury. Despite resuscitative efforts, the kid died on day thirteen from refractory shock and multi-organ failure. Post-mortem examination revealed severe tissue necrosis and systemic involvement, emphasising the critical need for early diagnosis, vigorous supportive care, and increased snakebite awareness to avoid paediatric mortality.

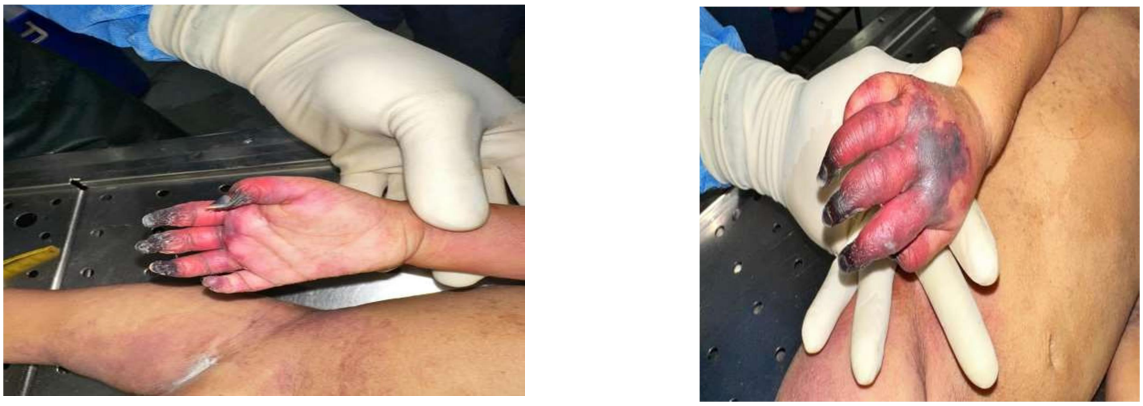

Fig 3: The patient has gangrenous alterations with purplish-black discolouration, a dry shrivelled appearance, and inward bending of the right 1st to 5th fingertips, spreading to the palmar and dorsal hand, with surrounding erythema and oedema that is distinct from normal forearm tissue. These findings indicate Clostridium perfringens infection.

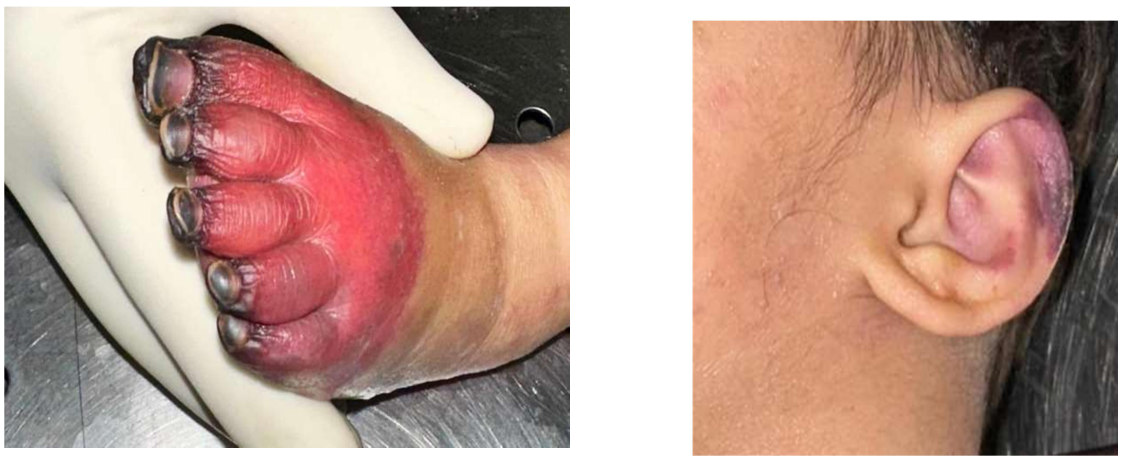

Fig 4: Gangrenous change in form of purplish black discoloration of left foot involving all five toes with dry, shrivelled appearance of toes with intense reddening and edema of surrounding tissues

Fig 5 :There is presence of reddish purple discoloration of left pinna, antihelix region in upper region with dry shrivelled appearance with clear demarcation from surrounding tissues.

