

Research Article

Pre-Hospital Delay Due to Faith Healers' Consultation Had Adverse Impact on Outcomes in Snakebite Patients- A Hospital-Based Study from Kangra District, Himachal Pradesh (2021–2025)

Nikunj Kankodia¹, Jaideep C Menon², Rajesh Kumar Sood³, Archana Phull⁴, Anu Suresh⁵, Omesh Kumar Bharti⁶, Tushar Saini⁷

¹Project Technical Support, Indian Council of Medical Research, ICMR, funded, Project SARPA, "Zero Snakebite Death Initiative, Community Empowerment & Engagement for Mitigation of Snake Bites Envenoming, PTS at District Kangra, Himachal Pradesh, India

²Department of Cardiology, Amrita Institute of Medical Sciences, Amrita Vishwa Vidyapeetham, Ernakulam District, Kochi, Kerala, India

³Medical Officer Health, O/o Chief Medical Officer, Kangra at Dharamshala, Himachal Pradesh, India

⁴Research Scientist, Indian Council of Medical Research, ICMR, funded, Project SARPA, "Zero Snakebite Death Initiative, Community Empowerment & Engagement for Mitigation of Snake Bites Envenoming" District Kangra, Himachal Pradesh, India

⁵Research Scientist, Indian Council of Medical Research, ICMR, funded, Project SARPA, "Zero Snakebite Death Initiative, Community Empowerment & Engagement for Mitigation of Snake Bites Envenoming" District Ernakulam, Kerala, India

⁶Deputy Director Health Services & State Epidemiologist, Directorate of Health Services, Kasumpti, Shimla, Himachal Pradesh, India

⁷Medical Officer, Civil Hospital Nurpur, District Kangra, Himachal Pradesh, India

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I N F O

Corresponding Author:

Jaideep C Menon, Department of Cardiology, Amrita Institute of Medical Sciences, Amrita Vishwa Vidyapeetham, Ernakulam District, Kochi, Kerala, India

E-mail Id:

Menon7jc@gmail.com

Orcid Id:

<https://orcid.org/0000-0002-0786-8123>

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A B S T R A C T

Background: Snakebite envenoming is a neglected tropical disease responsible for preventable deaths in rural India. In Kangra District, Himachal Pradesh, the unique combination of hilly terrain, dispersed habitation and wetland ecosystems resulting in unique risk factors for snakebite.

Objective: To study the clinical profile, health seeking pathways and outcomes of snakebite cases at a secondary-care facility over five years.

Methods: A retrospective data analysis from Civil Hospital Nurpur was done from January 2021 to December 2025. A total, 222 snakebite cases presented in this time period. A structured proforma of 62 variables was used for data collection. We included largely data variables that were complete and relevant (demographics, clinical features, venom type, pre-hospital delay, ASV use, complications or outcomes).

Results: Of the 222 cases analyzed, 59.9% were males (mean age: 36.8 ± 17.6 years). Lower limb bites cases were predominated (52.3%).

Envenomation type was classified in 127 cases; of these, haemotoxic envenomation accounted for 35 cases (15.8% of total; 27.6% of classified) and neurotoxic for 18 cases (8.1% of total; 14.2% of classified). Significant species identified ($n = 49$) were Russell's viper (67.4%). The crude case fatality ratio (CFR) was 7.2% ($n = 16$) of which, 13 (81.3%) were brought dead or died on arrival. The majority of the cases (82.4%) occurred in the monsoon months. Administered anti-snake venom (ASV) in 52.3% of cases and 4.5% reported anaphylaxis. Significantly, 8 (50%) of the total 16 deaths were clustered in the area around the Pong Dam water reservoir.

Conclusion: Pre-hospital delay and faith-healer consultation are the important modifiable determinant for snakebite mortality in Kangra. Of the cases with confirmed health-seeking behaviour, 43.7% (45/103) consulted a faith healer or temple before presentation to hospital, with delay of between 1-7 hours in some case. The Pong Dam reservoir area is an ecological mortality hotspot warranting targeted surveillance and community intervention.

