RETROSPECTIVE STUDY OF SNAKEBITES BASED ON HOSPITAL AND COMMUNITY SURVEY IN WESTERN DEVELOPMENT REGION, NEPAL

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T.U. REGISTRATION NO. 5-2-50-1175-2005

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A thesis submitted in partial fulfillment of the requirements for the award of the degree of Master of Science in Zoology with special paper Parasitology

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DECLARATION

I hereby declare that the work presented in this thesis has been done myself, and has not been submitted elsewhere for the award of any degree. All sources of information have been specifically acknowledged by reference to the author(s) or institution(s).

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RECOMMENDATIONS AND LETTER OF APPROVAL

The thesis entitled **"RETROSPECTIVE STUDY OF SNAKEBITES BASED ON HOSPITAL AND COMMUNITY SURVEY IN WESTERN DEVELOPMENT REGION, NEPAL"** has been carried out by **KAMAL DEVKOTA** for the partial fulfillment of Master's Degree of Science in Zoology with special paper PARASITOLOGY. This is his original work and has been carried out under our supervision. To the best of our knowledge, this thesis work has not been submitted for any other degree in any institutions and is approved for the examination and submitted to the Tribhuvan University in partial fulfillment of the requirements for Master's Degree of Science in Zoology with special paper PARASITOLOGY.

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II

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CERTIFICATE OF ACCEPTANCE

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PHOTOGRAPHS

LIST OF ABBREVIATIONS

Abbreviated form	Details of Abbreviations
WHO	World Health Organization
NTDs	Neglected Tropical Diseases
NHRC	Nepal Health Research Council
EDCD	Epidemiology and Disease Control Division
ASVS	Anti Snake Venom Serum
WDR	Western Development Region
CBS	Central Bureau of Statistics
VDC	Village Development Committee
CFR	Case Fatality Rate
STC	Snakebite Treatment Centre
PHC	Primary Healthcare Centre
PIB	Pressure Immobilization Bandaging
LCPI	Local Compression Pad Immobilization
mg	milligram
Vs	Versus
No.	Number
P	Probability value
df	Degrees of Freedom
χ^2	Chi-square

ABSTRACT

Snakebite is one of the most serious neglected public health problems in rural areas of WDR of Nepal, especially in four districts of Terai region (Rupandehi, Nawalparasi, Kapilbastu and Palpa) and is an important medical emergency and reason for admission to hospital due to deadly venomous Cobra and Krait bite. The study basically focused to analyze the annual snakebite incidences, human mortality and morbidity, amount of anti snake venom serum used for the patients, first aid measures adopted by the patients and duration of snakebite time to hospital arrival time. The retrospective study of snakebites recorded in 2008-2010 in different health institutions from WDR of Nepal, where treatments of snakebites are available was carried out during June 2011 to February 2012. Questionnaire surveys were conducted with the local people in small part of the study area Devdaha VDC by random sampling method in April 2012. Out of 6,993 cases of snakebite, 9.15% patients were found to have features of envenoming including 84 deaths during three years. The death rate was found 1.2% and the CFR was found 13.12%. The significant difference was found in number of snakebite cases visiting the different hospitals (p value < 0.001, df = 9, $\chi^2 = 37.0323$). Snakebite incidences occur most frequently (71.96%) during the month of June to September. The highest snakebite mortality and highest ASVS consumption were also recorded during the same months. As comparison to males (46.40%), females (53.60%) were more victimized. The 11-20 years age group was mostly victimized (26.34%). The mortality rate in case of children (0-10 years) was found to be higher than those of adults. The majority of the patients (52.15%) sustained bites in the lower extremities, while 30.67% were bitten in the upper extremities. This study recorded more or less equal proportion of day and night snakebite cases. The total consumption of polyvalent ASVS was 10,327 vials. An average of 16 ASVS vials was administered to each victim. It was found that a total of 1,313 vials were used by death cases only. The majority of the patients (45.11%) were reported within one hour after bite. Only 857 victims were reported having first aid treatment. In the questionnaire survey, many respondents applied tourniquets and very few applied PIB and LCPI as a first aid treatment method. Further research should be conducted to improve health facilities and management of snakebite and also for the production of ASVS in Nepal.

1. INTRODUCTION

1.1 Background

Snakebite is an injury caused by a bite from a snake's fangs, resulting in puncture wounds and sometimes resulting in envenomation (Kasturiratne et al. 2008). The morbidity and mortality due to snakebites is one of the most neglected public health problems in rural areas in many countries and accurate global incidence of envenomation remain fail to report correctly, only few countries have reliable epidemiological data on snakebites (Chippaux 1998, Kasturiratne et al. 2008, Alirol et al. 2010).

As compare to other tropical diseases, there were fewer clinical studies of snakebite. The number of snakebites induced deaths doubles the mortality figures in Asia and Africa (Table 1) due to *Entamoeba histolytica* infections (WHO 2005), Schistosomiasis and Leishmaniasis (Harrison et al. 2009), Malaria, Tuberculosis and other parasitic diseases like African Trypanosomiasis, Cholera, Denguehaemorrhagic fever, Leishmaniasis, Japanese encephalitis and Schistosomiasis (Mathers et al. 2007, WHO 2004, WHO 2007, Williams et al. 2010) but in the study of snakebite, only a small part of research investment in these diseases have been devoted. Although snakebite has already been listed as neglected tropical disease (NTDs) by WHO in April 2009 (Williams et al. 2010) but it has not been placed national health research priority of Nepal Health Research Council (NHRC), Ministry of Health, Nepal Government (NHRC 2012).

Snakes bite their predators for defensive purposes and their prey for hunting (White and Julian 2006). Some poisonous snakes bite once; some several times and still others hold on or chew (Shah et al. 2003). Bites from non poisonous snakes can also cause injury due to laceration caused by snake's teeth (Kitchens et al. 1987, Gold et al. 2002). Even in the case of poisonous snakebites, there is 50% probability of invisible of clinical symptoms (Thakeston et al. 2003). This bite is known as dry bite. Although antivenom is produced in sufficient quantities by several manufacturers (Simpson and Norris 2009), 56%-80% of snakebite victims first consult traditional healers before visiting a treatment centre (Snow 1994) thus delaying in antivenom treatment.

Table 1: Comparison of incidence and mortality rates of NTDs.

Neglected Tropical Disease	Incidence	Death rate (Mortality)	Authors
African Trypanosomiasis	2,17,000	14,000	(WHO 2004)
Denguehaemorrhagic fever	73,000	19,000	
Leishmaniasis	16,91,000	51,000	
Japanese Encephalitis	44,000	14,000	
Schistosomiasis	57,33,000	15,000	
Cholera	1,78,000	4,000	(WHO 2007)
Snakebite Envenoming	4,21,000-18,41,000	20,000-94,000	(Kasturiratne et al. 2008)

1.2 Snakebites in Nepal

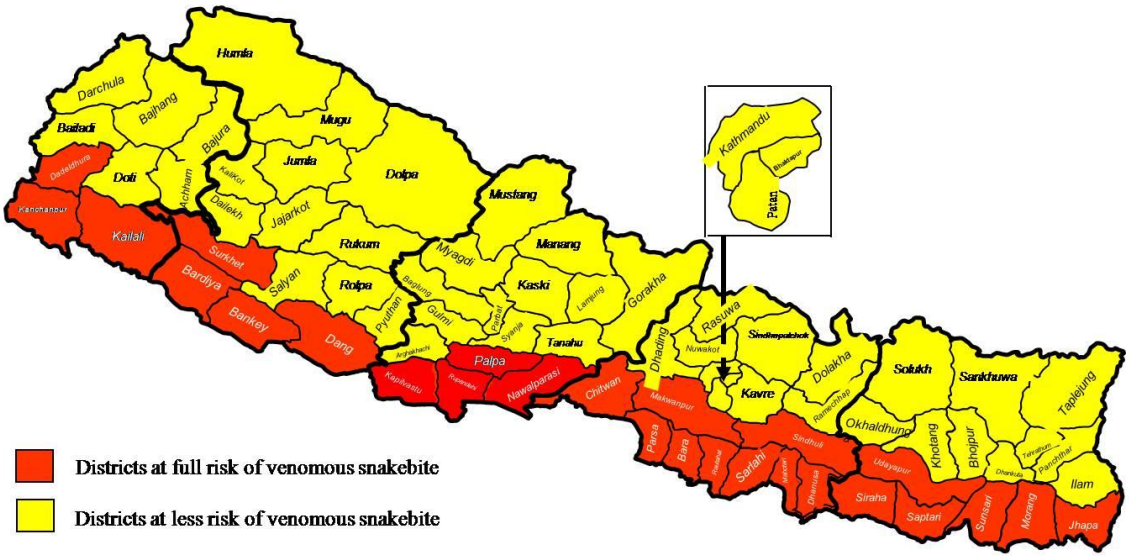

Figure 1: Poisonous snakebite affected districts (Source: EDCD, Nepal).

About 1,000 people die annually out of 20,000 snakebite cases, mainly in the Terai region (WHO 1987). About 26 districts (Figure 1) of the tropical lowland Nepal are at high risk to snakebite (Shah et al. 2003). The bites usually happens during midnights with further delay in treatment due to initial consultation with the traditional healers, lack of transport

facilities and unavailability of resourceful snakebite treatment centre so the need for advocacy for first aid management using bed nets, proper immobilization technique, identification of venomous snakes and early transport to the resourceful snakebite treatment centre is essential (Sharma et al. 2004b, WHO 2005, Pandey 2007).

1.3 Snakes of Nepal

About 3,000 species of snakes are found in the world, among which 600 species are venomous (Chippaux 1998). In India, 275 species of snakes are found among which 62 species are venomous, 42 species are mildly venomous and 171 species are non venomous (Vijayaraghavan 2008). Distribution of snakes varies sharply from Terai (100m) to high mountains (4800m). In Nepal, only 89 species of snakes are so far been identified among which 22 species are venomous (Shrestha 2001) including Saw Scaled Viper but the Saw Scaled Viper is not found in Nepal (EDCD 2012) and only 79 species of snakes are found in Nepal among which 21 species are venomous (Shah 2012). Two species, Checkred Keelback (*Xenochrophis piscator schnurenbergerii*) and Karan's Pit Viper (*Trimeresurus karanshahi*) are endemic to the country (Shah et al. 2003). In Nepalese culture and tradition, hindu people worship the Nag in the snake festival Nagpanchami (Photo 4). They believe that by doing so snakebite can be avoided and rain will be assured for their growing crops (Shah 1997).

1.4 Poisonous and Non poisonous Snakes of Nepal

All the Nepalese poisonous snakes are represented by only two families, Elapidae and Viperidae (Table 2). The family Elapidae contains highly poisonous snakes like Cobras, Kraits and Coral snakes which contain neurotoxic venom. The Cobras are represented by two genera and three species, *Naja naja* (Spectacled or Common Cobra or Nag), *Naja kouthia* (Monocled Cobra) and *Ophiphagus hannah* (King Cobra or Rajgoman), out of which the King Cobra is the largest poisonous snake of the world (Shah 1995). They are distributed from lowland Terai to as high as 3500m in mid mountains of the country (Sharma et al. 2013). Only one genus and six species represent the highly polished and shining Krait snakes in Nepal (*Bungarus caeruleus, B. lividus, B. fasciatus, B. niger, B. walli and B. bungaroides*) and they are found in the Terai to as high as 2300m in mid mountains (Sharma et al. 2013). Only one species of Coral snake *Sinomicrurus*

macclellandi univirgatus has so far been recorded from the country which is found in the Terai as well as in mid mountains up to 2200m (Sharma et al. 2013). The family Viperidae includes two subfamilies of the poisonous snakes, typical vipers (Viperinae) and pit vipers (Crotalinae), which contain haemotoxic venom. The family consists of five genera (*Gloydius, Ovophis, Daboia, Protobothrops and Trimeresurus*) and 12 species (Pandey and Thapa 2010, Sharma et al. 2013). The Russell's viper, *Daboia russelli* is the only one deadly poisonous snake amongst the Nepalese viperids, other members of the viperidae have either less toxic venom or they produce insufficient amount of venom to kill human being. Russell's viper is reported from the Terai, probably also occur in some parts of mid mountains up to 3000m (Whitaker 1978) and restricted to western Nepal (Bhetwal et al. 1998). The Crotalinae have a special sense organ, the loreal pit, to detect their warm blooded prey. This is situated between the nostril and the eye. The mountain pit viper, *Ovophis monticola* is one of the most common snakes of the mid mountains (Shah 1995). The Himalayan pit viper, *Gloydius himalayanus* is the snake of high mountains and mostly found above 1650m, sometime reaching above 4800m, a world highest altitude record for snakes (Shah and Tiwari 2004). All the Nepalese non poisonous snakes are represented by four families, Typhlopidae, Boidae, Pythonoidae and Colubridae (Table 2). Pythons are the largest non poisonous snakes of the country (Pandey and Thapa 2010).

Table 2: Snakes found in Nepal (Pandey and Thapa 2010).

S.N.	Name of families	Number of species
1	Typhlopidae	3
2	Boidae	2
3	Pythonoidae	3
4	Colubridae	58
5	Elapidae	10
6	Viperidae	12

1.5 Venom Apparatus and Biting Mechanism

Elapidae have relatively short permanently erect fangs. Viperidae have relatively long fangs which are normally folded but when the snake strikes, they are erected. Some Colubrid snakes also have venom conducting fangs situated far back on the jaw, in the row of palatine teeth. They are also known as rear fanged snakes (Figure 2).

