Original Research Paper:

Transporting snake bite victims to appropriate health facility within Golden Hour through toll free emergency ambulance service in India, save lives

Background: Snakebite is a neglected public health issue in India. The big four venomous snakes are Cobra, Krait, Russell's viper and Saw scaled Viper. Estimates of annual snakebite mortality in India are upto 50,000 deaths as exact figure is not known due to snakebite not being a notifiable event in India.

Methods and Materials: Computer Telephonic Integrated (CTI) data of snakebite patients transported by ambulances was obtained from Emergency Response Center of 12 states out of 16 Emergency Management and Research Institute (GVK EMRI) operating states for the year 2014. Data analysis was done using Micro Soft Excel. Victims who complained of snakebite and decided to avail the toll free 108 emergency ambulance service (EMS) were included in this study from GVK EMRI operating 10 States and 2 Union Territories that constitutes more than half of the country's population majority of this being rural.

Results: A total of 29,231 snake bite cases were enrolled in this study period. Of these 28206 used and 1025 did not use 108 transportation. Out of 28206 patients, 27805 were admitted to hospital. Out of remaining 401 cases, 168 cases expired before the EMS ambulance arrival, 161 were given first aid and 72 cases expired before admission on way to the hospital. Type of hospitals, patients transported and admitted to were, Government 25029, Private 2583 and Trust 193. Overall mean response time from base to scene was 00:22:56, at scene 00:10:06 and scene to hospital arrival was 00:47:02 (hh:mm:ss), nearer to golden hour. Out of 27805 admitted cases 8519 could be followed up after 48 hours, 6050 were all right and discharged from the hospital, 1879 were stable and out of danger but still in hospital, 9 were with condition still critical-in hospital, 41 required only First-Aid and 359 expired after 48 hours and status could not be ascertained in 181 cases due to non availability of telephone number as 108 EMS was activated by a call from bystander.

Conclusion: The GVK EMRI ambulances that are fully equipped with all life saving equipments and drugs including anti snake venom (ASV) are able to save lives in critical condition of snakebite victims while they are called on toll free number 108. This model of free transportation in emergency needs to be replicated in other parts of the country and also in high snakebite incident countries of Asia and Africa.

Keywords: Emergency, Anti Snake Venom, Transport, Ambulance.

Introduction:

Snake bites are the common cause of morbidity and mortality in tropical countries[1]. According to World Health Organization estimates, between 35,000 and 50,000 people die of snake bite each year[2]. Actual global incidence of envenomation and their severity remain largely misunderstood since the snakebite is not a notifiable incident in India[3]. Of the 3,000 snake species that exist in the world, about 600 are venomous[4]. In India, there are 216 species of snakes, of which mainly four are venomous snakes (Cobra, Krait, Russell's viper and Saw scaled viper)[5]. Venomous snakes immobilize their prey by injecting modified saliva (venom) that contains toxins into their prey's tissues through their fangs (Fangs-specialized, hollow teeth) [7]. Snakes also use their venoms for self defense and will bite people when threatened, startled or provoked. Snakebites caused by the families Viperidae (pit vipers) and Elapidae (kraits and cobras) are particularly dangerous to people [4] in South and Southeast Asia. India is the country with the highest annual number of envenoming (81,000) and deaths reported[4]. In South India, 60% did not have clinical evidence of bleeding, but demonstrated laboratory evidence of abnormal parameters. Acute kidney injury (AKI) was evident in 28% of patients and 15.3% required haemodialysis[21]. Using ASV based on appropriate identification of snakes can also save ASV and also snakebite victims from unnecessary side effects of ASV[22]. Indirect estimates of annual snakebite mortality in India that varied from approximately 1,300 to 50,000 [2, 3, 4]. Annual snakebite deaths were greatest in the states of Uttar Pradesh (8,700), Andhra Pradesh (5,200), and Bihar (4,500)[6]

Objective:

To study the epidemiology of snake bite cases reported to GVK EMRI, 108 Emergency Ambulance Services (EMS) operating states were studied for the year 2014 in India. 12 states were selected for study out of 16 states and snake bite cases reported and victim status (follow up) after 48 hours was studied from the date of incident.

Methods and Materials:

The study is a Retrospective secondary data analysis, based on the snake bite emergencies reported to GVK EMRI services in the operating states. Analysis of records was done for the year 2014. Computer Telephonic Integrated (CTI) data

obtained from Emergency Response Center of 12 states out of 16 GVK EMRI operating states was studied. Data analysis was done using Micro Soft Excel. Victims who complained of snakebite and decided to avail the 108 emergency ambulance service for the period of 12 months (January to December) for the year 2014 were included in this study from GVK EMRI operating 10 States and 2 Union Territories. The states included were, 1. AndhraPradesh 2.Chhattisgarh 3.Goa 4.Gujarat 5.Himachal Pradesh 6.Karnataka 7.Meghalaya 8.Tamilnadu 9.Telangana 10.Uttarakhand and Union Territories were 1.Dadar and Nagar Haveli 2.Daman & Diu respectively.