Keywords: Snakebite Envenoming, Snakebite, Anti-Snake Venom, Pre-Hospital Delay, Case Fatality Rate, Kangra, Faith Healers

Introduction

Snakebite envenoming has been recognized by the World Health Organization (WHO) as a priority neglected disease, with a global burden of 5.4 million snakebites and 81,410 to 137,880 deaths annually.¹ India accounts for half of snakebite deaths, with approximately 58,000 deaths annually.^{2,3} The 'Big Four' venomous snakes (Russell's viper (*Daboia russelii*), Common krait (*Bungarus caeruleus*), Indian cobra (*Naja naja*), and Saw-scaled viper (*Echis carinatus*)) are responsible for most medically important envenomation throughout the Indian subcontinent.⁴

In India affordable polyvalent anti-snake venom (ASV) is available from secondary-level hospitals, and despite this availability, snakebite deaths continue to occur due to many reasons. Common factors for snakebite deaths, particularly in hilly and forest areas, include delayed treatment, reliance on traditional healers, poor transport facilities, and inadequate healthcare services.^{3,9} In India, the majority of the population earns their livelihood by working in the agricultural field, where they have a chance of being bitten by snakes.⁴ Kangra District in Himachal Pradesh is disproportionately vulnerable to high snakebite death resulting from treatment delays due to some epidemiological factors such as high hills, scattered village communities, and poor ambulance connectivity. Another reason why there is a higher incidence of snake bite deaths in the Kangra district is the presence of a wetland ecosystem because of the Pong Dam project in the district.⁸

With respect to the vision of the World Health Organization of achieving a reduction of half in the mortality rate due to snakebites by the year 2030, India launched the National Action Plan for Prevention and Control of Snakebite Envenoming (NAPSE) in 2021.⁶ Details on the trends of incidence, delays in management, and factors influencing mortality are essential to achieve such goals. Despite multiple national-level estimations, hospital-based research from Himachal Pradesh's hilly districts remains scarce.

This study analyzes five years of snakebite data from Civil Hospital Nurpur to describe the clinical profile, health-seeking pathways, ASV utilization, complications, and outcomes, including mortality determinants—in a secondary-care hospital serving a predominantly rural hilly population.

Materials and Methods

Study Population and Sampling

We included all patients who visited Civil hospital Nurpur during the five-year study period with a history of snakebite irrespective of their age, sex, residence, status of clinical examination. Total 222 cases were enrolled as per inclusion criteria.

Data Collection

A structured proforma consisting of 62 variables was designed to allow for data collection from medical records following the Indian Council of Medical Research's Snakebite Surveillance framework. Incomplete information in medical records was supplemented through telephonic interviews of patients or caregivers, using contact information retrieved from records with institutional permission.

Analysis of Statistics

Information was inputted into Microsoft Excel and analysed using SPSS. Expand to include: Chi-square test (or Fisher's exact test where expected cell count < 5) was used for categorical associations. Statistical significance was set at $p < 0.05$. Continuous variables are expressed as mean $\pm$ SD or median (IQR). Categorical variables are expressed as frequencies and percentages. Spatial mapping was performed using [Google Maps] based on patients' residential block data.

Ethics Approval

Before proceeding with the collection of data, a permission letter for accessing all required hospital records was obtained from Medical Superintendent Civil Hospital Nurpur. The study did not involve any direct contact with or intervention on patients. To protect confidentiality, all patient identifiers were coded prior to the analysis. Hospital had taken written permission to start snakebite treatment and ASV use from the patients/relatives.

Results

Social and Demographic Characterises

Over a period of five years, 222 snakebite cases were analyzed. Of cases, 59.9% (n=133) were male and 40.1% (n=89) were female. The mean age was 36.8 years (SD ± 17.6 ; range: 3–76), which is consistent with the working-age population exposed to agricultural and outdoor occupational risk. Nurpur block was the home for most patients (n=103; 46.4%); others came from Fatehpur (n=31, 14%), Jawali (n=30, 13.5%), and Indora (n=28, 12.6%), which mirror the still-to-catchment area of the hospital. A few patients were from neighboring districts like Sirmaur, Chamba, and Gurdaspur (Punjab).

For patients with access to socio-economic data, 49 cases (22.1%) had health insurance coverage (Ayushman Bharat, HimCare, or Him Scheme), whereas 38 cases (17.1%) were not insured, and for a total of 135 cases, no record was available about the form of health cover they possess (60.8%). In our study, only one patient was recorded as having a below Poverty Line (BPL) card in the hospital administration database, which is most likely to be under-reporting rather than true prevalence of poverty.

Table 1 summarises the demographic and clinical characteristics of the study population.

Clinical Features

The commonest body site was the lower limb (foot, leg, or ankle) with 52.3% (n=116), as expected for occupational exposure while working in agricultural activities or pre-domestic settings such as roadsides and dark areas within or around the home. Twenty-point-three percent (n=45) of injuries were upper limb bites (hand, finger, or arm).