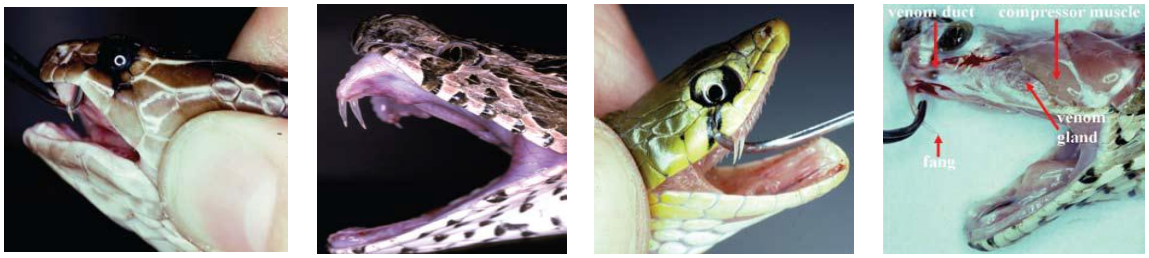

Figure 2: (From left to right) Elapidae – Sri Lankan Cobra (*Naja naja*)
Viperidae – Thiland Russell's Viper (*Daboia siamensis*)
Colubridae – Red-necked Keelback (*Rhabdophis subminiatus*)
Venom apparatus of an eastern Russell's Viper (*Daboia siamensis*)
Source of photos by DA Warrell

The venom system and the method of biting by a poisonous snake are similar in construction and action to the hypodermic needle with syringe. The injection needles are fangs (a pair of enlarged teeth in each side of the upper jaw). At the base of the fangs open the duct of the venom glands, which are modified parotid salivary glands. The venom glands of the poisonous snake are situated on each side of the head and behind the eye (Figure 2), surrounded by compressor muscles in which poison is secreted and stored (Gans and Gans 1978, Junghanss and Bodio 1995). The pressing of the glands forces the venom through duct and fang into the body of the victim. More than 90% of snake venom (dry weight) is protein and each venom contains more than a hundred different proteins: enzymes (constituting 80-90% of viperid and 25-70% of elapid venoms), non enzymatic polypeptide toxins and non toxic proteins such as nerve growth factor (Shah et al. 2003, WHO 2010).

1.6 Lethal Dose or Fatal Dose

The fatal dose is taken weight wise experimenting on laboratory animals (Mouse). It is observed that dose of venom of a snake varies according to situation (Table 3).

Table 3: Maximum extractable venom and fatal dose to man (Shah et al. 2003).

Snake species	Maximum extractable venom (mg)	Fatal Dose (mg)	Authors or Scientists
Cobra	200	12	(Deoras 1965)
Krait	22	6	
Russell's viper	150	15	
Cobra	150-300	13	(Jena and Sarangi 1993)
King Cobra	100	12	
Common Krait	5-20	10	
Banded Krait	35-50	10	
Russell's Viper	120-250	42	
Green Pit Viper	14	100	
Cobra	150-275	15-20	(Sharma and Kumari 1999)
King Cobra	500	15-20	
Krait	8-12	2-3	
Russell's Viper	130-250	40-70	

1.7 Anti Snake Venom Serum (ASVS)

The principle of anti venom is based on that of vaccines, developed by Louis Pasteur, however, instead of inducing immunity in the patient directly, it is induced in a host animal (horse) and the hyperimmunized serum is transfused into the patient. Antivenom is monospecific if the immune animal receives venom from single species (if only one venom is used), and polyspecific if the immune animal receives a pool of venoms from several different species (Theakston and Warrell 1991). There is no production of any antivenom serum in Nepal. Nepal import polyvalent antivenom from different companies of India. About 3,000 vials of polyspecific antivenom (*Naja naja, Bungarus caeruleus, Daboia russelii*, *Echis carinatus*) manufactured by the Serum Institute of India are imported from India each year but this is insufficient (Bhetwal et al. 1998). In Nepal, the ASVS is supplied by the Government of Nepal free of cost from 2000 to different level of health institutions and the consumption of ASVS is 30,000 vials and an average of 29 ASVS vials was administered to each victim per year (Shah 2011).

1.8 Rationale of the Study

Snakebite is an important medical emergency and reason for admission to hospital. Existing epidemiological data in Nepal are scarce and accurate data is very hard to obtain due to incomplete and irregular reporting from the health institutions. Many reports of snakebite cases treated with ASVS in Nepal do not include the cases treated by various NGO's, Private sectors and Army institutions. This study has been undertaken to extract

the epidemiological information of snakebites of 10 health institutions including Zonal Hospital, District Hospital, PHC, Sub-health Post, Army camps and Private Hospitals of Western Development Region (WDR) of Nepal where treatment of snakebites are available. Such epidemiological information is highly essential to know about the venomous cases, non venomous cases, annual snakebite incidences, human mortality and morbidity, the first aid measures, means of transport, the amount of ASVS used for the patients, duration of snakebite time to hospital arrival time and snakes involved in envenomation which can be helpful to improve and manage the data keeping in the health institutons and to make a public aware.

1.9 Limitations of the Study

The activities carried out by victims (farming, working in the field, walking on the road, working in cowshed, indoor activities, sleeping etc.) during the snakebite, bites occurred in various locations (indoor, bed, kitchen, toilet, field, roadside, forest, riverside etc.), occupational group (farmers, housewives, teachers, students, fisherman etc.), fangs marks (one, two, many or without marks), dry bites, suspected bites, clinical features (neurotoxicity or haemotoxicity) could not be calculated as there were no proper and complete records in the hospital record registers.

1.10 Objectives

The main objective of the study was to analyze the retrospective data of snakebite in Western Development Region (WDR), Nepal. The specific objectives were to analyze:

- The snakebite cases in different hospitals in WDR, Nepal.
- The knowledge, attitude and practice about the snakebite among people in Devdaha VDC.

2. LITERATURE REVIEW

Globally, about 5,00,000 (Swaroop and Grab 1954), 54,00,000 (Chippaux 1998), 12,00,000 to 55,00,000 (Kasturiratne et al. 2008) snakebites cases occur annually of which 26,82,500 (Chippaux 1998), 4,21,000 to 18,41,000 (Kasturiratne et al. 2008) cases are poisonous and 30,000 to 40,000 (Swaroop and Grab 1954), 1,25,000 (Chippaux 1998), 20,000 to 94,000 (Kasturiratne et al. 2008) deaths occur each year due to snakebite in the world as a whole, and the majority of the snakebite induced deaths occur in Asia, 25,000 to 35,000 (Swaroop and Grab 1954), 1,00,000 (Chippaux 1998), 15,400 to 57,600 (Kasturiratne et al. 2008). Although deaths are relatively rare in Australia, Europe and North America, there is high incidence in the Neotropics and other equatorial and subequatorial regions (Chippaux 1998, Kasturiratne et al. 2008). Swaroop and Grab (1954) of the Statistical Studies Section, WHO, recorded 3,300 to 4,500 deaths in Central and South America, 400 to 1,000 deaths in Africa, 50 deaths in Europe and 10 deaths in Australia. Similarly, Chippaux (1998) published an appraisal of the global situation and speculated the total number of snakebite and the number of deaths in Europe (25,000 and 30), Middle East (20,000 and 100), USA and Canada (45,000 and 15), Central and South America (3,00,000 and 5,000), Africa (10,00,000 and 20,000) and Oceania (10,000 and 200) each year. Kasturiratne et al. (2008) worked on the global burden of snakebite and estimated that the highest number of envenoming for India (81,000), Sri Lanka (33,000), Vietnam (30,000), Brazil (30,000), Mexico (28,000) and Nepal (20,000) annually. Harrison et al. (2009) examined the association between globally available data on snakebite induced mortality and socioeconomic indicators of poverty and he demonstrated that a snakebite envenoming is a disease of the poor. Baseline epidemiological study on snakebite treatment and management in Nepal recorded that every year more than 20,000 people are bitten by snakes and 1,000 die from the snakebite (WHO 1987).

Most of the epidemiological studies of snakes and snakebites in Nepal are concentrated to analyze the annual snakebite incidences, morbidity, mortality and CFR mainly in the Terai region (WHO 1987, Joshi et al. 2003, Joshi 2010, Sharma et al. 2003, Sharma et al. 2004a and 2004b, Pandey 2006 and 2007, Pandey et al. 2010, Panta 2006, Thapa and Pandey 2009). Pandey (2006 and 2007) carried out work on snakebite in hospital and field survey respectively in Chitwan and Nawalparasi districts of Nepal and the largest

numbers of snakebites 66% were recorded from Nawalparasi and 34% from Chitwan. The snakebite is an occupational hazard in the fact that the common victims were farmers, housewives, students and others (WHO 1987, Sharma et al. 2004a and 2004b, Pandey 2006 and 2007, Harrish et al. 2009, Pandey et al. 2010, Rahman et al. 2010) and the main activities of the victims at the time of bite and bites occurred in various locations were farming, working in the field, walking, fishing, outdoor, indoor, sleeping, inside home, premises of home, roadside, riverside, forest, and others. Sleeping under a bed net was a strong protective factor against snakebites occurring indoors while sleeping (Chappuis et al. 2007) whereas the place of sleeping in the house and the use of cot were not associated with the risk of snakebite.

WHO (1987) recorded local pain at the site of bite, swelling, cellulitis, ptosis, respiratory distress, salivation, blurred vision, paralysis, high blood pressure, bleeding and coagulation disorders as signs and symptoms of snakebites. One study in Eastern Nepal analyzed for clinical and epidemiological features found that all the victims with systemic envenoming had neurotoxicity and the coagulopathy was not recorded in any of the victims (Sharma et al. 2003). Sharma et al. (2004a and 2004b) recorded definitive fang marks in 46% while scratch marks in 51% patients. According to them local symptoms were experienced by patients with pain (46.3%), bleeding (27.3%), swelling (19.7%), inflammation (5.6%), blistering (3.1%) and general symptoms were observed in 40.2%. Ptosis was present in all cases (dysphonia, neck muscles weakness, diplopia, respiratory distress, limb weakness, altered sensorium, difficulty in deglutition and perioral paraesthesiae) and reaction to ASVS was observed in 28.16%. They also reported 143 snakebite cases including 75 bites with signs of envenoming resulting in 20 deaths and among 123 survivors, wound required dressing in 24% and surgery in 8% victims. Shrestha (2011) found that 85% of children had local or systemic complications, commonest being respiratory paralysis. A study of the bitten patients who developed no signs of systemic envenoming in Chittagong Medical College Hospital, Bangladesh recorded that among 884 patients admitted, 40% were systemically envenomed and 60% were without signs of either systemic or significant local envenoming (Harrish et al. 2009). Another study carried out to determine the prevalence of snakebite cases specially Viper bite cases admitted to medical ward, Pyay General Hospital showed poisonous, non poisonous and unknown bite cases comprises 13% of total admission and Viper bites comprises 8.1% of all admission in one year period among which 86.7% of all poisonous

snakebite cases are due to Viper bites (Theik et al. 2005). He recorded that the major complications were reduced urine output (59.3%) and shock (33.3%) and also emphasized that shock is an important determinant which predicts high mortality because there is 50% mortality in shocked patients and 71% of expired cases came with shock. The Krait and Cobra bite responsible for neurotoxicity was 29%, 38%, 34%, 31%, 35%, 34% and 19%, 21%, 24%, 20%, 24% 25% in the year 2000 to 2005 respectively and the Viper bite responsible for haemotoxicity was 0.16%, 0.2%, 2%, 2%, 1%, 2% in the year 2000 to 2005 respectively (Thapa and Pandey 2009).

According to Bhetwal et al. (1998), as compare to other western countries, most of the snakebite victims in Nepal did not seek help in time because of belief in traditional remedies and chronic shortage of antivenom in government hospitals and only at the last stage of clinical sign and symptoms, patients were brought to the hospitals among which many were brought dead on the way. An epidemiological study of snakebite cases in children of Nepal found that about 25% of all cases of snakebites were seen in children every year in the endemic areas of snakes (Joshi 2010) and as compared to adults, children have higher morbidity and mortality (Shrestha 2011) due to snakebites.

Shah et al. (2003) have prepared Snakebite Management Guideline in which they described the epidemiology of snakebite along with the identification of poisonous and non poisonous snakes of Nepal, signs and symptoms and first aid treatment. WHO (2005, 2010) published Guidelines for the Clinical Management of Snakebite in the South-East Asia Region. Pandey et al. (2010) emphasized that the first aid training changes the attitude of the people in management of snakebite victims and is one of the effective ways in decreasing mortality. Most of the researchers carried out the work on snakebite to improve management and found that poor access to health services increase snakebite related morbidity and mortality (Thiek et al. 2005, Chippaux 2008, Alirol et al. 2010, Rahman et al. 2010, Williams et al. 2010) therefore, they suggested that joint collaborative efforts from researchers, doctors and other medical workers, antivenom manufacturers, policy makers, public health authorities and international funders are required.

3. MATERIALS AND METHODS

3.1 Study Area

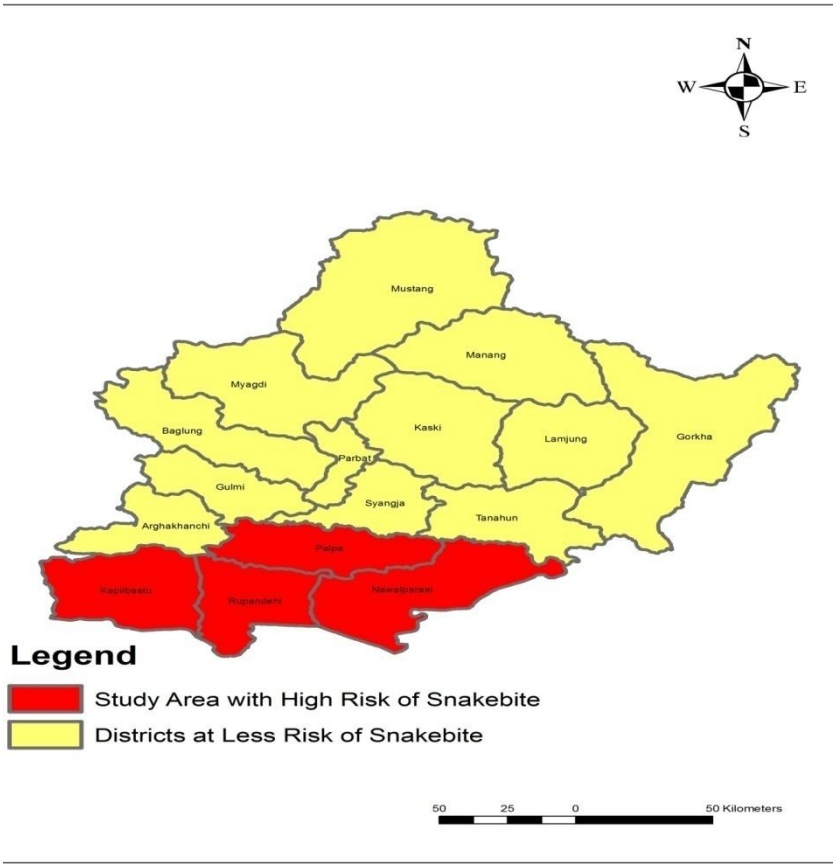

Figure 3: Map showing poisonous snakebite affected districts of WDR of Nepal.