About GVK-EMRI: GVK EMRI (Emergency Management and Research Institute) is a pioneer in Emergency Management Services in India, as a not – for – profit professional organization operating in the Public Private Partnership (PPP) mode with the respective governments funding the concept. April 2005 was the turning point for emergency medical services (EMS) in India. The EMRI organization was incepted with the objective of delivering comprehensive, speedy, reliable and quality Emergency Care Services. This has been done by establishing an Emergency Response System that coordinates every emergency related to Medical, Police and Fire through a single toll free number 1-0-8 which when called in an emergency, ensures prompt communication and activation of a response that includes, assessment of the emergency, dispatch of the ambulances, along with a well trained Emergency Medical Technician (EMT) to render quality pre-hospital care and transport of the patient to the appropriate health care facility[19]

Results:

A total of 29,231 snake bite cases were enrolled in this study period. Of these 28206 used and 1025 did not use 108 transportation. Out of 28206 patients, 27805 were admitted to hospital. Out of remaining 401 cases, 168 cases expired before the EMS ambulance arrival, 161 were given first aid and 72 cases expired before admission on way to the hospital. Major challenge the EMTs face is critical condition of the patients and their resuscitation on way to hospital. Administration of ASV on way to hospital also fraught with the risk of anaphylactic reaction. We have observed that the low doses of ASV given inside the ambulances have high protective effect as observed in some studies[20]. Type of hospitals, patients transported and admitted to were, Government 25029, Private 2583 and Trust 193. Overall mean response time for the ambulances was, from base to scene 00:22:56 (hh:mm:ss), at scene 00:10:06 and scene to hospital arrival 00:47:02, which is nearer to the golden hour. Out of 27805 admitted cases 8519 could be followed up after 48 hours, 6050 were all right and discharged from the hospital, 1879 were stable and out of danger but still in hospital, 9 were with condition still critical-in hospital, 41 required only First-Aid and 359 expired after 48 hours and status could not be ascertained in 181 cases due to non availability of telephone number as 108 EMS was activated by a call from bystander. (Fig 1) show high rate of envenomation in Tamil Nadu state and a peak

during July to August months (Table 1). Hourly distribution of snakebites show (Table 2) more bites during evenings and early mornings. Table 3 shows the distribution of those availed the service and those did not. Fig 5 shows the type of hospitals patients were taken for treatment and majority were taken to government hospitals. Table 6 shows the 48 hour follow up status and majority of the snakebite victims survived as they were brought to the hospital nearly within Golden Hour, average time taken 79.64 minutes (Fig 2,3,4) which is for better a position in hill states like Himachal Pradesh and Uttarakhand. Rapid transport initiative in Nepal has proved life saving[27]. Delay in reaching hospital and delay in ASV administration are important factors in mortality due to snakebites[28].

Discussion: Snake bite is a neglected public health problem in India and remains an underestimated cause of accidental death in developing countries[6]. The distribution of cases The potentially fatal effects of being "envenomed" (having venom injected) by these snakes leads to widespread bleeding, muscle paralysis, and tissue destruction (necrosis) around the bite site. Bites from some snakes can also cause permanent disability rather than mortality. Existing literature about disease burden of snake bites says young agricultural workers, especially males, are the most highly affected group, making snake bite envenoming a truly occupational disease[7] . Our study support this statement as the study results show majority of victims are males and belong to young (Table 4 &5) actively working age group from agriculture background, rest of the incidences are while on natural calls and other domestic purposes like grass cutting etc[7] and the majority of the victims received snake bite in their lower extremities while walking bare foot. A small number received some sort of management within two hours of snake bite but a large number did not seek any medical care but preferred traditional remedies and went to Faith Healers[8]. The use of traditional medicine for snake bite is a feature of most areas of the developing world where venomous snakes are prevalent[8]. Improvements in early referral and appropriate care will only occur when traditional healers are integrated into primary health care and hospital-based healthcare systems. Many snakebite victims from rural areas are not rushed for hospitalization but seek traditional treatments[9]. Unfortunately, public health authorities, nationally and internationally, have given little attention to this problem, relegating snake bite envenoming to the category of a major neglected disease of the 21st century[7]