A bite venue was documented in 150 cases: 37.3% (n=56) occurred on agricultural fields, 24.7% (n=37) at home,

and 10.7% (n=16) on roads; the place of the bite was not recorded for 72 cases.

Based on clinical classification, according to the initial features and WBCT results, hemotoxic envenomation was experienced in 35 (15.8%); neurotoxic envenomation in 18 (8.1%); and non-venomous/not classified were seen in 73 (32.9%) cases. One case presented with mixed features of snakebite (0.5%). The majority of the envenomation type was undetermined because documentation was incomplete.

Of the total 222 cases, snake species could be identified in 49 cases (22.1%). Among these, Russell's viper (*Daboia russelii*) was the most commonly identified species, accounting for 67.4% (n=33), followed by cobra (n=8; 16.3%) and common krait (n=8; 16.3%), as shown in figure 1. No cases of saw-scaled viper were identified. Species identification was not possible in 173 cases (77.9%), limiting detailed species-level analysis. The predominance of Russell's viper aligns with the observed hemotoxic clinical features in this cohort.

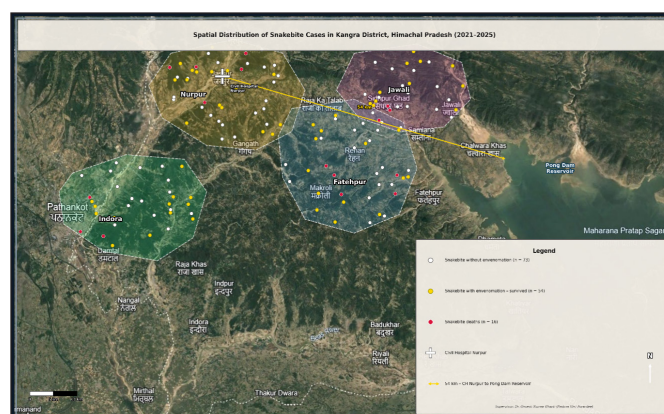
WBCT on admission was performed in 199 cases (89.6%), indicating a relatively uniform diagnostic pattern. A total of 10 patients (4.5%) reported anaphylactic reactions during ASV administration, treated with antihistamines, steroids, and/or adrenaline when indicated.

White dots indicate snakebite cases without envenomation (n = 73), yellow dots indicate snakebite cases with envenomation who survived (n = 54), and red dots indicate snakebite deaths (n = 16). The cross symbol represents Civil Hospital Nurpur, while the yellow arrow indicates the approximate 54 km distance between Civil Hospital Nurpur and Pong Dam Reservoir. Visible dots may not exactly correspond to the total number of documented cases due to overlapping geographic locations and incomplete address details in some hospital records.

Table 1. Demographic and Clinical Characteristics of Snakebite Cases (n=222), Civil Hospital Nurpur, Kangra District, 2021–2025

Variable	Category	n	%
Sex	Male	133	59.9
	Female	89	40.1
Mean Age (years)	36.8 $\pm$ 17.6 (range 3–76)	—	—
Site of Bite	Lower limb (foot/leg/ankle)	116	52.3
	Upper limb (hand/finger/arm)	45	20.3
	Other/Not recorded	61	27.4
Place of Bite (n=150)	Field/Agricultural setting	56	37.3
	Home	37	24.7
	Road	16	10.7
	Other/Not recorded	41	27.3

Envenomation Type	Haemotoxic	35	15.8
	Neurotoxic	18	8.1
	Mixed	1	0.5
	Non Venomous/ Not classified/ Not documented	168	75.7
Snake Species (among identified cases, n=49)	Russell's viper	33	67.4
	Cobra	8	16.3
	Common krait	8	16.3
	Saw-scaled viper	0	0
Faith Healer Visit (recorded cases, n=103)	Yes	45	43.7
	No	58	56.3
Health Insurance (recorded cases, n=87)	Insured (Ayushman/HimCare/Him Scheme)	49	56.3
	Uninsured	38	43.7



time, as well as animal/snake activity around the rains and floods. All five years were represented, but the number of cases in each varied.

The yearly numbers of cases varied between 26 in 2023 and 56 in 2025, there being no obvious linear relationship. In relation to the CFR, there was an observed downward trend between 2021 and 2025 (10.9% and 3.6%, respectively), perhaps suggesting some positive effect in relation to patient outcome.