In WDR of Nepal, four districts (Rupandehi, Nawalparasi, Kapilbastu and Palpa) are at high risk of venomous snakebite and other districts are at less risk of venomous snakebite (Figure 3). Demographic data were obtained from a 2011 Population Census, Central Bureau of Statistics (CBS), Kathmandu, Nepal. According to the 2011 National Population Census, the total population of these four districts are 23,56,820 among which 11,37,307 are males and 12,19,513 are females (Table 4).

Table 4: Health institutions of poisonous snakebite affected study sites in WDR of Nepal.

S. N.	Name of the hospitals	Districts	Population		
			Total	Male	Female
1.	Lumbini Zonal Hospital, Butwal	Rupandehi	8,80,196	4,32,193	4,48,003
2.	Bhim Hospital, Bhairahawa	Rupandehi			
3.	Prithvi Chandra Hospital, Parasi	Nawalparasi	6,43,508	3,03,675	3,39,833
4.	Primary Health Care Centre (PHC), Chormara	Nawalparasi			
5.	Sri Bajradal Gan, STC, Triveni Army Camp	Nawalparasi			
6.	Kaligandaki Community Hospital, Kawasoti	Nawalparasi			
7.	Taulihawa Hospital, Taulihawa	Kapilbastu	5,71,936	2,85,599	2,86,337
8.	Gorusinge STC, Gorusinge	Kapilbastu			
9.	Primary Health Care Centre (PHC) Rampur	Palpa	2,61,180	1,15,840	1,45,340
10.	United Mission Hospital, Tansen	Palpa			
			23,56,820	11,37,307	12,19,513

Source: (National Population Census, 2011, CBS, Kathmandu, Nepal).

3.2 Methods of Snakebite Data Collection

The retrospective study of snakebites recorded in 2008-2010 in different health institutions from WDR of Nepal was carried out during June 2011 to February 2012. A total of ten health institutions (1 Zonal Hospital, 3 District Hospitals, 2 PHC, 1 Private Hospital, 1 Community Hospital, 2 Army Camps) where treatment of snakebites are available and snakebite victims used to reported were visited to extract the epidemiological information of snakebite. Pre-tested data collection tools were used to extract all the relevant information of snakebite epidemiology of the study area. The analysis covered details of age, sex, caste, occupation, date of bite, time of bite, duration of bite time to hospital arrival time, bite sites, locations, activities during bite, first aid measures, traditional and local practices, clinical features, no. of ASVS used, management and outcomes. Snakebite reported in medical records based on an eyewitness and /or claim of victim, brought snakes, clear sign of snakebite wounds, and

symptoms of snakebite envenomations were included in the study. The data were obtained from the admission register and snakebite case record sheets. The profiles of the patients were studied carefully to avoid duplication in case of referral of the patients from one centre to another. Then, all the data collected were made entry into the computer system and data analysis was done in accordance with the need of objectives. The statistical analysis was done by the use of MS Excel and R software. Ethical approval letter for the study was taken from Ethical Clearance Review Board, Nepal Health Research Council (NHRC) and Central Department of Zoology, Institute of Science and Technology, Tribhuvan University, Nepal.

3.3 Questionnaire Surveys and Interview

Questionnaire form was designed to collect local people's knowledge about the snakebite, sites of snakebites, first aid measures, means of transports used, preferred treatment centre etc. Questionnaire surveys were conducted with the local people in small part of the study area Devdaha VDC by random sampling method in April 2012. Using a pre established questionnaire form, 200 respondents were queried who either suffered or not suffered snakebite in their lifetime. The head of each household or another senior family member is his or her absence was interviewed. Since some snakebite victims may have been absent due to death or migration or if unable to give reliable answers during the study period, the data was recorded from the secondary persons (victims' relatives or neighbours). The households that were fully vacant during the visit were excluded from the study. Data collection activities were reviewed and cross checked regularly to minimize the data collection errors. Informed written consent was taken from the respondents during the interview.

Demographic data were obtained from a 2011 Population Census, Central Bureau of Statistics (CBS), Kathmandu, Nepal. According to the 2011 Population Census, the total population of the Devdaha VDC is 28,214 among which 12,836 are males and 15,378 are females including 6,435 households. The VDC is situated in the vicinity of the Lumbini Zonal Hospital, dedicated to the clinical management of victims of snakebites, located in Butwal, Rupandehi district. The permission letter was taken from the office of Devdaha VDC.

3.4 Data Analysis

The death among envenomed victims was analyzed as Case Fatality Rate (CFR) and the death among all victims was analyzed as death rate or mortality rate.

Ages are grouped into the interval of 10 years. Out of 6,993 cases, 6,888 cases have age records in the hospital registers and included in the analysis and 105 cases from Sri Bajradal Gan, STC, Triveni Army Camp have no age records in the hospital register and not included in the analysis.

Sites are grouped into five categories; Hand, Leg, Head, Chest and Unknown (patients knew that they were bitten but they don't know exactly where they have been bitten). Out of 6,993 cases, only 5,214 cases have sites records in the hospital registers and included in the analysis and 1,779 cases (1453 from Bhim Hospital, Bhairahawa, 299 from Sri Bajradal Gan, STC, Triveni Army Camp and 27 from Primary Healthcare Centre (PHC), Chormara) have no sites records in the hospital register and not included in the analysis.

Times are grouped into the interval of six hours (Unknown time means patients did not know the bitten time but hospital recorder wanted to record the bitten time and listed as unknown). Out of 6,993 cases, only 5,089 cases have time records in the hospital registers and included in the analysis and 1,904 cases (1453 from Bhim Hospital, Bhairahawa, 299 from Sri Bajradal Gan, STC, Triveni Army Camp 27 from Primary Healthcare Centre (PHC), Chormara and 125 from Taulihawa Hospital) have no time records in the hospital register and not included in the analysis.

To calculate the duration of snakebite time to hospital arrival time, those data of the patients were excluded from the study where either time of bite or arrival was not mentioned in the hospital records. Out of 6,993 cases, only 3,868 cases have time duration records in the hospital registers and included in the analysis and 3,125 cases have no time duration records in the hospital registers and not included in the analysis.

Kruskal-Wallis rank sum test was carried out to test the significant difference in number of snakebite cases visiting the hospitals.

Null Hypothesis (Ho): There is no significant difference in the number of snakebite cases visiting the hospitals.

Alternative Hypothesis (H1): There is significant difference in the number of snakebite cases visiting the hospitals.

4. RESULTS

4.1 Envenoming, Death Rate (Mortality Rate) and Case Fatality Rate (CFR)

A total of 6,993 cases of snakebite were recorded (2,142 cases in 2008, 2,168 in 2009 and 2,683 in 2010) during the three years and 640 (9.15%) patients were found to have features of envenoming (197 in 2008, 182 in 2009 and 261 in 2010). A total of 84 deaths (20 deaths in 2008, 29 in 2009 and 35 in 2010) were recorded during three years. The death among all cases of snakebite was found 1.2% (0.93% in 2008, 1.34% in 2009 and 1.30% in 2010). The CFR among all cases of snakebite was found 13.12% (10.15% in 2008, 15.93% in 2009 and 13.41% in 2010), (Table 5).

Table 5: Total snakebite cases, Poisonous cases and Death cases.

Name of the hospital	Total Cases			Poisonous Cases			Death		
	2008	2009	2010	2008	2009	2010	2008	2009	2010
Lumbini Zonal Hospital, Butwal	1239	1217	1277	163	145	171	20	28	27
Bhim Hospital, Bhairahawa	489	488	476	-	-	-	-	-	-
Gorusinge STC, Gorusinge	148	92	122	31	24	32	-	-	-
Taulihawa Hospital, Taulihawa	91	125	149	-	-	-	-	-	-
Sri Bajradal Gan, STC, Triveni Army Camp	NR	NR	299	-	-	32	-	-	-
Kaligandaki Community Hospital, Kawasoti	121	162	152	3	9	9	-	1	4
Prithvi Chandra Hospital, Parasi	NR	NR	124	-	-	11	-	-	2
Primary Health Care Centre (PHC), Chormara	NR	9	18	-	-	-	-	-	-
United Mission Hospital, Tansen	48	75	35	-	4	4	-	-	1
Primary Health Care Centre (PHC) Rampur	6	NR	31	-	-	2	-	-	1
Total	2142	2168	2683	197	182	261	20	29	35

4.2 Months Distribution

Analysis of collected data showed that the highest snakebite incidences (71.96%) were recorded during the month of June to September (14.96%, 21.16%, 21.14% and 14.70%). The snakebite incidences slowly started to decline from the month of October to January (7.99%, 3.33%, 0.80% and 0.56%) respectively and slowly started to rise from the month of February to May (0.82%, 2.17%, 4.16% and 8.21%) respectively (Figure 4).

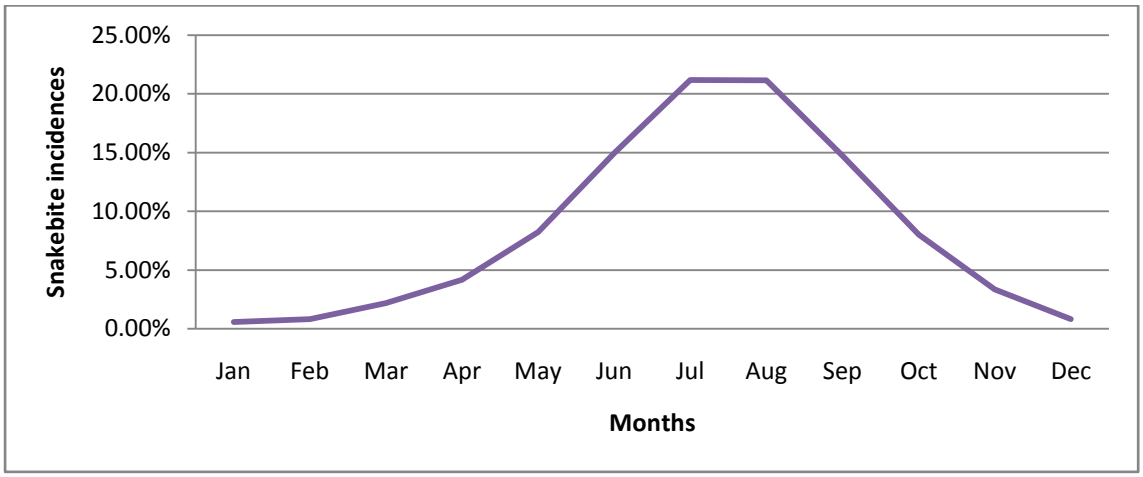

Figure 4: Month distribution of snakebite cases.

Out of 84 deaths (20 deaths in 2008, 29 in 2009 and 35 in 2010), the highest snakebite deaths were recorded during the month of June, July, August and September. The ASVS consumption in June, July, August and September were found 359 vials, 240 vials, 284 vials and 335 vials respectively. It was found that a total of 1,313 vi`als (348 vials in 2008, 329 vials in 2009 and 636 vials in 2010) were used by deaths cases only (Figure 5).

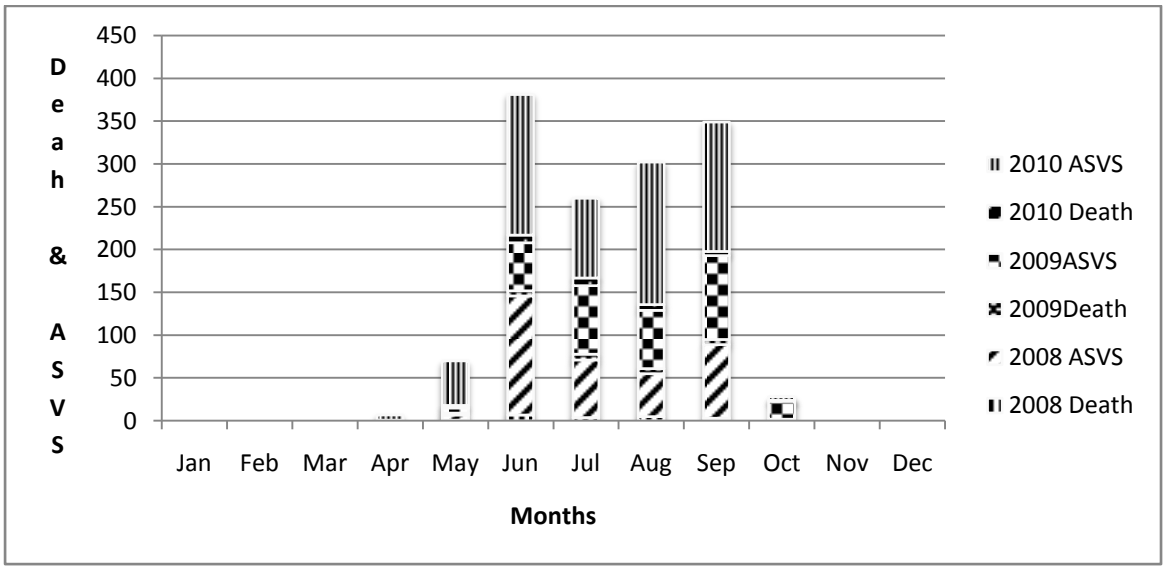

Figure 5: Mortality Vs Months distribution and ASVS Consumption of snakebite cases.

4.3 Sex Distribution

As comparison to males, females were more victimized by snakebites. Out of total cases, 53.60% were females (53.87% in 2008, 53.04% in 2009 and 53.82% in 2010) and 46.40% were males (46.13% in 2008, 46.96% in 2009 and 46.18% in 2010), (Figure 6).