Snake bite is an important preventable health hazard[10] in India with its population over a billion people, accounted for the highest estimated number of bites and deaths for a single country[4]. The reasons for the high levels of snake bite mortality include scarcity of anti-venom in Primary Health Centres (PHCs), poor health care services, and difficulties with rapid access to appropriate health centers [11]. Our study result confirm that that some snakebite victims die (4.2%) before reaching the health centre in due time (leading to underestimation of snakebite mortality), and others do not go to the health centres because they

were cured with some residual debility due to local effects of the venom (leading to underestimation of morbidity)[12].It is essential for drawing up guidelines for dealing with snake-bites to plan drug supplies, particularly antivenom, and to train medical staff on snake-bite treatment protocols that are different at different centres due to difficulties and variable presentations [23, 24]. Internationally, anti-venoms must conform to the standards of pharmacopoeia and the World Health Organization (WHO) [26].Present cost of one vial of 10 ml of ASV of Serum Institute of India is $ 6[10]. The patient should be given strict instructions to return to the hospital after ASV treatment if any of the following occurs: increase in pain or onset of redness or swelling, fever, epistaxis, bloody or dark urine, nausea or vomiting, faintness, shortness of breath, diaphoresis, or other symptoms except mild pain at the bite site[1]

A Campaign to advise Public regarding snakebite on followi ng points is needed: An ounce of prevention is worth a ton of first aid.

Avoid places like tall grass, bushes and deep holes and always poke the way forward.

While walking in dark places wear long pants, rubber boots etc for protection.

Use light source in dark places and watch as you step/sit in outdoors.

Never handle a snake, even if you think it is dead. A moment ago killed snakes may still bite by reflex.

Do not give anything per oral to victims of snake bite.

Do not cut/suck/put ice at the site of bite.

Do not administer stimulants or pain medications unless directed by a physician.

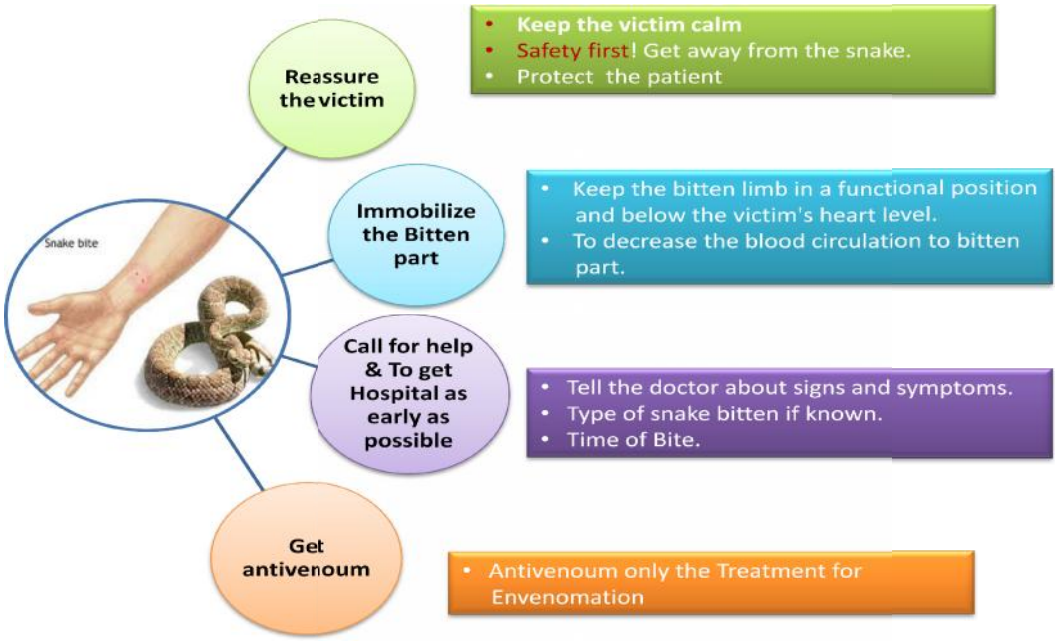
Remove any items or clothing which may constrict the bitten limb if it swells and do not use tourniquet.

Educate the people in recognition of various snakes & their symptoms after the bite.

Drawing up guidelines for management, planning health care resources (particularly anti venom), and training medical staff to treat snakebites.

Educate the people on traditional healer's approach who delay anti-venom administration.

Do it **RIGHT** immediately after the bite: [2,8,12, 13]



Conclusion:

The GVK EMRI ambulances that are fully equipped with all life saving equipments and drugs including anti snake venom are able to save lives in critical condition of snakebite victims while they call on toll free number 108 in 16 states of India. This model needs to be replicated in other parts of the country and also in high snakebite incident countries of Asia and Africa.