ASV Dose Distribution

ASV was employed in Civil Hospital Nurgur in 116 patients (52.3% of total patients). Of the 147 patients in whom complete data regarding the total amount of ASV dose was available, the total dose was the median (interquartile range [IQR] 0-10) 10 vials while mean dose was 5.5 vials (standard deviation [SD] 5.2). Further 57 cases (38.8% of ASV users) received standardized doses (10 vials) suggesting Adherence to guidelines. Total ASV dose >10 vials were given to 6 cases (4.1%); one patient received 20 vials for persistence of coagulopathy with absence of clot retraction and the other received 16 vials with increasing process and continuing symptoms. ASV was not administered to 64 patients (28.8%) because of a high percentage of dry bites (32.9%) and asymptomatic victims. There were 10 patients (4.5%) who were found to develop anaphylactic reactions to ASV as shown in table 2.

Complications

Complications were seen in the vast majority of patients. Coagulopathy (confirmed by absence of WBCT clotting or bleeding signs) was the most common, occurring in 26 patients (11.7%) and usually related to hemotoxic envenomation (Russell's viper bite). Neuroparalysis was seen in 16 patients (7.2%). Clinical manifestations included ptosis, diplopia, dysphagia, dysarthria, or respiratory failure requiring ventilation. This usually occurred with neurotoxic envenomation (Krait and Cobra bite). Respiratory failure requiring intubation or mechanical ventilation occurred in 6 patients (2.7%). An acute kidney injury evidenced by either renal dysfunction or the need for dialysis was noted in four patients (1.8%), with one patient undergoing hemodialysis sessions thrice at a tertiary referral center. Anaphylactic reaction to ASV was noted in 10 patients (4.5%), while local tissue necrosis or cellulitis was noted in 4 patients (1.8%). Isolated instances of transient supraventricular tachycardia (SVT, n=1) and status epilepticus (n=1) are reported rarely. The distribution of complications is presented in Table 3.

Outcomes and Mortality

Of 222 cases, 133 (59.9%) were successfully treated and discharged from the hospital, 52 (23.4%) were referred to higher centres for further management, 21(9.5%) left against medical advice (LAMA), and 16(7.2%) died on admission giving an overall case fatality rate (CFR) of 7.2% [Table 4].

Of the 16 deaths, 13 were at patients who were dead on arrival or died within a few minutes of coming to hospital, resuscitation attempt with no measurable vitals.

Of the three admitted patients, two died from severe haemotoxic envenomation with coagulopathy and acute kidney injury and one died from neurotoxic envenomation with respiratory failure.

The relationship between prehospital delay and outcome was investigated in the 106 cases where delay had been recorded. Of the 13 patients who presented beyond six hours (>6 hr delay group), all were either dead on arrival or expired shortly after arrival. No deaths were noted among the 1–3-hour delay cohort (n=54). This pattern suggests a strong temporal relation between pre-hospital delay and death, but this is not proof of causality in this retrospective design (Table 5).

ASV = Anti-Snake Venom; CHC = Community Health Centre; LAMA = Left Against Medical Advice; WBCT = Whole Blood Clotting Test.

Delay to first ASV = estimated interval between snakebite and first ASV dose at any facility, based on documented arrival and bite times.

ASV dose columns reflect total vials administered at CH Nurgur only (not including peripheral doses for referred cases).

** 27 cases had no dose recorded in the register; these are included in totals but excluded from dose-band sub-analysis.*

+ 'Referral status not documented' (n=36) = referral field blank or 'Not recorded'; these cases received ASV at CH Nurgur but first-contact facility is unknown.

Dose colour coding: green = 10 vials (standard protocol); amber = 1–4 vials or >10 vials (non-standard); grey italic = not administered.

Outcome totals: Discharged 62 + Referred 45 + LAMA 5 + Death/Brought dead 4 = 116. Remaining 12 of 16 total deaths occurred among non-ASV cases (brought dead / no active treatment).

Colour legend: Yellow rows = documented faith-healer / temple visit before hospital arrival (Cases 1–2). Pink rows = brought dead / no prior formal treatment documented (Cases 4–6, 8–9, 12–15).

CHC = Community Health Centre; PM = post-mortem examination; ASV = anti-snake venom; DRPGMC = Dr Rajendra Prasad Government Medical College; RPGMC = Regional PG Medical College; GMC = Government Medical College.

Case 3: died after discharge; causal relation to snakebite uncertain per available records.