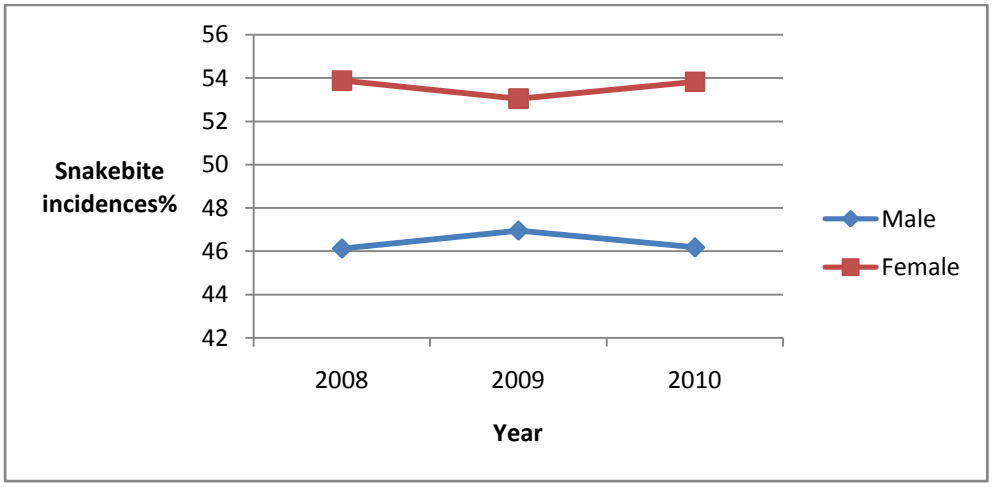

Figure 6: Sex distribution of snakebite cases.

Out of 84 deaths, 38.09% (55% in 2008, 24.13% in 2009 and 40% in 2010) were males and 61.90% (45% in 2008, 75.86% in 2009 and 60% in 2010) were females (Figure 7).

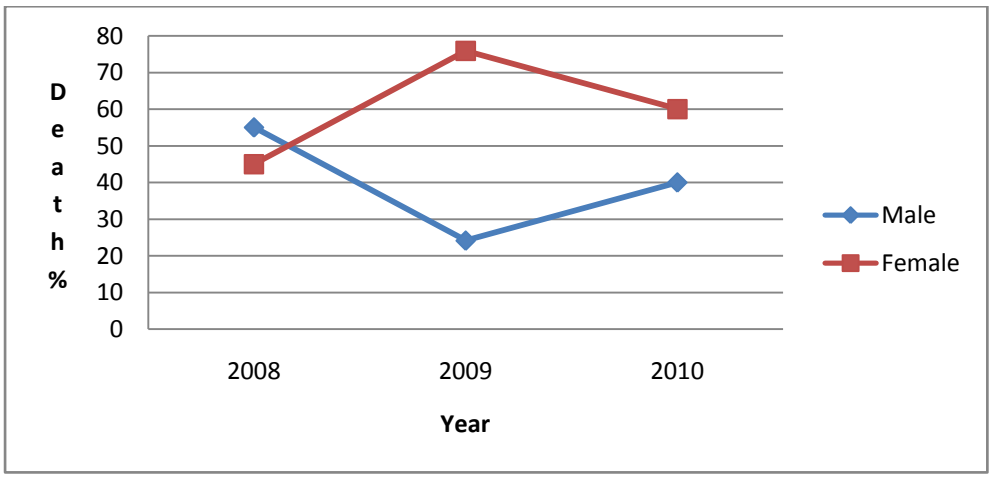

Figure 7: Mortality Vs Sex distribution of snakebite cases.

4.4 Age Distribution

The 11-20 years age group was mostly victimized (26.34%) by snakebite as comparison to other age groups. Snakebite was most common in the age group of 11-40 years, which constituted 67.12% (26.34% in 11-20, 23.62% in 21-30 and 17.16% in 31-40) of the total cases (Figure 8).

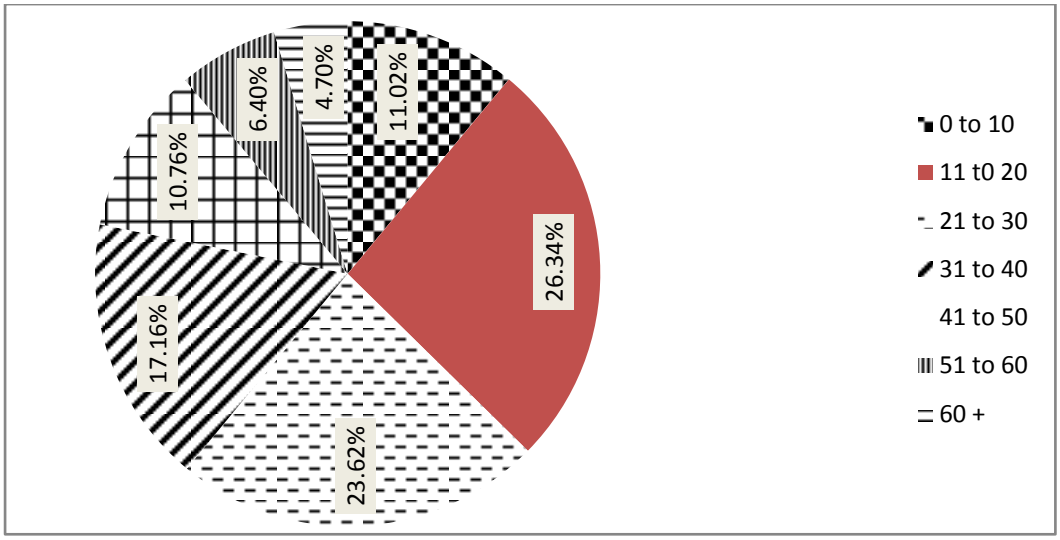

Figure 8: Age distribution of snakebite cases.

The 0-10 years age group was mostly victimized (30% in 2008, 44.82% in 2009 and 28.57% in 2010) by snakebite as comparison to other age groups (Figure 9).

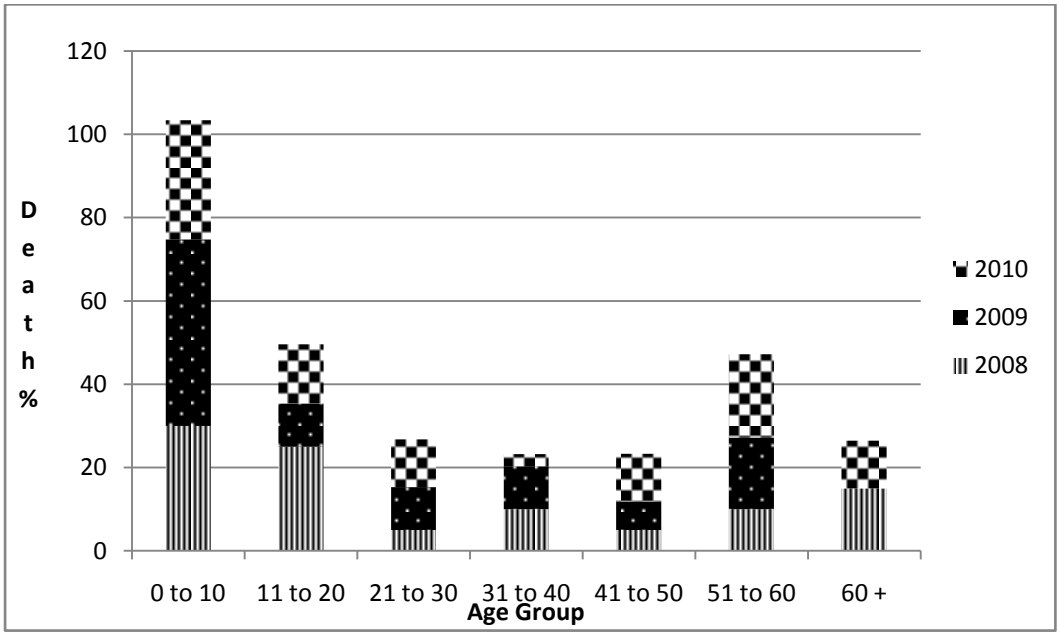

Figure 9: Mortality Vs Age distribution of snakebite cases.

4.5 Sites Distribution

The majority of the patients 52.15% (49.49% in 2008, 56.55% in 2009 and 50.58% in 2010) sustained bites in the lower extremities or leg (Photo 1), while 30.67% (38.29% in 2008, 29.14% in 2009 and 25.34% in 2010) were bitten in the upper extremities or hand (Photo 2), 1.40% (1.75% in 2008, 0.90% in 2009 and 1.53% in 2010) were bitten in the

head and neck region, 0.77% (0.85% in 2008, 0.54% in 2009 and 0.90% in 2010) were bitten in the chest region and 15.01% (9.62% in 2008, 12.87% in 2009 and 21.64% in 2010) were bitten on other parts of the body (Figure 10).

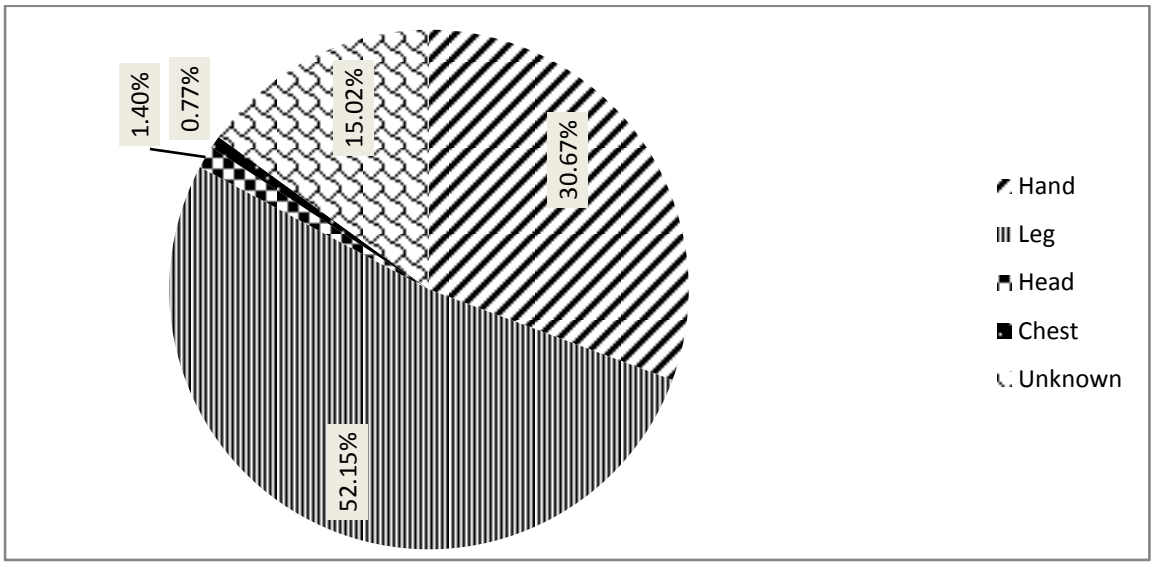

Figure 10: Sites distribution of snakebite cases.

A total of 44.04% (40% in 2008, 58.62% in 2009 and 34.28% in 2010) deaths sustained bites in the lower extremities while 20.23% (35% in 2008, 20.68% in 2009 and 11.42% in 2010) were bitten in the upper extremities, 5.95% (5% in 2008 and 11.42% in 2010) had been bitten on the head and 29.76% (20% in 2008, 20.68% in 2009 and 42.85% in 2010) cases were unknown where the patients were bitten (Figure 11).

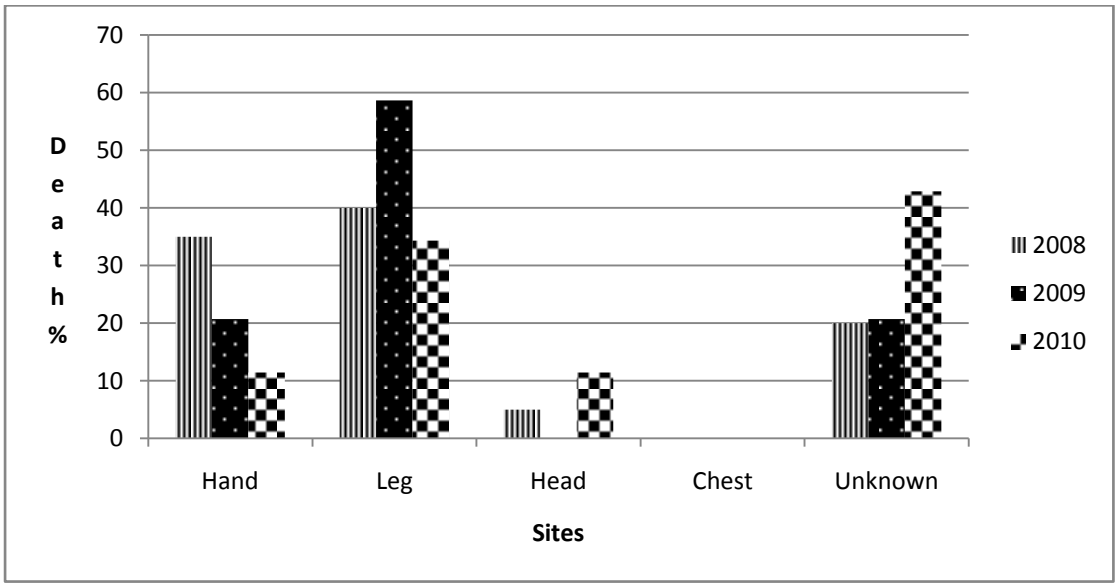

Figure 11: Mortality Vs Sites distribution of snakebite cases.

4.6 Time Distribution

The largest numbers of snakebites 41.50% (40.77% in 2008, 45.80% in 2009 and 38.62% in 2010) were recorded between 15:00 to 21:00 hours followed by 21:00 to 03:00 hours (Figure 12).