Public health authorities need to create awareness among people in snake bite prone areas. It is highly associated with active working age group so this group deserves attention from national and international health authorities. Victims may die before reaching the health care centers or others thinking they are cured may leave the hospitals leading to underestimation of morbidity. The only specific treatment for poisonous snake bite is to receive anti- venom, so every victim must be transported to treatment centers where anti-snake venom is available within first hour after the bite. Traditional healers need to be integrated into primary health care and hospital-based healthcare systems.

Figure 1: Distribution of sample of Snake bites cases for the year 2014.

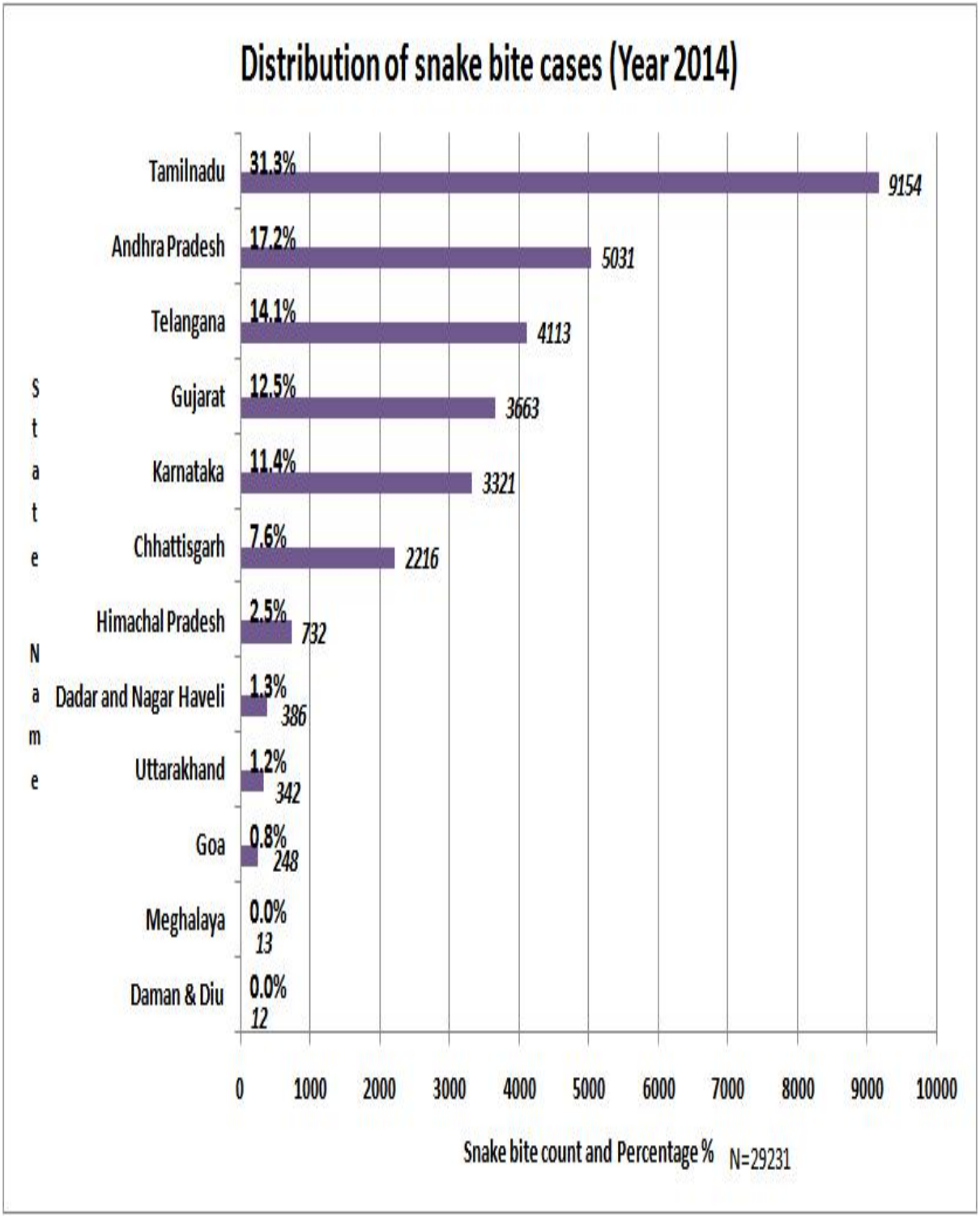

Distribution of snake bite cases (Year 2014)
State Name
Tamilnadu
Andhra Pradesh
Telangana
Gujarat
Karnataka
Chhattisgarh
Himachal Pradesh
Dadar and Nagar Haveli
Uttarakhand
Goa
Meghalaya
Daman & Diu
31.3%
9154
17.2%
5031
14.1%
4113
12.5%
3663
11.4%
3321
7.6%
2216
2.5%
732
1.3%
386
1.2%
342
0.8%
248
0.0%
13
0.0%
12
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Snake bite count and Percentage %
N=29231