Case 7: classified as 'Brought dead' in raw data (brought dead at CH Nagrota Suriyan; referred to CH Nurpur for PM); treatment was attempted at peripheral CHC before death.

Case 10 (Satya Kumar): died at CH Indora during treatment; bite site not documented in admission record but PM confirms right hand puncture marks.

Case 11: ASV given at CH Nurpur; patient referred onward to Amandeep Hospital Pathankot and died; classified 'brought dead' in final outcome column of dataset.

Case 15: prolonged course from September to November 2025 (~73 days post-bite); most complex timeline in the series.

Case 16: snakebite on 15-08-2023 (Independence Day); death on 28-08-2023; five-facility chain across Himachal Pradesh and Punjab.

Block classification is based on residential address in the ICMR 62-variable proforma. 'Referred via Indora' for Case 16 indicates referral route, not residential block (patient is from Bihar).

Table 2. Anti-Snake Venom (ASV) Utilisation Parameters (n=222), Civil Hospital Nurpur, 2021–2025

Parameter	n / Value	Percentage (%)
ASV administered at CH Nurpur	116	52.3
ASV administered at peripheral institution (pre-referral)	15	6.8
No ASV required (dry bites / asymptomatic)	64	28.8
Standard dose (10 vials)	57	38.8*
Higher dose (>10 vials)	6	4.1*
Lower dose (≤5 vials)	84	57.1*
Anaphylactic reaction during ASV administration	10	4.5
Median total ASV vials (among those who received)	10	—

Table 3. Distribution of In-Hospital Complications among Snakebite Cases (n=222), Civil Hospital Nurpur, 2021–2025

Complication	Number of Cases	Percentage (%) of Total (n=222)
Coagulopathy	26	11.7
Neuromyopathy	16	7.2
Respiratory Failure / Distress	6	2.7
Acute Kidney Injury (AKI)	4	1.8
Anaphylactic Reaction to ASV	10	4.5
Local Cellulitis / Tissue Necrosis	4	1.8
Other (SVT, seizures, altered sensorium, AKI + hematuria)	5	2.3

Table 4. Distribution of Patient Outcomes among Snakebite Cases (n=222), Civil Hospital Nurpur, 2021–2025

Outcome Category	Number of Cases	Percentage (%)
Discharged	133	59.9
Referred	52	23.4
Left Against Medical Advice (LAMA)	21	9.5
Deaths	16	7.2
Total	222	100.0

Table 5. Referral Pathway, ASV Dose Distribution, and Clinical Outcomes among Snakebite Cases Receiving ASV at Civil Hospital Nurpur, Kangra District, Himachal Pradesh (2021–2025) (n = 116)

Referral Source / First Contact Facility	Cases (n)	Median Delay to First ASV	ASV Dose at CH Nurpur					Clinical Outcome			
			1–4 vials	5–9 vials	10 vials	>10 vials	Not Administrated	Discharged	Referred	LAMA	Death / Brought Dead
Directly presented to CH Nurpur	59	1–3 hours	4	12	24	3	16	30	27	1	1
CH Fatehpur → CH Nurpur	7	3–6 hours	—	2	4	—	1	5	2	—	—
CH Indora → CH Nurpur	5	3–6 hours	—	1	2	—	2	3	2	—	—
CH Gangath → CH Nurpur	4	3–6 hours	—	—	2	—	2	1	2	—	1
CH Jawali → CH Nurpur	3	Variable	—	—	3	—	—	2	—	—	1
Other referrals (CHC / Private)	2	Variable	—	—	1	1	—	—	1	1	—
Referral status not documented†	36	Not documented	—	7	20	3	6	21	11	3	1
TOTAL	116	—	4	22	56	7	27*	62	45	5	4

Table 6. Clinical Profile, Referral Pathway, and Post-Mortem / Clinical Findings among All 16 Snakebite Fatalities — Civil Hospital Nurpur, Kangra District, Himachal Pradesh (2021–2025)

Case No.	Age / Sex	Residential Block	Bite Site	Pre-Hospital Course & Delay	Referral Pathway	ASV / Treatment	Final Status	Post-Mortem / Treatment Records
1	65/F	Jawali	Left little finger	Temple visit documented before hospital; neurotoxic symptoms (ptosis, respiratory distress); bite time ~07:00 AM; arrived CH Jawali <1 hour; faith healer: YES (temple, ~10 min)	CH Jawali → CH Nurpur	ASV 10 vials at CH Nurpur; ventilation and CPR provided	Death during treatment	Neurotoxic envenomation — ptosis and respiratory distress documented; expired despite resuscitation