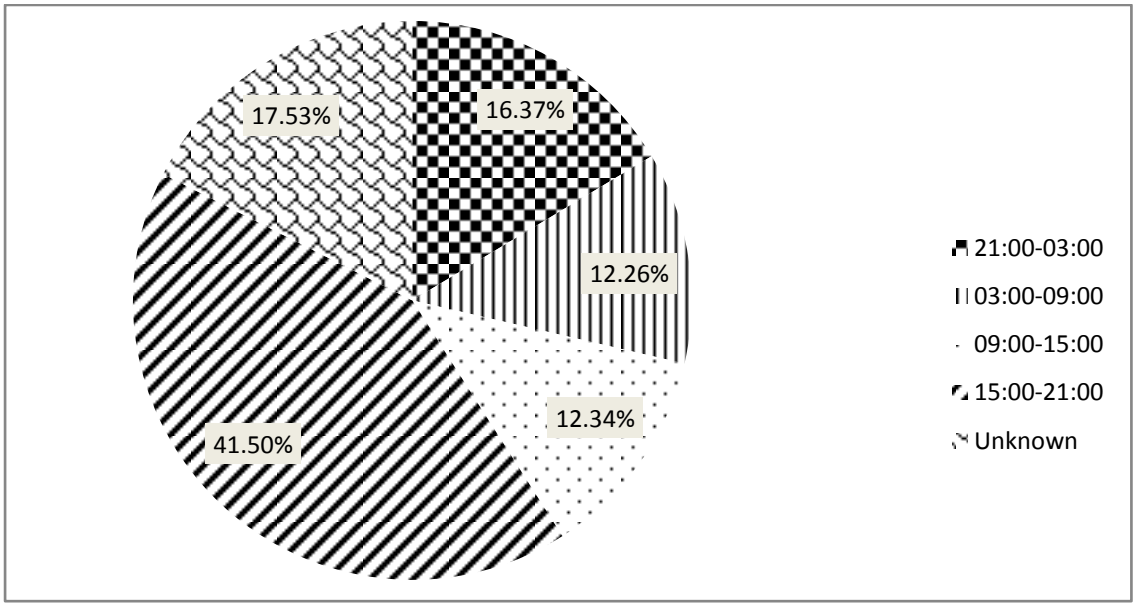

Figure 12: Time distribution of snakebite cases.

A total of 25% deaths (30% in 2008, 31.03% in 2009 and 17.14% in 2010) were reported between 21:00-03:00, 14.28% deaths (10% in 2008, 10.34% in 2009 and 20% in 2010) were reported between 03:00-09:00, 16.66% deaths (15% in 2008, 20.68% in 2009 and 14.28% in 2010) were reported between 09:00-15:00, 16.66% deaths (10% in 2008, 13.79% in 2009 and 22.85% in 2010) were reported between 15:00-21:00 and 27.38% deaths (35% in 2008, 24.13% in 2009 and 25.71% in 2010) were reported as unknown (Figure 13).

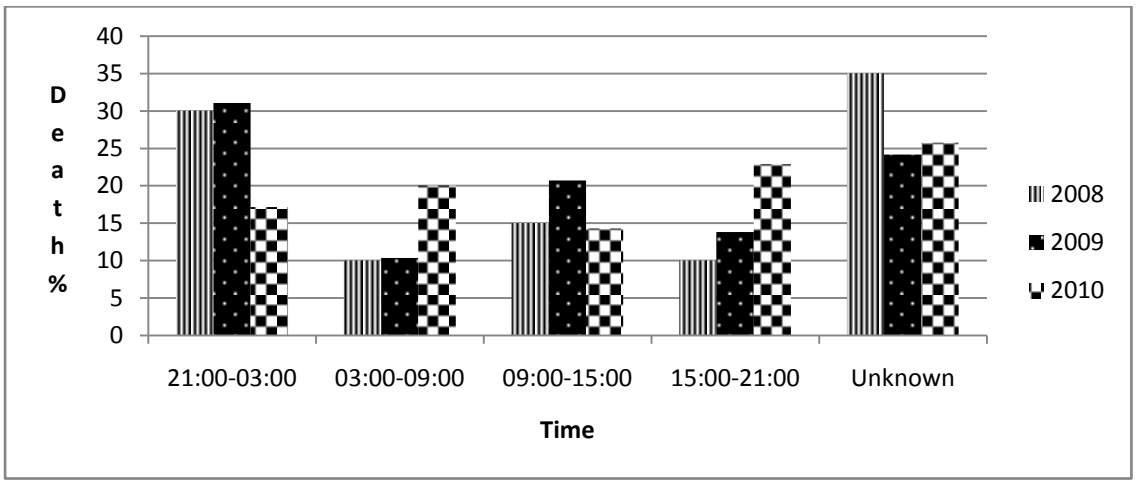

Figure 13: Mortality Vs Time distribution of snakebite cases.

4.7 Duration of Snakebite Time to Hospital Arrival Time

A total of 3,868 cases (3,064 from Lumbini Zonal Hospital, Butwal, 399 from Kaligandaki Community Hospital, Kawasoti, 259 from Gorusinge STC, Gorusinge, 77 from Primary Health Care Centre (PHC) Rampur and 129 from United Mission Hospital, Tansen) have time duration records in the hospital registers among which 45.11% cases were reported within one hour, 37.95% cases were reported within 2-3 hours, 10.06% cases were reported within 3-5 hours and 6.88% cases were reported more than five hours (Figure 14).

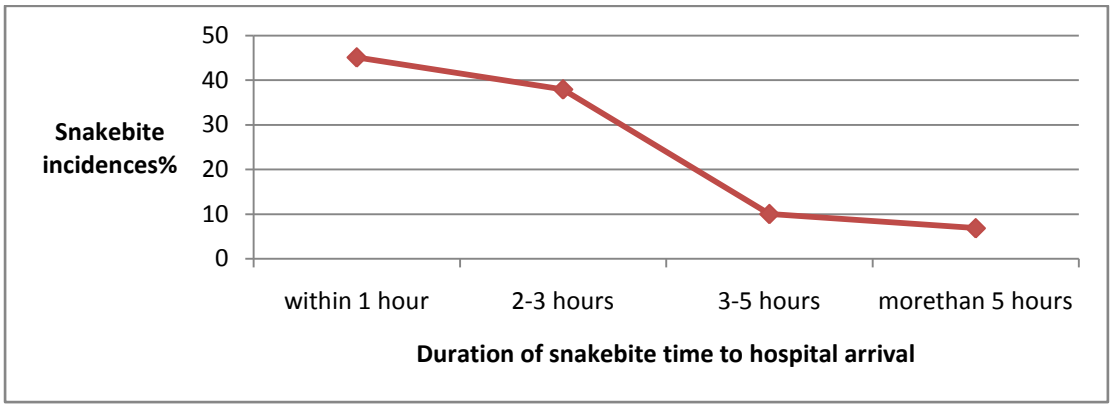

Figure 14: Duration of snakebite time to hospital arrival time.

Out of total deaths, 19.04% deaths (15% in 2008, 20.68% in 2009 and 20% in 2010) were reported within one hour, 16.66% deaths (5% in 2008, 20.68% in 2009 and 20% in 2010) were reported within 2-3 hours, 16.66% deaths (20% in 2008, 20.68% in 2009 and 11.42% in 2010) were reported within 3-5 hours, 10.71% deaths (20% in 2008, 10.34% in 2009 and 5.71% in 2010) were reported in more than five hours and 36.90% deaths (40% in 2008, 27.58% in 2009 and 42.85% in 2010) had no duration records (Figure 15).

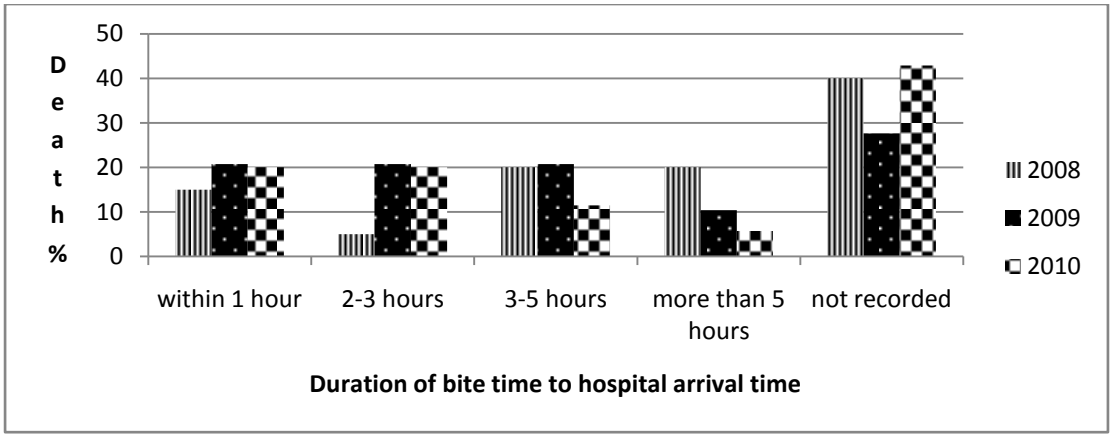

Figure 15: Mortality Vs Duration of snakebite time to hospital arrival time.

4.8 Consumption of ASVS (Amount of Anti Snake Venom Serum Used)

Total requirement of polyvalent ASVS in these hospitals in three years was 10,327 vials (3,285 vials in 2008, 2,527 vials in 2009 and 4,515 vials in 2010). The maximum ASVS used were 140 vials and minimum ASVS used were 2 vials for the treatment of single patients. An average of 16 ASVS vials was administered to each victim (Figure 16).

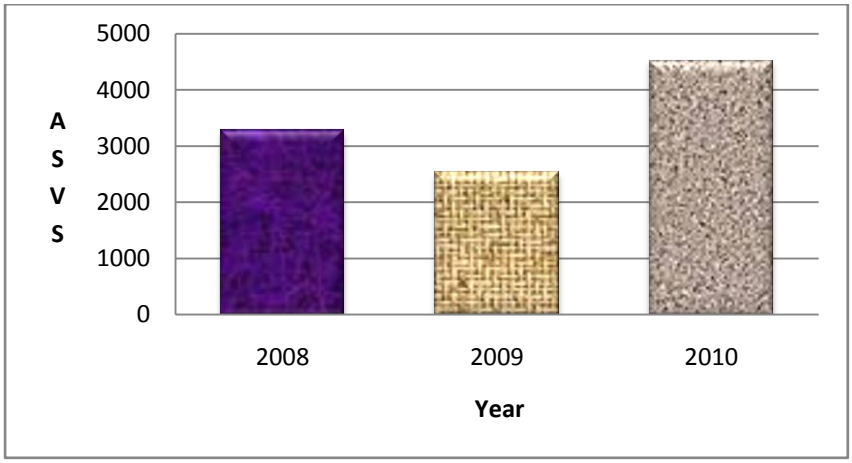

Figure 16: Consumption of ASVS vials.

4.9 Seeking First Aid and Traditional Methods of Treatments

Only 857 victims (124 from Prithvi Chandra Hospital, Parasi, 371 from Kaligandaki Community Hospital, Kawasoti and 362 from Gorusinge STC, Gorusinge) were reported having first aid treatment. Most of snakebite victims used inappropriate and harmful first-aid methods. Tourniquets (Photo 3) are used by up to 91% of the patients and rest were found to use snake stone or Garud dhunga (Photo 3), chillies, cutting wound, sucking wound, applying cloacae of the chicken on the wound, ingestion of alcohol and kerosene.

4.10 Snakes Involved in Envenomation

Only a total of 478 victims or bystander had seen the snake. The snake seen by them according to hospital records were Cobra (28), Krait (184), Viper (66), Dhamin (9), Green snake (27), Coral snake (5) and 159 are unknown to them.

Table 6: The CFR and Death rate.

Name of the Hospital	Total snakebite cases	Enveno-mation cases	Death cases	CFR (%)	Death (%)
Lumbini Zonal Hospital, Butwal	3733	479	75	15.66	2.00
Bhim Hospital, Bhairahawa	1453	-	-	-	-
Gorusinge STC, Gorusinge	362	87	-	-	-
Taulihawa Hospital, Taulihawa	365	-	-	-	-
Sri Bajradal Gan, STC, Triveni Army Camp	299	32	-	-	-
Kaligandaki Community Hospital, Kawasoti	435	21	5	23.81	1.15
Prithvi Chandra Hospital, Parasi	124	11	2	18.18	1.61
Primary Health Care Centre (PHC), Chormara	27	-	-	-	-
United Mission Hospital, Tansen	158	8	1	12.50	0.63
Primary Health Care Centre (PHC) Rampur	37	2	1	50	2.70
Total	6993	640	84	13.12	1.20

4.11 Kruskal-Wallis Rank Sum Test

From the Kruskal-Wallis rank sum test it was found that (p value < 0.001, df=9, χ^2 =37.0323), so the Null Hypothesis (Ho) is rejected and the Alternative Hypothesis (H1) is accepted. This means there is significant difference in number of snakebite cases visiting the different hospitals of the study area (Figure 17).

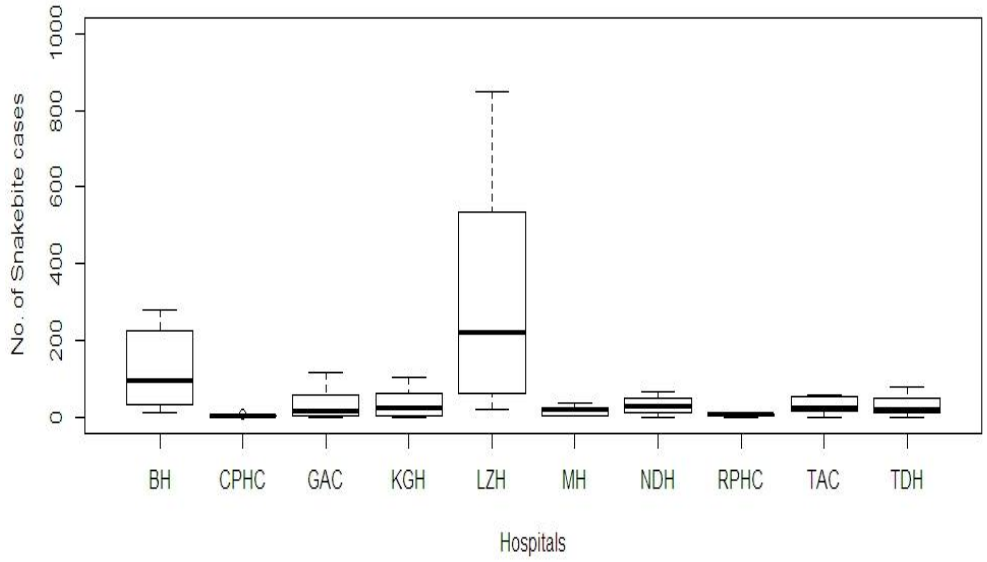

Figure 17: Box plot showing the number of snakebite cases in different hospitals.

