SNAKEBITES IN SOUTHERN VIETNAM: ADMITTED PATIENTS AND SNAKE SPECIES INVOLVED

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ABSTRACT - This study deals with the snakebite problem in southern Vietnam. The focus is on the number of admitted patients at clinics and hospitals in four provinces and at Cho Ray Hospital in Ho Chi Minh City and differences in snakebite patterns between the provinces, i.e. snake species responsible for envenomation. In some provinces there are clear signs of increased number of snakebites due to more frequent interactions between humans and snakes. Some policy views of the snakebite problem are discussed, such as building a national strategy to deal with this important issue.

INTRODUCTION

The majority of venomous snakes are found in the world's tropical regions, and the majority of snakebites occur in rural areas of these regions where many people have to cope with snakes literally in their own backyard. Actual statistics are usually unreliable, especially when attempting to attribute cases to specific species. Snakebite statistics are not systematically reported in most countries. Many cases do not find their way into official records, and for many developing countries they may be of local interest only. However, envenoming from snakebites is an important public health problem in many tropical and subtropical countries. Very few countries possess a reliable epidemiological reporting system capable of providing precise data on snakebites. The lack of accurate statistics has prompted researchers to rely on scientific reports and other publications in an attempt to understand these issues.

People, as well as clinicians, living in many parts of Africa, Asia, and Latin America have witnessed this devastating environmental and occupational disease that is summarized by Williams et.al. (2010, p. 89):

"Like malaria, dengue, tuberculosis, and parasite diseases, the risk of snake bite is always present. Unlike many of these other public health risks, however, the burden of human suffering caused by snake bite remains unrecognised, invisible, and unheard of by development agencies and government alike."

The reason for the low interest can be explained by a lack of knowledge or general interest in these issues. In addition, many developing countries have limited resources to deal with this issue as there are many other important health problems given priority. Another part of the explanation might be a kind of national centre-periphery dimension, implying that the rural areas are getting less attention and interest from the urban centres where the political and planning processes are located (Eriksson, 2008).

The first comprehensive review of the global snakebite situation was made by Swaroop and Grab (1954). This survey estimated the total number of snakebite deaths in the world (excluding China, the USSR and the central European countries) at between 30 000 and 40 000 annually. Of this total, the highest figures were those for Asia (25 000–35 000), followed by South America (3 000–4 000). North America (including Mexico), Europe and Oceania had relatively few snakebites related deaths (300–500, 50 and 10, respectively). For Africa, the authors thought that the annual total number of deaths was around 400–1 000.

It was difficult for them to provide any approximate estimate because of the lack of reliable records. Swaroop an d Grab's review was based mainly on hospital admissions, and such data is very unreliable and fraught with inaccuracies. The authors stressed that the available statistical data were mostly unreliable and at best could serve to provide only an approximate and highly conservative estimate of the snakebite problem.

Chippaux (1998) attempted to update the study by Swaroop and Grab, but he also relied on limited epidemiological data in arriving at estimates. According to his survey, Asia had in the 1990s – about 100 000 deaths per year; Central and South America, 5 000; the USA and Canada, 15, Europe, 15; the Middle East, 100; and finally Oceania, 200. Altogether Chippaux's total figure for snakebite deaths was 125 000 per year. Swaroop and Grab's figures, according to Chippaux, were greatly underestimated. But it is also hard to authenticate Chippaux's figures as his study is mostly based on uncertain assumptions and limited literature reviews.

White (2000) anticipates more than 150 000 deaths while Gutierrez et.al. (2006) talk about tens of thousands of deaths. Another overview of the global snakebite situation was made by Kastuiratne et.al. (2008). The estimates were based on limited and rough regional data for some countries and their estimates landed on 20 000 to 94 000 deaths per year.

To these figures should about 400 000 amputations be added (Mion and Olive, 1997) and also various kinds of short and long-term illnesses that lead to serious social and economic repercussions such as losing the possibility to work for one's living.

The number of bites is even more difficult to estimate and figures varies from less than half a million to about 5.5 million – all of these estimates are often rough guesses or are based on unreliable data. The insufficient data can be another main reason behind the very limited interest in the recognition of snakebite as an important public health issue. To make reliable studies there is a huge need to accomplish time-consuming field studies and to adapt these studies to various circumstances and prerequisites in different countries. In 2009, snakebite was recognized for the first time by WHO as a neglected tropical disease.