Snakebite envenomation remains a substantial occupational and environmental risk, particularly in rural agricultural areas. Farooqui et al. (2014) examined the epidemiological trends of fatal snakebite cases in Loni, Maharashtra, emphasising the seasonal increase in incidences, particularly during the monsoon months, as well as the vulnerability of farmers. Similar studies in India (Sharma et al., 2013; Bawaskar et al., 2020) found that lower extremities are the most prevalent bite areas, with Viper and Krait species being the primary perpetrators. The reliance on traditional healers, as well as the time it takes to seek medical attention, contribute to higher death rates. [5]

Snakebite envenomation is a common yet underreported cause of death in India, particularly in rural regions. Mohapatra et al. (2011) estimated 45,900 deaths per year, with a high frequency in males aged 15-29 and during the monsoon season. High mortality rates in places such as Uttar Pradesh and Andhra Pradesh are consistent with previous research (Warrell et al., 1999; Bawaskar et al., 2008), which highlight delays in medical care and reliance on traditional healers (Alirol et al., 2010). Given India's considerable contribution to global snakebite deaths, greater community awareness, prompt treatment, and reinforced healthcare systems are critical (Gutiérrez et al. 2006).[6]

Snakebite envenomation is a serious public health hazard in India, with Suraweera et al. (2020) forecasting 1.2 million deaths from 2000 to 2019, with an average of 58,000 each year. The majority of fatalities occurred in rural regions, largely at home, with a surge during the rainy season and a concentration in eight high burden states. These findings are consistent with previous research (Mohapatra et al., 2011; Warrell et al., 2013), which highlighted spatial and seasonal grouping. Limited healthcare access, delayed ASV administration, and dependence on traditional healers all lead to poor outcomes (Alirol et al., 2010; Gutiérrez et al., 2017). Targeted preventive, enhanced rural healthcare, and prompt ASV access are critical interventions (Bawaskar et al., 2008). The WHO's goal of reducing snakebite mortality by 2030 necessitates comprehensive intervention and continuing epidemiological surveillance.[10]

This study is consistent with previous research on snakebite epidemiology and management in Australia, identifying the Eastern Brown snake as the predominant cause and VICC as the most prevalent envenomation syndrome. It emphasises early diagnosis, rapid antivenom administration, and adherence to national norms. Despite a lower-than-expected rate of envenomation, one episode of serum illness was reported, most likely because to the limited sample size. A higher rate of early patient discharge was seen with no negative consequences. The findings support current standards while proposing additional investigation into regional variances and discharge patterns.[1]

CONCLUSION

Snakebite envenomation is a severe yet neglected public health threat, disproportionately affecting rural and agrarian populations where employment risk is high. This study reveals dynamic case trends and chronic death, revealing systemic gaps in intervention despite medical advances. The significant discrepancy between recorded cases and non-MLC IPD mortality emphasises the critical need for standardised techniques and faster ASV delivery. Mitigating this epidemic requires an aggressive multipronged approach that includes teaching vulnerable communities about poisonous snake identification, implementing strict penalties against fake healers, and encouraging parental vigilance to reduce paediatric cases. This five-year statistical analysis underlines the importance of policy-driven recalibration, improving healthcare accessibility, and amplifying public health initiatives. Only via systematic intervention frameworks can we significantly reduce snakebite-related mortality and improve patient outcomes.