The box plot shows that the Median of the snakebite cases is higher at LZH and lowest at CPHC. The number of snakebite cases in LZH is very high which may be due to greater catchment area of Zonal hospital, easy transportation, available of ASVS vials, health facilities and trained manpower in the management of snakebite in this hospital.

LZH = Lumbini Zonal Hospital, Butwal
BH = Bhim Hospital, Bhairahawa
GAC = Gorusinge STC, Gorusinge
TDH = Taulihawa Hospital, Taulihawa
TAC = Sri Bajradal Gan, STC, Triveni Army Camp
KGH = Kaligandaki Community Hospital, Kawasoti
NDH = Prithvi Chandra Hospital, Parasi
CPHC = Primary Health Care Centre (PHC), Chormara
MH = United Mission Hospital, Tansen
RPHC = Primary Health Care Centre (PHC) Rampur

4.12 Results of Questionnaire Survey

Out of 200 respondents, only 79 respondents were known about the snakebite cases in their families or neighbours and 121 were unknown about it during 2008-2010.

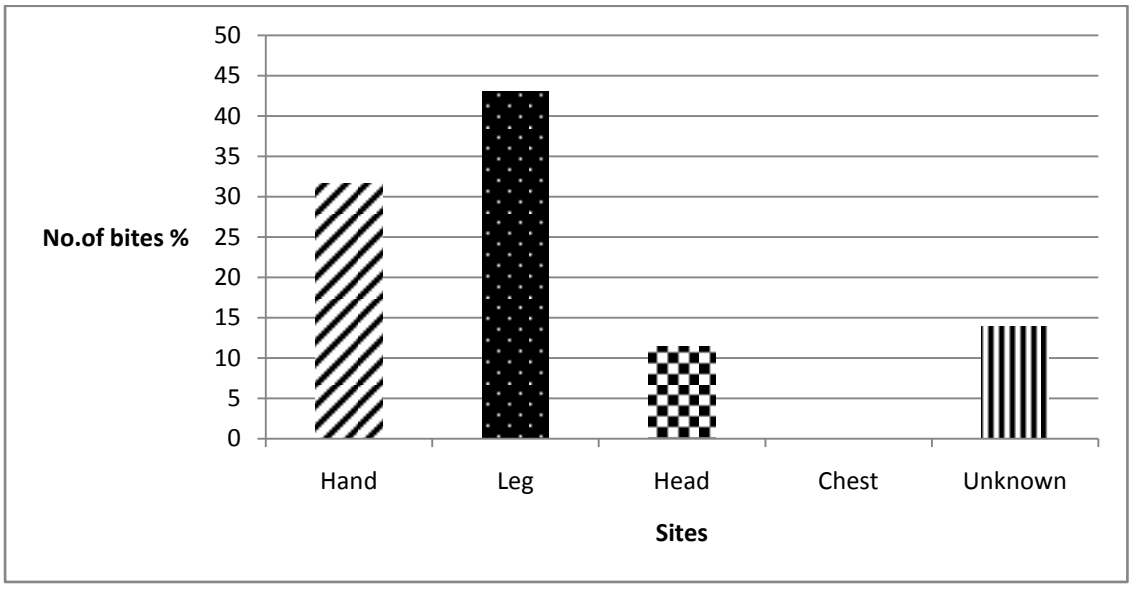

Figure 18: Sites distribution of snakebite victims of Questionnaire Survey.

Out of 79 respondents, 43.03% were bitten in the leg, 31.64% were in hand, 11.39% were on head and 13.92% were unknown bitten cases (Figure 18). And 64.5% applied tourniquetes, 16.5% applied cutting and sucking wound, 7.5% applied herbal medicine, 6.5% applied Pressure Immobilization Bandaging (PIB) and 5% applied Local Compression Pad Immobilization (LCPI) as a first aid treatment (Figure 19).

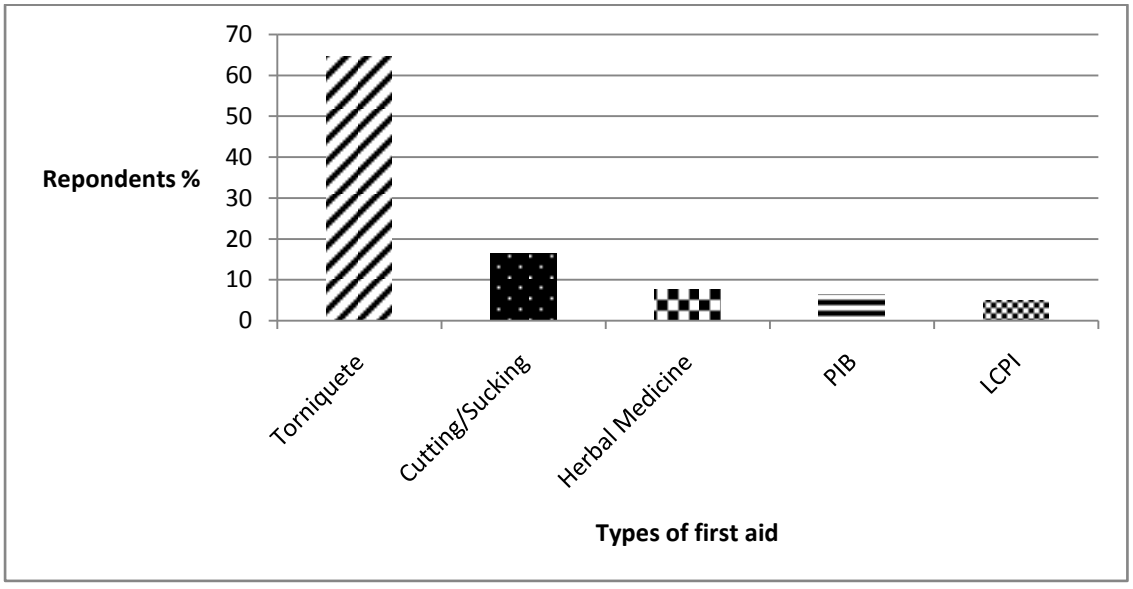

Figure 19: First aid and traditional methods of treatment applied by the respondents of Questionaire Survey.

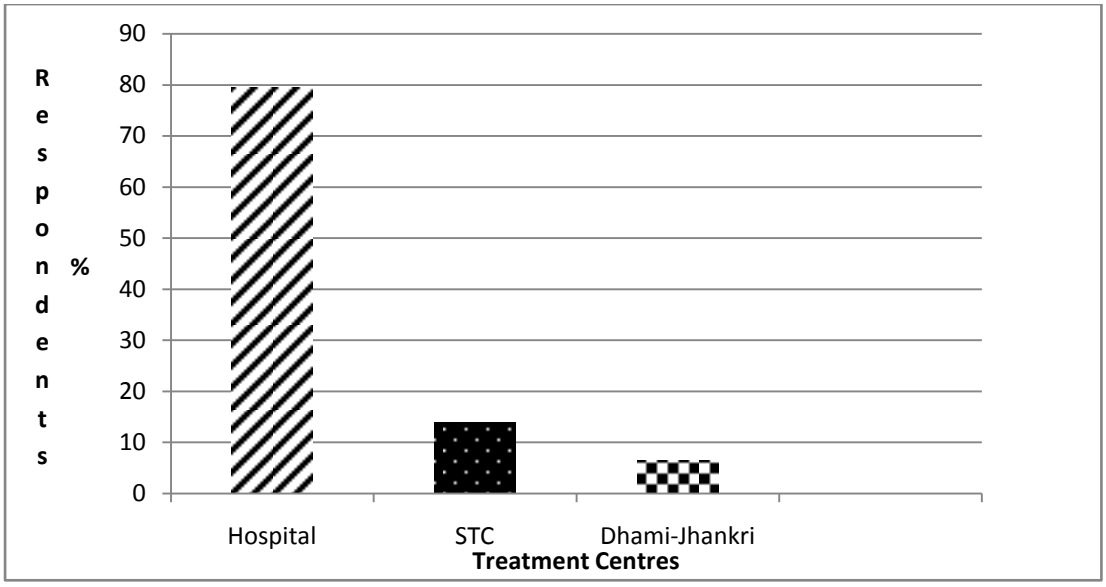

Figure 20: Treatment centre used by respondents of Questionnaire Survey.

Out of 79 respondents, 79.5% respondents brought the snakebite victim to hospital, 14% to STC and 6.5% to traditional healers (Dhami-jhakri) at first (Figure 20). And 54.5% used motorcycle, 37.5% used ambulance and 8% used bus as a means of transports (Figure 21).

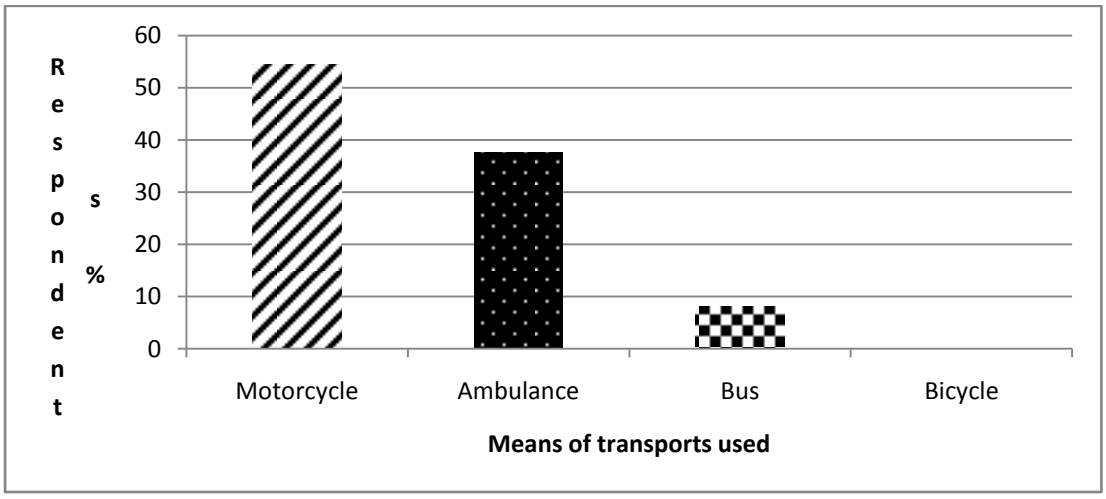

Figure 21: Means of transport used by respondents of Questionnaire Survey.

Out of 200 respondents, 17 respondents brought dead snake along with patients to hospitals for the identification (Photo 5), 183 respondents have the piles of logs, bricks, stones, grasses, bushes, birds' nests etc. around the house which is the favourable environment for the snake to hide itself, 31 respondents have seen snakes while eating other animals and insects like frog, chicken, grasshopper etc. and 9 respondents have participated in seminar related to snakes and snakebite.

5. DISCUSSION

Present study recorded 9.15% features of envenoming. Sharma et al. (2003, 2004a and 2004b) reported 9.29%, 11% and 52% features of envenoming respectively from Southeastern Nepal. Pandey (2006 and 2007) and Pandey et al. (2010) reported 12%, 42% and 26% features of envenoming in hospital and community based survey respectively in Chitwan and Nawalparasi districts, Nepal. In present study, the death among all cases of snakebite was found 1.2%. Sharma et al. (2003, 2004a and 2004b) recorded 2%, 3% and 14% death among all cases respectively from Eastern Nepal. Pandey (2006 and 2007) recorded 3% and 12% death among all cases. Panta (2006) recorded 20% death rate. High mortality rate (21.9%) was seen in patients with more prolonged time interval between time of bite and first dose of ASVS received (Theik et al. 2005). An initial visit to a traditional healers and lack of transport facilities were associated with an increased risk of death whereas an initial transport to the specialized treatment centre with ASVS, and transport by motorcycle were strongly associated with a decreased risk of death (Sharma et al. 2004b). A review on snakebite done by the Alirol et al. (2010) in South-Asia, recorded highly variable mortality rates, ranging from 0.5% to 58% and most fatalities occur before reaching treatment centers. In Bangladesh, out of 98 snakebites, only one death was observed which may reflect the majority of snakebites are non-venomous (Rahman et al. 2010). In present study, CFR due to snakebite ranged from 12.50% to 50% in various treatment centers (Table 6). The CFR among all cases was found 13.12%. WHO (1987) recorded 4.5% CFR, Sharma et al. (2003) recorded 21.37%, Sharma et al. (2004b) recorded 27%, Pandey (2006) recorded 25%, Pandey (2007) recorded 27%, Thapa and Pandey (2009) recorded 18.76% in 2000, 15.69% in 2001, 15.56% in 2002, 14.55% in 2003, 13.94% in 2004 and 13.04% in 2005, Pandey et al. (2010) recorded 22%, Sherstha (2011) recorded 28% CFR respectively and the significant differences in the CFR in various treatment centers may be due to lack of national protocol, lack of trained manpower in the management of snakebite and shortage of ASVS in certain centers (Sharma et al. 2003).

The maximum incidences of snakebites from June to September are due to the abundance of their prey and other environmental factors (rain drives the reptiles and come out of their shelter), maximum field activities in a primarily agrarian society of Nepal (the time for plantation, weeding and harvesting). The minimum incidences snakebite in winter

reflects their hibernation. These findings were supported by the similar findings of WHO (1987), Bhetwal et al. (1998), Sharma et al. (2003), Sharma et al. (2004a and 2004b), Theik et al. (2005), Pandey (2006 and 2007), Panta (2006), Harrish et al. (2009), Thapa and Pandey (2009), Rahman et al. (2010) Shrestha (2011). In contrary to these findings, Joshi (2010) reported greater number of snakebites in the month of November, December and January. In the result of questionnaire survey in the present study, it was found that out of 200 respondents; only 79 were known about the snakebite cases in their families or neighbors (Photo 9) during 2008-2010.