THE SNAKEBITE PROBLEM IN VIETNAM

Vietnam, officially the Socialist Republic of Vietnam, occupies a land area of about 310 000 km^2 and has a population of more than 92 million. Vietnam is divided into more than 60 provinces including five centrally governed cities, belonging to eight geographical regions.

Vietnam is located between 8 and 24 degrees north and is a country of tropical lowlands, hills, and densely forested highlands. Mountains and hills cover large parts of Vietnam's territory. The wide range of latitude and altitude and wide variety of landform, from swampy deltas, limestone karst and high mountains has given the country a great diversity of natural environments and a high level of biodiversity.

Although the entire country lies in the tropics and subtropics, the climate varies considerably from region to region. Temperatures are high all year round for southern and central Vietnam; but northern Vietnam has a cooler season as the north monsoon occasionally brings cold air in from China. Because of differences in latitude and the marked variety of topographical relief, the climate tends to vary considerably from place to place.

In recent years new and endemic animal species have been discovered in Vietnam, which also applies to the herpetofauna. More than 210 snake species have been recorded in Vietnam including 72 genera, divided into eight families. Depending on the classification systems used the number of venomous snakes used a total of up to 60 venomous snakes have been recorded, comprising 37 species (15 genera) of the family Elapidae and 23 species (9 genera) of the family Viperidae.

Available published data on the snakebite issue in Vietnam is very scarse. No national survey of snakebite incidents has been carried out. From 1948 to 1952, 124 cases of cobra bites were treated in the Institut Pasteur, Saigon; of these, two died. The Province of Cantho registered four deaths from snakebites in the period from 1948 to 1950 (Swaroop and Grab, 1954). Michael Barme, former Director of the Pasteur Institute Laboratory in Saigon reported a high incidence of fatal cases from sea snake bites. However, the exact number of cases cannot be confirmed due to the spread of superstitions about snakebite in many villages situated in areas far away from urban centres (Barme, 1963).

Out of 131 snakebite victims from April to June 2001 and from June to July 2002 at Cho Ray Hospital (Ho Chi Minh City), 93.1 per cent were bitten by venomous snakes (Calloselasma rhodostoma 30.5 per cent, Trimeresurus albolabris 28.2 per cent, Naja kaouthia 13.0 per cent, Naja siamensis 13 per cent, Bungarus candidus 5.3 per cent and Ophiophagus hannah 3.1 per cent). The majority of snakebites victims were farmers from Ho Chin Minh City and nearby provinces. Six of the 131 cases were fatal, implying a mortality rate of 4.58 per cent. Four cases were attributed to C. rhodostoma and two cases were due to severe prolonged neurotoxic envenomation caused by B. candidus combined with secondary pneumonia (Quyen, 2003).

A field study from villages in two communes in Bac Can province, in northern Vietnam, revealed a snakebite incidence of about 10 bites per 1000 population/year, but a low fatality rate (Eriksson, 2008). It is a high snakebite incidence, which can partly be explained by a completely rural population working in an environment dominated by agriculture and outdoor activities. Another factor explaining the high incidence is this study's reliance on interviews rather than clinical data, thus incorporating snakebite cases not known to clinics.

According to the doctors at the clinics, there were three main causes of people being bitten by snakes: people walking in a forest searching for firewood, people working in rice fields and people searching for snakes, i.e. snake handlers or snake traders. The most common snakes involved in envenomation were green vipers, cobras and kraits.

Another important factor behind inadequate knowledge about snakebite incidence is the victims' decisions to visit traditional healers instead of seeing a medical clinic. Based on interviews with clinics, inhabitants and community leaders a rough estimate was that less than 20 per cent of the snakebite victims visited a clinic. Those visiting the healers include victims with mild cases as well as more serious ones. With their limited resources the clinics had very little to offer. Their capacity to treat serious cases was curtailed as they lacked antivenin. The field study also revealed that some of the doctors interviewed expressed the opinion that traditional healers were better at dealing with snakebite cases than modern medicine!

A retrospective study of 60 consecutive patients envenomed by Bungarus multicinctus treated at the intensive care unit (ICU) of the PCC during the 4-year period 2000-2003 showed that bites by this krait commonly occur in rural areas during night-time (Hung, Höjer and Nguyen, 2009).