2	52/F	Nurpur	Right foot	~5-hour delay; temple visit documented (~1 hr lost); bite at ~12:30 PM; arrived CH Nurpur ~5 hrs later	CH Nurpur → RPGMC Tanda	ASV 10 vials administered at CH Nurpur	Death during treatment	Haemotoxic manifestations — coagulopathy and hypotension documented
3	74/F	Nurpur	Left great toe	Referred within ~1 hour from CHC Gangath; died after discharge — causal relation to bite uncertain per records	CH Gangath → CH Nurpur	ASV and supportive care at CH Nurpur	Died after discharge	Local swelling and haemotoxic features at admission; all investigations reportedly normal at discharge; death outside hospital
4	25/F	Fatehpur	Left leg	Bite ~08:00 PM on 07-07-2022; local treatment sought before referral; arrived CH Nurpur dead on 08-07-2022 at 12:45 AM (~4–5 hr delay)	Local treatment → CH Fatehpur → CH Nurpur	No ASV documentation (brought dead)	Brought dead	PM: Extensive blood infiltration around puncture marks on left leg; haemotoxic envenomation pattern
5	55/F	Indora	Left hand / ring finger	Bite ~05:00 PM on 01-08-2022; local treatment before referral; declared dead at CH Nurpur at 07:30 PM (~2.5 hrs)	CH Fatehpur → CH Nurpur	Not documented (brought dead)	Brought dead	PM: Haemorrhagic infiltration around puncture wounds on left hand / ring finger
6	1.5/M	Fatehpur	Right foot	Paediatric out-of-hospital fatality; no formal health-seeking documented; no referral pathway recorded	No referral — brought directly for post-mortem	Not documented	Brought dead	PM: Two pinpoint puncture marks (reddish-blue, 0.2×0.1 cm, 1.2 cm apart) on outer right foot; gross blood infiltration on dissection
7	6/F	Jawali (Nagrota Suriyan)	Right index finger	Presented to CH Nagrota Suriyan at 02:50 AM on 30-09-2025 with alleged unknown bite; died during treatment; body referred for PM	CH Nagrota Suriyan → CH Nurpur (post-mortem)	Treatment attempted before death	Died during treatment	PM: Right index finger puncture marks with evidence of envenomation; death during active treatment at peripheral CHC
8	11/F	Fatehpur (Haripur)	Right foot	Arrived at CH Fatehpur dead; severe pre-hospital delay; brought to CH Nurpur for PM on 04-09-2025	CH Fatehpur → CH Nurpur (post-mortem)	Not documented (brought dead)	Brought dead	PM: Two pinpoint puncture marks (0.1×0.1 cm, 2.0 cm apart) on right foot; reddish-blue discoloration; gross blood infiltration on dissection

9	56/M	Gangath	Right foot	Found dead in agricultural field; time of bite unknown; non-hospital death on 09-08-2025	Non-hospital death — PM at CH Nurpur	No treatment documented	Brought dead	PM: Two pinpoint puncture marks (1.2 cm apart) over right foot; clotted blood; blood infiltration on dissection; separate abrasion on left foot (no infiltration)
10	16/M	Indora	Thumb / hand	Bite ~02:00–02:30 AM on 04-08-2025; taken to CH Indora; declared dead during treatment at 03:50 AM (~1.5 hrs post-bite)	CH Indora → CH Nurpur (post-mortem)	Treatment initiated at CH Indora before death	Died during treatment	PM: Pinpoint puncture marks on right hand/thumb with haemorrhagic discoloration; severe rapid envenomation
11	21/M	Gangath	Right ankle	Multi-facility transfers; prolonged referral delay; ASV given at CH Nurpur but inadequate definitive care; died during transfer	CH Gangath → CH Nurpur → (DRPGMC Tanda advised) → Amandeep Hospital Pathankot	ASV given at CH Nurpur; No ASV at CH Gangath	Died during transfer	PM: Bluish discoloured area (1.2×1.1 cm) on inner right foot, 3.6 cm below lateral malleolus; blood infiltration on dissection
12	51/M	Pathankot (Punjab)	Left hand	Declared brought dead at Amandeep Hospital Pathankot at 03:08 PM on 04-10-2024 with suspected snakebite; body sent for PM	Amandeep Hospital Pathankot → CH Nurpur (post-mortem)	Unknown	Brought dead	PM: Two pinpoint puncture marks (1.6 cm apart) on palmar left hand; clotted blood; blood infiltration on dissection
13	5/M	Indora	Left foot	Paediatric out-of-hospital fatality on 14-07-2023; no documented health-seeking or referral pathway	No referral — brought directly for post-mortem	Not documented	Brought dead	PM: External examination and alleged history suggestive of snakebite; extensive haemorrhagic tissue changes in left foot