A female dominance was observed among all cases reflects greater female population, males may have been outside the country for their occupation and more female activities in this region which in turn encounter more snakebite which was similar (51% female) to the findings of (Pandey 2006). Unlike to this result, higher incidence of snakebite in males has been recorded 54% (Devkota et al. 2000), 53% (Devkota et al. 2001), 51.3% (Bista et al. 2003), 73% (Sharma et al. 2003), 53.47% (Sharma et al. 2004a), 60% (Sharma et al. 2004b), 82% (Theik et al. 2005), 54% (Pandey 2007), (Panta 2006), 50% in 2000 and 2001, 54% in 2002, 51% in 2003, 52% in 2004 and 2005 (Thapa and Pandey 2009), 52% (Rahman et al. 2010). Harrish et al. (2009) and Alirol et al. (2010) observed 2.6:1 and 2:1 male to female ratio respectively.

The majority of snakebite 26.34% (27.12% in 2008, 27.68% in 2009 and 24.55% in 2010) was found in the 11-20 years age group corresponds to the findings of other previous studies (WHO 1987, Heap and Cowan 1991, Devkota et al. 2001, Bista et al. 2003, Sharma et al. 2003, Sharma et al. 2004a, Theik et al. 2005, Pandey 2006 and 2007, Panta 2006, Harrish et al. 2009, Thapa and Pandey 2009, Alirol et al. 2010, Rahman et al. 2010). This is probably due to the greater involvement of the productive life stages in various household activities and they were more likely to be outside for the agricultural and other outdoor activities. Although the incidence of the snakebite among the adult was higher than in children, the death rate in the case of children was found to be higher than those of adults. Snakes inject the same dose of venom into children and adults so the children must therefore be given exactly the same dose of anti-venom as adults (Sharma et al. 2013). The higher death rate among children than adults is probably due to small body surface area (per kg body weight), the lethal dose to the size ratio as children require less venom and less time to die up snakebite (Panta 2006). Hence, the present study showed the children below 10 years age group were in the risk of death due to snakebite.

This result is similar to the findings of Pandey (2006) who reported the maximum fatality rate (27%) in the age group 0-10 years followed by gradually less fatality rate among adults which indicated the greater amount of venom per kg body weight in children. Snakebite cases in mid-hill districts of Nepal recorded that the total children (below 15 years) snakebite mortality was 70% and morbidity was 30% (Joshi 2010). Shrestha (2011) carried out a study on snakebite envenomation in children below 15 years old, who got ASVS over a period of 48 months and compared with adults, children with snake envenomation have higher morbidity and mortality. In contrast to present study, Pandey (2007) recorded maximum fatality rate (25%) in the age group 30-40 years. Snakebite deaths are as a result of numerous factors other than age, possibly including the species of snake, the area of the body bitten, the amount of venom injected and absorbed amount of venom per kg body weight, time to get to a hospital after bite, the health conditions of the victim and management after arrival (Russell 1980, Kitchens et al. 1987, Gold et al. 2002).

The majority of the patients sustained bite in the lower extremities probably due to snakes were unintentionally press down or crush with the feet, bites in the upper extremities probably due to touching the snakes while working and bites in the head, neck and other regions may occur during sleep on the ground as Kraits often enter human dwelling at night in search of food (Sharma et al. 2003). The sites of the snakebite observed in this study were analogous to the findings of other previous studies; leg 53.3%, hand 26.7%, head 2.7% and others 7.3% (WHO 1987), leg 46.7%, hand 43.8%, head 8.2% and others 1.3% (Bista et al. 2003), leg 65%, hand 32% and others 3% (Sharma et al. 2003), leg 62%, hand 33.6% and others 4.4% (Sharma et al. 2004a), leg 79%, hand 20% and trunk 1% (Sharma et al. 2004b), leg 93% and hand 7% (Theik et al. 2005), mainly on legs and hands (Panta 2006), leg 66%, hand 28% and others 6% (Pandey 2007), 94% on extremities and 6% on elsewhere (Harrish et al. 2009), 68-74% on extremities, 3-6% on head and 1-2% on trunk (Thapa and Pandey 2009), leg 74.4%, hand 18.6% and head 7% (Pandey et al. 2010), 60-80% on leg (Alirol et al. 2010), leg 71%, hand 27% and others 2% (Rahman et al. 2010), 91% on extremities (Shrestha 2011). The results mentioned above were also supported by the sites wise death rate results and the results of questionnaire survey in the present study.

The time difference in this study was similar to the findings of other previous studies (Devkota et al. 2000 and 2001, Sharma et al. 2003, 2004a and 2004b, Panta 2006, Pandey

2007, Thapa and Pandey 2009, Rahman et al. 2010, Shrestha 2011). This study recorded more or less equal proportion of day and night snakebite cases. The snakebites in the night time and early morning shows the nocturnal habits of Kraits which enters houses at night in search of food and bite their human victims while sleeping on the floor, a common sleeping habit among the people in the rural areas (Bawaskar 2002) and the snakebites in the day time and evening shows the diurnal habits of Cobra and also the Vipers. It was supported by a review on snakebite in South-Asia done by the Alirol et al. (2010) who noted that the time of bite depends on the relative abundance of diurnal and nocturnal snakes so Krait bites generally occur at night, whereas Viper and Cobra bites mostly occur during the day time.

Only a total of 3,868 victims reported duration of bite time to hospital arrival time. A study done by the WHO (1987) recorded nearly 27% of the patients were treated within 30 minutes of having been bitten, 3% within 2-3 hours and 20% within 4-5 hours. The highest number of fatal cases occurred in patients treated 7 hours or more after being bitten. Sharma et al. (2003) recorded 24% of victims were reported within one hour, while 37% within 2-3 hours. Sharma et al. (2004a) recorded 29.3% victims were reported within one hour, 41.7% within 1-2 hours, 17.2% within 2-3 hours and 14 patients arrived seven hours after snakebite. Pandey (2007) recorded 41% victims were reported within 1-2 hours after a bite. A study conducted by the Pandey et al. (2010) noted mean duration for reaching the hospital was approximately one hour which was also similar to this study. The delay before transport was significantly longer for victims with a fatal outcome than for survivors (Sharma et al. 2004b). The delay before hospital arrival in this context appeared to have been mainly due to lack of transport facilities and an initial consultation of traditional healers (in the questionnaire survey of present study, 6.5% respondents brought the snakebite victim to traditional healers or Dhami-jhakri at first) in certain groups of victims. The neurotoxic effects of Krait or Cobra venom are usually clinically evident within first hour after the bite, rapidly progressing to respiratory paralysis (Trishnananda et al. 1979). The maximum number of deaths occurred within the first one to two hours of hospital arrival, which may be due to the multiple bites by Cobra and lack of first aid treatment. Moreover, since Krait bites are generally painless with little or no fang marks, victims might not have recognized the bite or might not have felt forced to seek treatment immediately (Sharma et al. 2004b).

In the present study, there were no records of using the means of transport in hospital based survey but in questionnaire survey, 54.5% used motorcycle, 37.5% used ambulance and 8% used bus as a means of transports. The rapid transport by motorcycle was strongly associated with a decreased risk of death and complications from snakebites in Southeastern Nepal (Sharma et al. 2004b). Bicycle was the commonest means of transport followed by ambulance and motorcycle (Pandey et al. 2010).

Total consumption of polyvalent ASVS in the present study was 10,327 vials. The minimum ASVS vials used were 2 vials and maximum were 140 vials for the treatment of a single patient. An average of 16 ASVS vials was administered to each victim. It was found that a total of 1,313 vials were used by death cases only. The highest ASVS consumption was found in June to September. The highest ASVS consumption in these months appears to be logical because of the maximum incidence of snakebites due to the different environmental factors and maximum field activities in these months which in turn encounter more snakebite. WHO (1987) recorded total consumption of polyvalent ASVS were 3,000 vials annually and increasing every year. Sharma et al. (2003) recorded total consumption of ASVS were 5,859 vials and minimum 2 vials to maximum 115 vials were used for the treatment of single patient. Sharma et al. (2004a) recorded minimum 5 vials to maximum 70 vials were used for the treatment of single patient. Pandey (2006) recorded minimum 6 vials to maximum 89 vials with an average of 32 vials administered to each victim. Thapa and Pandey (2009) recorded the average ASVS administration decreased from 16.061 to 13.59 vials per envenomed victims in 2000-2005 respectively. The use of intravenously administered ASVS is the only scientifically and medically approved treatment of snakebites with clear signs of poisoning. Consumption of around 10,327 vials of polyvalent ASVS in present study shows the increasing demand of anti-venom. The maximum use of ASVS vials without definite indication in some cases may be due to unnecessary use of ASVS vials. The belief to available standard guidelines and proper training of health workers on snakebite management will help to prevent unnecessary and haphazard use of ASVS vials (Sharma et al. 2003).

Only 857 victims were reported having first-aid treatment. Most of the snakebite victims used inappropriate and harmful first-aid methods. Tourniquets are used by up to 91% of the patients (which can increase local complications by increasing tissue anoxia and triggering severe systemic envenoming right after their removal (Gold et al. 2002) and is now strongly disapproved by most experts) and the absence of the use of PIB and LCPI

methods in this study. Majority of the patients had ingested chillies before coming to the treatment centre to conform envenomation. According to local belief the loss of taste is one of the earliest indications of sign of poisoning. This may give false assurance to the victims and may delay their urgently needed medical treatment. The use of excessive chillies may also influence the clinical feature by inducing abdominal pain, nausea, vomiting etc. (Sharma et al. 2004a). Other first-aid practices found in this study were incising bite site, sucking wound, using snake stone (Garud dhunga), applying cloacae of the chicken on the wound, ingesting of alcohol and kerosene. This result was corresponded to the findings of other similar studies (Snow 1994, Chippaux 1998, Sharma et al. 2004a and 2004b, Panta 2006, Pandey 2007, Harrish et al. 2009, Alirol et al. 2010, Rahman et al. 2010). In contrast to this study, Pandey et al. (2010) showed only 26% of the snakebite victim went to the traditional healers before arriving to hospital, 56% adopted PIB and LCPI techniques and 18% directly presented to snakebite treatment centre after the first-aid training in management of snakebite victims in Madi valley and is one of the effective ways in decreasing mortality. Comparing the findings of Pandey et al. (2010), the questionnaire survey of present study showed 64.5% applied tourniquetes, 16.5% applied cutting and sucking wound, 7.5% applied herbal medicine, 6.5% applied PIB and 5% applied LCPI as a first aid treatment. One study in Bangladesh showed that only 2% of the patients used PIB method and 42% of the patients first visited the traditional healers before coming to the hospital (Harrish et al. 2009). The majority of deaths could be due to dependency on traditional healers who used different types of traditional treatments thus delaying access to proper treatment centre (Pandey 2007). The use of medically insignificant first aid measures indicated the reflection of the recommendation in teaching materials of schools and universities in Nepal (Pandey and Khanal 2013).

Only 478 victims or bystander had seen the snake - Cobra (28), Krait (184), Viper (66), Dhamin (9), Green snake (27), Coral snake (5) and 159 were unknown to them. Sharma et al. (2003) recorded a total of 1,265 victims or bystander had seen the snake and 126 of them claimed that they could identify the snakes. Snakes identified by them were Cobra (43), Krait (25), Green pit viper (35), Rat snake (8), Mountain pit viper (11) and Water snake (4). Sharma et al. (2004a) recorded that although the snake had been seen by 378 victims, only 24 could identify the type of snake as Cobra (17), Krait (4) and Green pit viper (3). Sharma et al. (2004b) recorded that snakes were identified by 61% of the

victims and were most frequently reported as Cobra (58%), Common Krait (12%) and Water snake (24%). Pandey (2007) recorded 57% of the total respondents illogically claimed their ability to identify the species of snakes. A study in Bangladesh (Harrish et al. 2009) recorded 20 snakes responsible for bites without signs of systemic envenoming which were brought to hospital for the identification. Eighteen were colubrids, Chequered keelback (1), Radiated rat snake (4) and Common wolf snake (13) and two were elapids, Banded Krait (1) and Monocled Cobra (1). Pandey et al. (2010) reported venomous bite accounted for 11 of the cases, out of which nine were elapids and two were pit vipers bites. Shrestha (2011) recorded most of the bites (61%) were by unidentified snakes. Although it was recorded that some of the victims or bystander had seen and identified the biting species of the snake in present study, Forsythe-Jauch (1975) suggested that it did not help in the management, as many of the commonly seen non poisonous snakes even at close observation appear poisonous snakes and vice versa.

6. CONCLUSION AND RECOMMENDATIONS

Snakebite is a serious public health problem in WDR of Nepal, especially in four districts of Terai region (Rupandehi, Nawalparasi, Kapilbastu and Palpa). The bites from deadly venomous snakes like Cobra, Krait and Viper are very common to this region. Out of 6,993 cases of snakebite, 9.15% patients were found to have features of envenoming including 84 deaths during three years. The death among all cases of snakebite was found 1.2% and the CFR among all cases was found 13.12%. There is significant difference in number of snakebite cases visiting the different hospitals (p value < 0.001, df=9, χ^2 =37.0323).

Snakebite incidences occur most frequently (71.96%) from June to September. As comparison to males (46.40%), females (53.60%) were more victimized by snakebite problem. The incidence of the snakebite among adult was higher than in children. The 11-20 years age group was mostly victimized (26.34%) as comparison to other age groups. The majority of the patients (52.15%) sustained bites in the lower extremities, while 30.67% were bitten in the upper extremities. This study recorded more or less equal proportion of day and night snakebite cases. The majority of snakebites (41.50%) were reported between 15:00 to 21:00 hours. The total consumption of polyvalent ASVS was 10,327 vials. The minimum vials used were 2 vials and maximum used were 140 vials for the treatment of single patient. An average of 16 ASVS vials was administered to each victim. Only a total of 3,868 victims were reported duration of bite time to hospital arrival time. The majority of the patients (45.11%) were reported within one hour. Only 857 victims were reported having first-aid treatment. Most of snakebite victims used inappropriate and harmful first-aid methods. Tourniquets are used up to 91% of the patients and no patients were found to have a use of PIB and LCPI methods. Other first-aid practices found in this study were ingestion of chillies, incising bite site, sucking wound, using snakestone, applying cloacae of the chicken on the wound, ingestion of alcohol and kerosene. A total of 478 victims or bystander had seen the snakes like Cobra, Krait, Viper, Dhamin, Green snake, Coral snake and some were unknown to them.