Table 1: Monthly distribution of snake bite cases:

State Name	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	*Grand Total*
Andhra Pradesh	262	204	276	350	346	448	624	711	621	487	393	309	*5031*
Chhattisgarh	39	62	107	124	180	328	398	358	293	178	114	35	*2216*
Dadar and Nagar Haveli	15	10	19	8	21	44	83	59	35	48	34	9	*385*
Daman & Diu	1		2			2	2	1	1	3	1		*13*
Goa	23	23	15	19	26	28	17	16	12	32	18	19	*248*
Gujarat	93	95	140	158	207	294	492	606	534	526	361	157	*3663*
Himachal Pradesh	1	1	7	25	42	82	154	179	155	70	8	8	*732*
Karnataka	163	192	201	229	302	375	295	280	342	348	294	300	*3321*
Meghalaya		1			1	4		4	1	2			*13*
Tamilnadu	545	477	541	649	811	650	685	1041	1032	1158	819	746	*9154*
Telangana	196	179	217	308	325	409	579	658	508	321	275	138	*4113*
Uttarakhand		3	4	7	21	25	47	65	110	47	8	5	*342*
Grand Total	*1338*	*1247*	*1529*	*1877*	*2282*	*2689*	*3376*	*3978*	*3644*	*3220*	*2325*	*1726*	*29231*

Table 2: Hour wise distribution of Snake bite patients:

Hour wise	Andhra Pradesh	Chhattisgarh	Dadar and Nagar Haveli	Daman & Diu	Goa	Gujarat	Himachal Pradesh	Karnataka	Meghalaya	Tamilnadu	Telangana	Uttarakhand	Grand Total
0	126	56	8		6	78	20	101	2	222	104	5	728
1	63	61	5		5	60	22	76		183	87	5	567
2	59	56	5	1	3	56	12	86		158	75	4	515
3	60	41	3		6	57	11	51		135	68	5	437
4	57	40	6		6	53	10	53		126	57	3	411
5	57	63	9		2	46	21	48		173	70	4	493
6	83	64	14		2	71	19	45		229	83	9	619
7	120	80	9		3	95	26	65		243	100	8	749
8	153	99	11		2	133	20	99	1	334	104	5	961
9	223	86	17		5	192	21	125		513	139	14	1335
10	292	115	19		7	219	39	142	1	558	206	22	1620
11	356	124	18		10	192	46	187		536	233	32	1734
12	302	95	21		13	196	32	205		555	269	23	1711
13	256	89	15		13	179	34	214	2	466	234	19	1521
14	234	74	16	1	3	174	22	207		415	223	10	1379
15	238	102	31		7	224	36	173	1	355	211	13	1391
16	223	95	17		9	185	29	187		375	211	15	1346
17	260	70	14	2	18	180	32	157	3	418	207	16	1377
18	274	120	24		13	206	35	151		448	228	20	1519
19	418	156	27		28	241	44	206	1	663	294	30	2108
20	395	173	38	2	28	311	51	228		673	324	32	2255
21	348	164	26	3	18	234	67	211	1	620	254	20	1966
22	267	103	21	2	25	173	51	198		464	189	19	1512
23	167	90	11	2	16	108	32	106	1	292	143	9	977
Grand Total	5031	2216	385	13	248	3663	732	3321	13	9154	4113	342	29231

Table 3: Distribution of snake bite Patients who availed and not-availed the ambulance:

State Name	Closed	First-Aid	No Emergency	Victim shifted by other ambulance	Victim Expired (Before ambulance reached the spot)	Enroute death	Service Not Required	Victim Already Shifted	Victim Not Found	Grand Total
Andhra Pradesh	4802	1			3	11	214			*5031*
Chhattisgarh	2033	11	8		17	17	130			*2216*
Dadar and Nagar Haveli	385				1					*385*
Daman & Diu	12									*12*
Goa	244						4			*248*
Gujarat	3518	1	3		74	33	34			*3663*
Himachal Pradesh	714	10		1	2	2		3		*733*
Karnataka	3198	90			26			2	5	*3321*
Meghalaya	12	1								*13*
Tamilnadu	8611		34		39		225	243	2	*9154*
Telangana	3950				3	4	156			*4113*
Uttarakhand	326		1		3	5	2	4	1	*342*
Grand Total	*27805*	*114*	*46*	*1*	*168*	*72*	*765*	*252*	*8*	*29231*