14	11/F	Nurpur	Right foot	Brought dead directly to CH Nurpur on 19-07-2023 at 04:23 AM; no prior formal care documented	CH Nurpur (direct — post-mortem)	Not documented (brought dead)	Brought dead	PM: Pinpoint puncture mark (0.1×0.1 cm) in web space between 3rd and 4th toe of right foot; blood infiltration on dissection
15	50/M	Jawali	Not clearly documented	Bite on 06-09-2025; received treatment at DRPGMC Tanda, Raj Hospital, and CH Nurpur; admitted CH Nurpur from 28-09-2025; deteriorated on 18-11-2025; referred to DRPGMC Tanda but taken to Fortis Kangra; brought dead	DRPGMC Tanda → Raj Hospital → CH Nurpur → (Fortis Kangra)	Treatment received at multiple facilities; documentation incomplete at CH Nurpur	Brought dead	PM conducted; prolonged multi-facility course (~73 days); alleged snakebite confirmed as cause of death; no clear bite mark documented at final PM
16	18/M	Referred via Indora (Bihar origin)	Left foot / toe	Bite on 15-08-2023; prolonged illness ~13 days; multi-facility referral chain spanning HP and Punjab; died during transfer on 28-08-2023	GMC Amritsar → CH Indora → CH Nurpur → Mukerian Private Hospital (died en route)	ASV administered at GMC Amritsar; subsequent facilities not documented	Died during referral pathway	PM: Abrasions on left foot/toe; chronic post-envenomation complications; five-facility referral chain documented

Spatial Distribution

Cases in four blocks accounted for 86% of total cases, with Nurpur (46.4%), Fatehpur (14.0%), Jawali (13.5%) and Indora block (12.6%) as shown in Table 6. Of the 16 deaths, eight (50%) were registered patients who lived in nearby villages around the Pong Dam reservoir from Nurpur, Fatehpur and Jawali blocks. This abnormal spatio-temporal clustering of deaths within the Pong Dam reservoir region fits with an ecological association since wetland areas support higher rodent densities coupled with dense agricultural activity offer optimal conditions for Russell's viper and Krait habitation as well as human-snake interface.

Economic Burden

In the subset of cases reporting expenditure data, the average out-of-pocket treatment cost was ₹13,217 (SD ± ₹27,276; median ₹3,000), with one extreme value at a total expense of ₹1,30,000 due to referral at a tertiary level and multiple dialysis. The mean transportation cost was ₹2,000 (SD ± ₹2,265). The mean is of the reported wage loss was ₹5,084 (SD ± ₹4,070). These numbers only show documented cases and likely represent an undercount of the actual economic impact due to the degree of missing data. To sum up, our findings suggest that rural agricultural households are financially vulnerable to snakebites.

Discussion

This is a large hospital-based study over 5 years that describes the clinical and epidemiological profile of snakebite cases from a secondary-care facility in the hilly Kangra District—an under-represented setting in Indian published snakebite literature. The overall CFR of 7.2% is consistent with estimates from hilly and isolated rural districts, where mortality risk is increased due to delays in reaching emergency transport.^{2,4,10}

The higher incidence in males (59.9%) and a mean age of 36.8 years reflect the occupational exposure pattern among adult male agricultural workers, corroborated nationally as well as across South Asia.^{2,4,7} Clustering during the monsoon season (82.4% of cases, June–September) results from temporal overlapping between increased agricultural activity, habitat displacement of snakes due to flooding, and reduced ground visibility—a phenomenon that has been documented in other comparable settings.^{8,12}

Of known species ($n=49$), Russell's viper was dominant at 67.4%—coherent with the ecological dominance of Viperidae in Indo-Gangetic agricultural ecosystems in North India. The considerable rate of dry bites (32.9%) provides further support for a WBCT-guided approach to the administration of ASV as opposed to prophylactic treatment, in line with international evidence that 20–50% of snakebites by venomous species suffer no envenomation.^{7,8,11}

Consultation with a faith healer was recorded in 43.7% of cases where health-seeking behavior was documented, constituting a clinically important and modifiable source of pre-hospital delay. It is consistently identified as an independent predictor of delayed presentation and adverse outcomes in studies from rural India and South Asia.^{3,9,13,15} Notably, data collection during this study revealed a distinctive pattern of health-seeking behavior specific to this region: snakebite victims predominantly made the temple their first point of contact, and a substantial proportion returned to the temple even after receiving formal hospital treatment—underscoring the depth of community trust in traditional healing in this population. At the local temple, an 'inside-out' treatment method is practiced: a mixture of sacred sand and water sourced from the temple is both applied externally to the snakebite site and administered orally to the patient.