Our assessment of snakebite incidence and Non-MLC IPD mortality from 2020 to 2024 highlights the ongoing impact of envenomation, despite medical improvements. Case patterns show a peak in 2023 (362 cases), with continuously high numbers in 2022 and 2024 (345 each), while IPD deaths fluctuated, reaching their lowest in 2022 (2 deaths) and highest in 2024 (7 deaths). A noticeable cyclical spike during the monsoon season underlines the heightened risk of human-snake confrontations. The epidemiological findings indicate that among 1663 snakebite cases, males (21-30 years old) and farmers were the most affected, with hemotoxic venom (35%) being the most common. King Cobra instances outnumbered Russell's Viper, Krait, and Saw Scaled Viper, with lower limb bites being the most common. While more than 60% survived beyond three days, 26 died within 24 hours, emphasising the importance of early intervention. Cases were concentrated in North Goa, South Goa, Maharashtra, and Karnataka, demanding specialised clinical and public health interventions.The mismatch between case

numbers and fatality rates indicates a lack of timely response, ASV administration, and access to critical care. To reduce mortality and improve patient outcomes, snakebite management must be strengthened through early diagnosis, prompt treatment, and community-based prevention efforts.

REFERENCES

1) Chandru, Pramod, et al. "Suspected snakebite in a tertiary referral centre in Western Sydney: a 10-year case series." *Toxicology Communications* 7.1 (2023): 2249704.
2) Kumar, Pramod. "Snakebite and LAD." *Journal of Society for Wound Care & Research* 13.1 (2020).
3) Shrestha, Gyaneswhor, et al. "An ischemic complication of a snake bite: Case report." *International journal of surgery case reports* 112 (2023): 108962.
4) Alsolaiss, Jaffer, et al. "Investigating Snake-Venom-Induced Dermonecrosis and Inflammation Using an Ex Vivo Human Skin Model." *Toxins* 16.6 (2024): 276.
5) Farooqui, Jamebaseer M., et al. "Incidence of fatal snake bite in Loni, Maharashtra: An autopsy based retrospective study (2004–2014)." *Journal of forensic and legal medicine* 39 (2016): 61-64.
6) Mohapatra, Bijayeeni, et al. "Snakebite mortality in India: a nationally representative mortality survey." *PLoS neglected tropical diseases* 5.4 (2011): e1018.
7) Pillay, V. V. *Modern Medical Toxicology.* 4th ed., Jaypee Brothers Medical Publishers, 2013.
8) Kalantri, Shriprakash, et al. "Clinical predictors of in-hospital mortality in patients with snake bite: a retrospective study from a rural hospital in central India." *Tropical Medicine & International Health* 11.1 (2006): 22-30.(DOWNLOADS)
9) Ahmed, Syed Moied, et al. "Retrospective analysis of snake victims in Northern India admitted in a tertiary level institute." *Journal of Anaesthesiology Clinical Pharmacology* 28.1 (2012): 45-50.
10) Suraweera, Wilson, et al. "Trends in snakebite deaths in India from 2000 to 2019 in a nationally representative mortality study." *Elife* 9 (2020): e54076.
11) Gajbhiye RK, Munshi H, Bawaskar HS. National programme for prevention & control of snakebite in India: Key challenges & recommendations. Indian J Med Res. 2023 Apr;157(4):271-275. doi: 10.4103/ijmr.ijmr_2424_22.
12) Jesudasan, John Emmanuel; Abhilash, Kundavaram Paul Prabhakar. Venomous Snakebites: Management and Anti-snake Venom. Current Medical Issues 17(3):p 66-68, Jul–Sep 2019. | DOI: 10.4103/cmi.cmi_33_19

13) "The Guardian." *South Sudan Medics Trial AI App to Identify Snakes and Improve Bite Treatment.* 25 Sept. 2024, https://www.theguardian.com/global-development/2024/sep/25/south-sudan-medics-trial-ai-software-to-identify-snake-and-improve-bite-treatment.

14) Frost, Jim. "Retrospective Study: Definition & Examples." *Statistics by Jim*, https://statisticsbyjim.com.

15) Reddy, K. S. Narayan. *Essentials of Forensic Medicine and Toxicology.* 34th ed., Jaypee Brothers Medical Publishers, 2017.