Mortality due to snakebite in WDR of Nepal, especially in LZH is very high which denote a high prevalence of venomous species in the catchment area of LZH. Out of 84 deaths, 75 deaths (20 in 2008, 28 in 2009 and 27 in 2010) were recorded from LZH alone.

The highest snakebite mortality and highest ASVS consumption were recorded during June to September. It was found that a total of 1,313 vials were used by death cases only. Female mortality was observed dominance than males. The mortality rate in case of children (0-10 years) was found to be higher than those of adults. Majority of deaths sustained bites in the lower extremities or leg followed by the upper extremities or hand. The mortality according to time also shows more or less equal proportion of day and night snakebite cases. Majority of deaths were reported within first one to two hours.

In the questionnaire survey, out of 200 respondents, most of the respondents were unknown about the snakebite cases in their families or neighbors. Leg was the common bite site followed by hand. Many respondents applied tourniquets and very few applied PIB and LCPI as a first-aid treatment method. Many respondents brought the victim to hospital and snakebite treatment centre but some brought to the traditional healers (Dhami-jhakri) at first. This may be one of the reason which delays in treatment leading to death on the way before reaching hospital although the transport facilities is available easily. A very few respondents brought dead snake along with patients to hospital for the identification. Many respondents have favorable environment for the snake around the house. Only nine respondents were participated in the seminar related to snake and snakebite.

From this study, it was found that in the WDR, there is a high prevalence of venomous species and more probability of deadly venomous Cobra and Krait bite. Also, the children below ten years were mostly victimized as compare to other age groups, more or less equal proportion of day and night snakebite cases and the maximum number of deaths occurred within the first one to two hours of hospital arrival, so it can be concluded that this region is more affected by the Cobra bite.

The main recommendations based on this study are as follows:

- The favorable environment for the snakes such as the piles of logs, bricks, stones, grasses, bushes, birds' nest etc. around the houses where snakes can hide should be cleaned.
- Snakebite is an occupational hazard for rural people. So the risk of being bitten can be lowered with preventive measures, such as wearing safety boots while walking and working in the field, using torchlight in the dark places, by sleeping on a cot using bed nets and avoiding areas known to be inhabited by dangerous snakes.
- In some areas the high mortality and CFR from snakebite means scarcity of health facilities, shortage of ASVS in certain centers, lack of trained manpower in the management of snakebite, inappropriate and harmful first-aid methods, an initial visit to a traditional healers, lack of transport facilities, prolonged time interval between time of bite and first dose of ASVS received, lack of national protocol etc. To reduce mortality and CFR due to snakebite, health education and training on snakebite should be conducted in different parts of the country by promoting health facilities, an initial transport to a specialized treatment centre with ASVS, transport by motorcycle, promotion of potentially effective and appropriate first-aid methods etc. Researchers, doctors and other medical personnel, public health authorities, international funders, traditional healers and mass people should be included in such discussion.
- There is no production of any ASVS in Nepal. Nepal import polyvalent antivenom from different companies of India targeted on four species only (*Naja naja, Bungarus caeruleus, Daboia russelii and Echis carinatus*) which may be less effective and may cause adverse effects to the bite of other venomous species. So the further research should be done for the production of ASVS in Nepal considering not only the four species but a number of other species that are responsible for the venomous bites.
- Data keeping in health institution should be improved and well managed.
- The single national snakebite management protocol should be disseminated nationwide.
- It is strongly recommended to list snakebite as a specific notable disease in Nepal as well and should be included in the curriculum of universities.

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SN	Registration number	# Name and Demography of Victim					# Date and time of snakebite; duration of snakebite and ED report (English date)		
	(Emergency/ Indoor/OPD)	Name	Gender (M/F)	Age	Profession (Occupation)	Ward no, VDC, District	Date of bite (DD/MM/YY)	Time of bite (in hours)	Duration of SB to ED report (in hours)
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

	# Enumeration of bite								# Bite site, Location and activities during bite		
SN	**fang marks**				**Envenomations**		**Dry bites**	**Suspected Snakebite**	**body parts**	**Locations**	**Activities**
	one	**two**	**many**	**without marks**	**Nonenvenomed**	**Envenomed**			**Leg, Hand, Head, Chest etc.**	**Bed, kitchen, indoor,outdoor, field, road, cowshed, toilet,**	**indoor activities, outdoor activities, others**
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

	First-aid measures		Traditional first-aid and Local Practices								
			Tourniqet Application			Incision and Sucking					
SN	Pressure Immobilization Banadaging method (PIB)	Local Compression Pad Immobilization Methods (LCPI)	Single	Double	Multiple	Incision of bite site	Sucking wound	Application of herbs	Application of snake stone	Others (if any)	Complications from Traditional treatments (bleeding, wound infection, loss of finger/limb, imprint of troniquet, etc)
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
20											

	Clinical Features									
	Neurotoxicity						Haemotoxicity			
SN	Ptosis	Unconciousness	Salivation	Vomiting	Abdominal pain	difficulties in swallowing	Local swelling	Bleeding in gums, …etc	20 Min./WBCT (+/-)	Additional Remarkable symptoms
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										

Enumeration of envenomed and admitted snakebite victim								
SN	Duration of snakebite and first use of antivenom (in hrs)	Total number of anti-snake venom vials used	Total hours of antivenom use	Total days of hospital stay	Outcomes			Reaction to Antivenom
					Survived successfully	Survived with disability	Death	
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								

देवदह गा.वि.स. क्षेत्रमा सर्पदंशको महामारी

सर्वेक्षण फारम

१. तपाईं वा तपाईंको परिवार वा छिमेकमा कसैलाई २०६४ पौषदेखि हालसम्ममा कसैलाई सर्पले टोकेको छ वा छैन ?

छ ..... छैन .....

...../...../.....गते

२. यदि टोकेको छ भने कुन अंगमा र के काम गरिरहँदा टोकेको थियो ?

अंगको नाम	काम/टोकेको ठाउँ	
हात	खेतमा	भान्सामा
खुट्टा	गोठमा	शौचालयमा
टाउको	बिस्तारामा	अन्य ठाउँ
थाहा छैन		

३. सर्पदंशको बिरामीलाई कस्तो खालको प्राथमिक उपचार गर्नुहुन्छ ?

डोरीले बाँध्ने	जडिबुटी दल्ने
ब्लेडले काट्ने र रगत चुसेर फ्याँक्ने	गरुड ढुंगा लगाउने
अन्य	

४. सर्पदंशका बिरामीलाई सर्बप्रथम पहिले कहाँ लग्नुहुन्छ ?

धामी झाँक्री र तान्त्रिक	अस्पताल
सर्पदंश उपचार केन्द्र	अन्य

५. बिरामीलाई अस्पताल पुर्‍याउन कुन साधन प्रयोग गर्नुहुन्छ ?

साइकल	एम्बुलेन्स	मोटरसाइकल	
बस	स्ट्रेचर	डोली	डुंगा

यदि अस्पताल पुर्‍याएको भए, उक्त बिरामीका लक्षणहरु कस्ता खालका थिए ?

क्र.स.	लक्षणहरु	टोकेको ठाउँमा	बाटोमा	अस्पतालमा
१	आँखा लट्ठिने			
२	बेहोस हुने			
३	र्‍याल छाड्ने			
४	बान्ता गर्ने			
५	पेट दुख्ने/पोल्ने			
६	निल्न गाह्रो हुने			
७	सुन्निने			
८	रगत बगिरहने			

६. सर्पदंशबाट अंगभंग वा मृत्यु भएका घटनाहरु छन् ?

छ छैन

छ भने बिस्तृत तथ्याङ्क

७. तपाईं वा नजिकैको कसैले टोकेपछि सर्पलाई मारेर चिन्हको लागि बिरामीसँगै अस्पताल पुर्‍याउनु भएको छ ?

छ छैन

८. मानिस बाहेक गाईवस्तु वा अरु कुनै जनावरलाई पनि टोकेको थाहा पाउनु भएको छ ?

छ छैन

९. घर वरपर सर्पहरु बस्न मन पराउने खालको वातावरण छ छैन ?

जस्तै : झाडी/चराको गुँड/मुढा वा दाउराको थुप्रो आदि

छ छैन

१०. सर्प सम्बन्धी कुनै कार्यक्रममा भाग लिनु भएको छ ?

छ छैन

छ भने कस्तो खालको कार्यक्रम .....

आयोजक.....

अन्य केही तथ्याङ्क वा जानकारी भए :.....

उत्तरदाताको विवरण

नाम :

ठेगाना:

जिल्ला

वार्ड नं. :

टोल नं.

मो/फोन नं. :

उत्तरदाताको हस्ताक्षर/सहिछाप

मिति :

Clinical features of snakebite

(Shah et al. 2003, WHO 2005, WHO 2010, EDCD 2012 and Sharma et al. 2013):

The general symptoms are nausea, vomiting, malaise, abdominal pain, generalized pain, weakness, very anxious, drowsiness, faintness etc. and the major sign and symptoms of systemic envenoming include

Cobra and Krait bites

- Repeated vomiting, epigastric pain
- Ptosis (difficulty in opening the eyes) and external ophthalmoplegia
- Difficulty in opening mouth, difficulty in swallowing and difficulty in breathing
- Blurred vision, slurred speech (change in voice), abnormalities of taste and smell
- Abscess formation and local tissue damage (necrosis)
- Paralysis of facial and other muscles (hands and feet)
- Salivation
- Broken neck sign

Viper bites

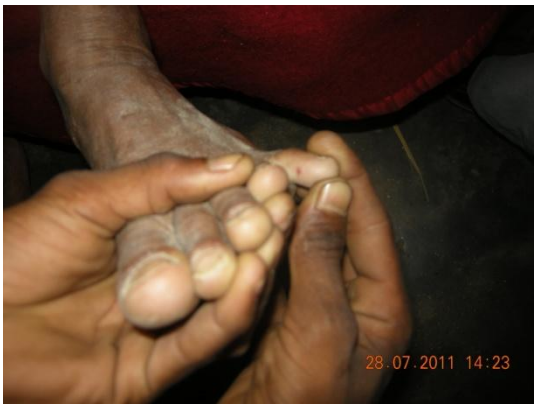
- Fang marks
- Swelling, blisters
- Necrosis of the skin, muscles and tissues
- Skeletal muscles breakdown, stiffness and tenderness of muscles
- Lymph node enlargement
- Acute renal failure
- Ptosis and external ophthalmoplegia (in case of Russell's viper bites)
- Bleeding from any site may occur. Bleeding from recent wound, from old partly healed wound, from gingival sulci, gums, in skin, eye, inside the abdomen, rectal bleeding, vaginal bleeding, haematuria, bleeding inside the skull and brain.

Recommended first-aid treatments

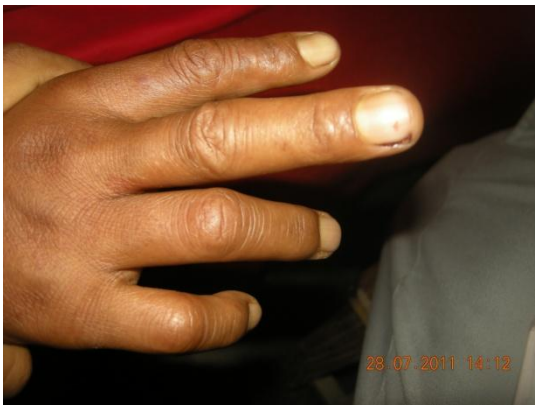
(Shah et al. 2003, WHO 2005, WHO 2010, EDCD 2012 and Sharma et al. 2013):

- Immobilization of the bitten limb with a splint or sling is an important and effective first aid method. Any movement or muscular contraction increases absorption of venom into blood and lymphatic.
- Consider Pressure Immobilization Bandaging (PIB) for some elapid bites. Ideally, an elasticized, stretchy, crepe bandage, approximately 10cm wide and at least 4.5 meters long should be used. If that is not available, any wide and long strips of cloth can be used. The bandage is bound firmly (at a pressure of 50-70 mmHg) around the entire bitten limb, starting distally around the fingers or toes and moving proximally, to include a splint or sling.
- Pressure immobilization is recommended for bites by neurotoxic elapids snakes but should not be used for viper bites because of the danger of increasing the local effects of the necrotic venom. If it is not possible to apply pressure bandage, compression pad can be applied. A rubber or folded material pad approximately 5cm square and 2-3cm thick is placed directly over the bite site anywhere on the body and bound in place with a non-elastic bandage at a pressure of at least 70 mmHg. The use of Local Compression Pad Immobilization (LCPI) applied over the wound, without pressure bandaging the entire bitten limb, has produced promising results in Myanmar.
- Avoid any interference with the bite wound as this may introduce infection, increase absorption of venom and increase local bleeding.
- Immediate transport the victim to the nearest treatment centre, where the treatment facility with ASVS is available.

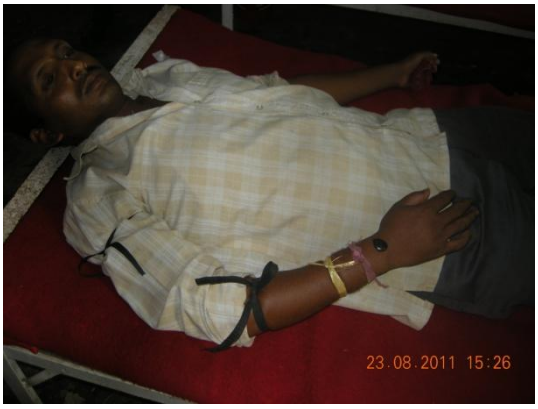
Photoplates



1: Snakebite in lower extremities



2: Snakebite in upper extremities



3: Patients using multiple tourniquetes and snake stone (Garud dhunga)

4: Worshiping at Nagpanchami festival

5: Killed Cobra near the residental area

6: Group of *Amphiesma stolatum*

7: Researcher interviewing the patient

8:Researcher interviewing health personnel

9: Researcher during questionnaire survey

10: Researcher dissecting the snakes

11: Researcher during the snakebite management training

12: Researcher during the workshop on Ethical Health Research by NHRC