Demographics:

Table 4: Gender distribution of snake bite patients:

State	Male	Female	Grand Total
Andhra Pradesh	3034	1783	4817
Chhattisgarh	1030	1054	2084
Dadar and Nagar Haveli	168	216	384
Daman & Diu	11	1	12
Goa	159	85	244
Gujarat	1776	1852	3628
Himachal Pradesh	306	414	720
Karnataka	1880	1216	3096
Meghalaya	5	8	13
Tamilnadu	4683	3543	8226
Telangana	2231	1725	3956
Uttarakhand	131	198	329
Grand Total	**15414**	**12095**	**27509**

Table 5: Distribution of Age Group of Snake bite patients:

Victim Age in Years	1 to 10	11 to 20	21 to 30	31 to 40	41 to 50	51 to 60	61 to 70	71 to 80	81 to 90	91 to 100	> 100
Andhra Pradesh	177	559	1143	1204	918	563	214	34	4	0	1
Chhattisgarh	142	367	585	476	294	132	73	11	4	0	0
Dadar and Nagar Haveli	46	75	92	70	52	40	7	1	2	0	0
Daman & Diu	0	5	5	0	1	1	0	0	0	0	0
Goa	7	38	83	54	35	16	9	2	0	0	0
Gujarat	216	597	974	798	582	300	129	26	3	3	0
Himachal Pradesh	32	157	156	137	126	52	40	15	5	0	0
Karnataka	195	457	752	657	503	322	153	51	5	0	1
Meghalaya	3	3	4	3	0	0	0	0	0	0	0
Tamilnadu	345	944	1546	1843	1641	1188	556	138	22	1	1
Telangana	162	501	1101	948	689	385	146	21	3	1	0
Uttarakhand	16	69	93	72	31	23	22	2	1	0	0

Time lines:

Response Time (RT): Out of the total sample received overall mean response time for activation of EMS to scene of arrival was 00:22:56, at scene 00:10:06 and scene to hospital arrival was 00:47:02 (hh:mm:ss) and is more in Hilly terrains than plains, **a**s shown in (Figures 2, 3, 4) below:

Fig 2:

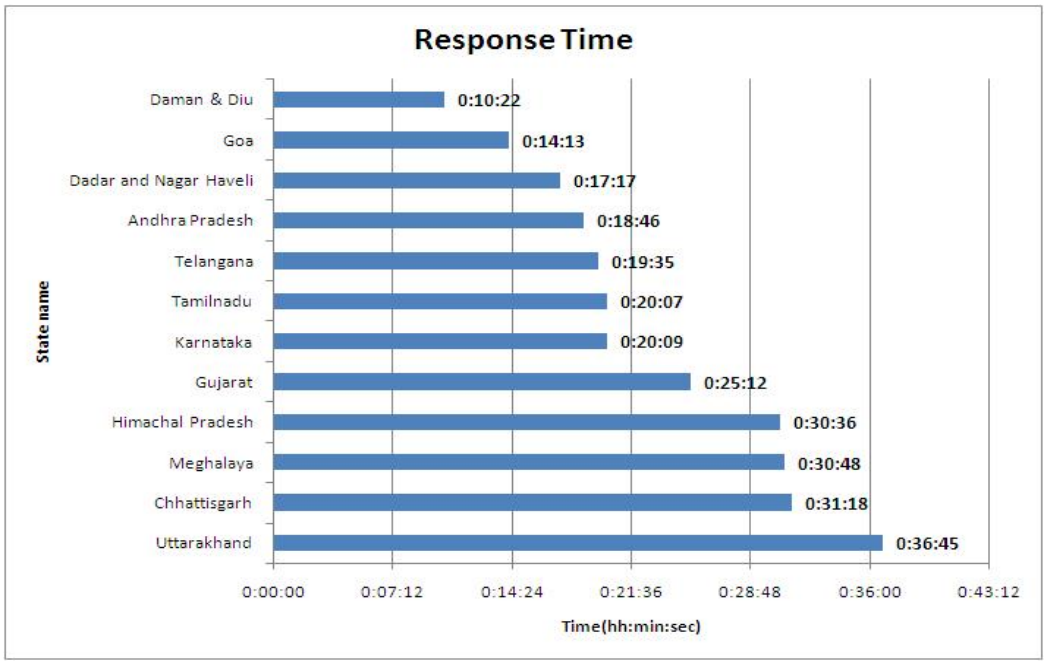


Fig 3:

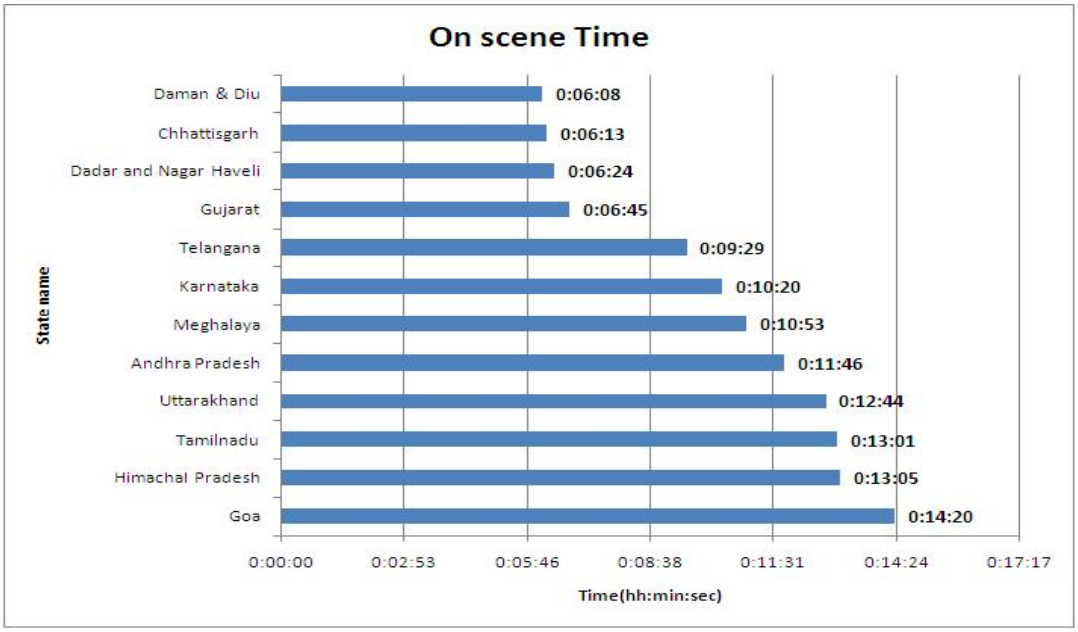


Fig 4:

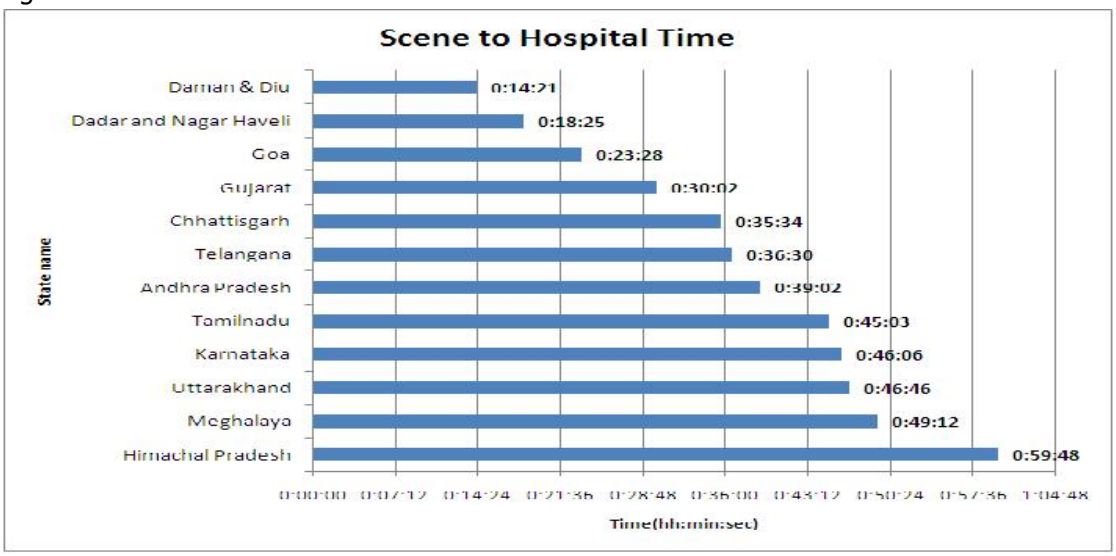


Fig 5: Types of hospitals admissions of snakebite patients:

Type of hospitals patients transported and admitted to various hospital were: Government 23822, Private 2583 and Trust 193.