The community holds a strong belief that this method prevents death from snakebite, with a widely shared conviction of 'zero snakebite deaths' among those treated at the temple. In stark contrast, community members expressed significant doubt about hospital treatment, perceiving it as offering only a 'fifty-fifty' chance of survival—a perception that drives them to favor temple care despite the availability of ASV at the formal facility. This

belief system represents a structural barrier that cannot be addressed through clinical messaging alone; engagement with temple practitioners as co-referral partners is essential.

There is no established pharmacological basis for this treatment; the critical concern is the time lost during temple visits, documented at between 1 and 7 hours in recorded cases, during which hemotoxic coagulopathy or neurotoxic paralysis may progress beyond the point at which ASV can reverse the clinical course. Tourniquet application, documented in six cases, further worsens local tissue ischemia and may lead to limb necrosis.^{3,9} emphasizing the requirement for focused community de-education that specifically addresses these deeply held beliefs.

ASV use complied with national protocol in most individuals treated. This 4.5% anaphylaxis rate is within the previously reported Indian range; all reactions were treated successfully with ASV not attributed to any deaths, thus confirming that this protocol can be undertaken safely if properly monitored.¹¹ The clinically concerning LAMA rate of 9.5%: patients leaving prematurely are at risk of receiving inadequate treatment, whether undertreated coagulopathy or secondary infection; future intervention design would benefit from qualitative follow-up to ascertain somatic drivers—financial, social, or perceived improvement.

Undoubtedly, its economic impact is under-represented due to incomplete information; however, it provides a median out-of-pocket expense of ₹3,000 and an average wage loss of ₹5,084, potentially catastrophic for rural agricultural families. This financial vulnerability likely reinforces temple-first health-seeking behavior, since temple care is provided free of charge. Spatial analysis further identified the Pong Dam reservoir area as an ecological hotspot, with 50% of all deaths occurring among patients residing in its surrounding blocks—a pattern consistent with the dense rodent populations, agricultural activity along water bodies, and high snake density that characterize wetland ecosystems.⁸ We advocate for targeted community awareness in this high-risk zone, identification and mapping of snakebite hotspots in catchment areas, and expanding insurance coverage and treatment cost waivers for snakebite under NAPSE as urgent mitigatory interventions.⁶ It must be noted that the Integrated Health Information Platform (IHIP) portal, the national surveillance system for notifiable diseases, is known to significantly underreport snakebite incidence and mortality, as reporting remains inconsistent and largely depends on passive facility-based notification. The actual burden of snakebite envenomation and deaths in Kangra District—and across India—is therefore likely to be substantially higher than what is captured in official IHIP data. This underscores the importance of active, prospective hospital-based surveillance such as the present study to generate more accurate local estimates.

Conclusion

The study presents a 5-year experience from a secondary-care facility in the hilly Kangra District and describes a snakebite envenomation CFR of 7.2%. Pre-hospital delay aggravated by consultation with local traditional healers and poor resourced emergency vehicle transfer continues to be the most important and mutable cause of mortality. Pong Dam reservoir is a hotspot or high-priority ecological micro zone for targeted surveillance and community action based on the spatial clustering of deaths.

Priority areas include community awareness for agricultural workers in Pong Dam buffer villages, better 108 ambulance access to hilly blocks, basic capacitation at peripheral health centers for pre-referral ASV stabilization, and the systematic recording of delayed times (pre-hospital). Enhanced referral systems and community interventions in ecological hotspot areas are critical to reducing snakebite mortality in Kangra District and to meeting India's NAPSE and WHO targets.

Ethical Issue

This study does not involve any patients/volunteers/Human Biological Material/Animals. This

data has been obtained from the record already available in the Civil Hospital Nurpur, Kangra

Himachal Pradesh.

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No financial support or assistance from any source/funding agency has been taken for this

Study as this is a retrospective record-based study

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