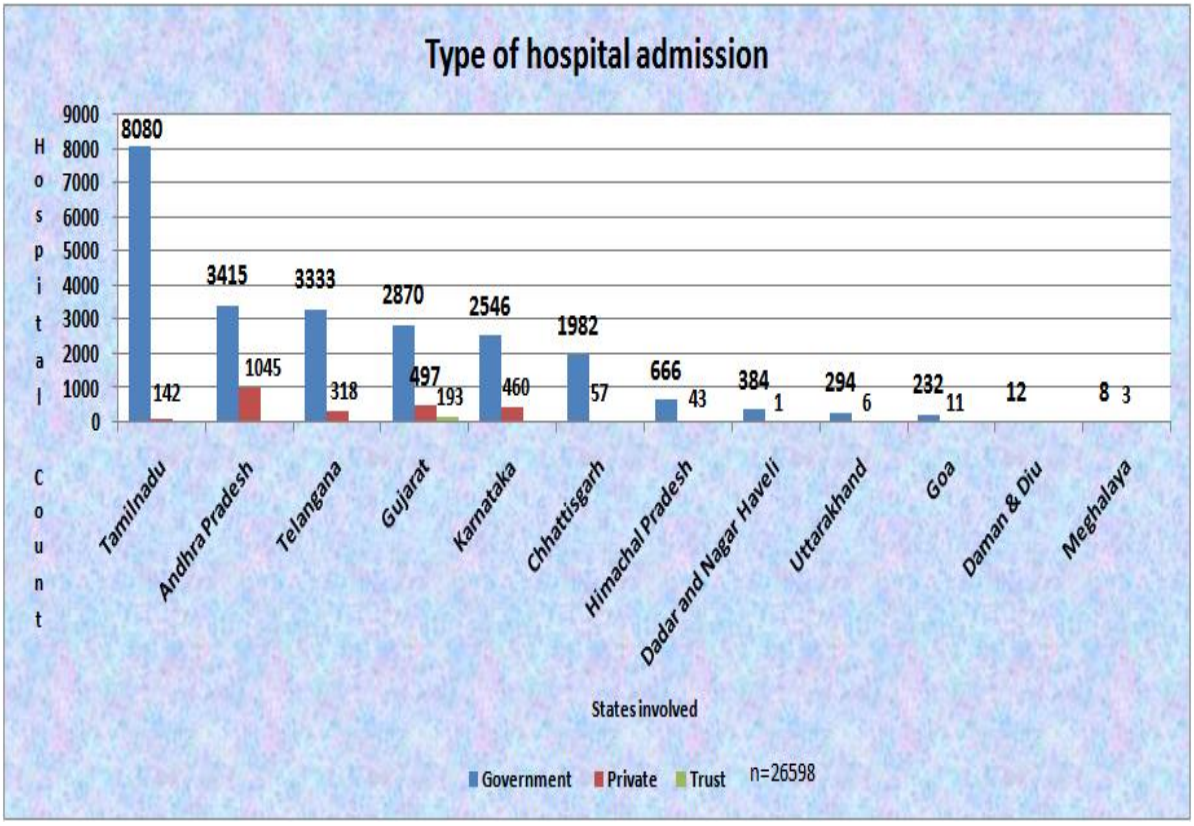


Table 6: 48 hours follow up of snakebite patients:

States	All right and discharged from the hospital	Stable, Out of danger, but still in hospital	Condition is still critical in hospital	First-Aid	Can't say	Expired	*Grand Total*
Andhra Pradesh	1555	120	1	2	53	71	*1802*
Chhattisgarh	670	125	1	21	16	52	*885*
Dadar and Nagar Haveli	160	25	2		8	1	*197*
Daman & Diu	3	2					*5*
Goa	88	5		1			*94*
Gujarat	1629	461	2	3	3	91	*2190*
Himachal Pradesh	207	93	1	10	1	13	*325*
Karnataka		199					*199*
Meghalaya	7			1			*8*
Tamilnadu		774				35	*809*
Telangana	1672	75	2	2	100	92	*1943*
Uttarakhand	59			1		4	*64*
Grand Total	*6050*	*1879*	*9*	*41*	*181*	*359*	*8519*

Limitations of the study:

The source data we have obtained is unable to describe the signs and symptoms and pre-hospital treatment given by emergency medical technician (EMT) in 108 ambulance services was not documented in all states hence we took very less variables for which the data was available to maintain uniformity. However we need to emphasise that ASV was given inside the ambulances to critical patients and have proved effective[25] as medicines to manage any adverse drug reaction are available inside the ambulances.

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