A study to assess the possible efficacy of a new antivenom bitten by Bungarus multicinctus was performed during 2004-2006 at an ICU in Hanoi. Findings were favourable clinical efficacy of the tested antivenom, but it was not possible to perform the study as a randomized placebo-controlled trial (Hung, Höjer, Kiem and Nguyen, 2010)

Oral information received from the Ministry of Health stated that some hospitals and research institutes in Vietnam may have collected some information about snakebite victims and their treatment, but this information/statistics has not been processed or published. The Ministry of Health has no information of its own or a database about snakebites in Vietnam.

OBJECTIVES AND STUDY AREA

This study has the aim the further investigate the snakebite problem in Vietnam by studying the snakebite situation in four southern provinces; Tien Giang, Ba Ria Vung Tau, Dong Nai and Binh Phuoc.

During two periods, late January/early February 2012 and late February 2013, two field trips were carried out in Tien Giang, Ba Ria Vung Tau and Dong Nai provinces, while the visit to the Binh Phuoc province only took place during the field trip in 2012 as the result from the visit in 2012 concluded that no patient were no longer treated for snakebites in this province. They were admitted to a hospital in Ho Chi Minh City. In 2013 a visit was made to Cho Ray Hospital in Ho Chi Minh City. Data for Cho Ray Hospital has been included for 2011 and 2012.

The main intention was to visit clinics and hospitals dealing with snakebite cases in these provinces. During the visit to the Binh Phuoc province, meetings were also held with a snake handler/snake trader and a traditional healer.

During the first field trip in 2012 a visit was also made to the Institute of Vaccines and Medical Biologicals (IVAC, Pasteur Institute) in Nha Trang, Khánh Hòa province, Vietnams producer of snake antivenom. [i]

Contacts with clinics and hospitals have been made directly to these units, not through any regional or central government body as there is no such centralized function dealing with snakebites in Vietnam. The main issue was to investigate main snakebite structures, i.e. the number of snakebite patients admitted to clinics and hospitals and snake species involved.

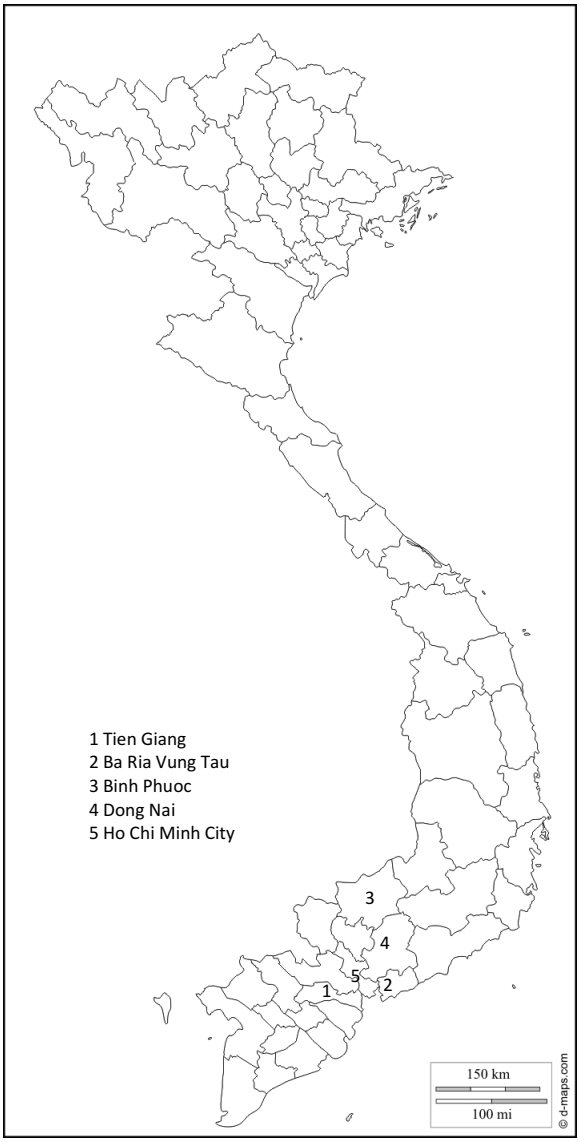

Fig. 1 – The five geographical areas investigated.

TIEN GIANG PROVINCE (DONG TAM SNAKE FARM)

Dong Tam Snake Farm is located in the Tien Giang Province (1 703 000 inhabitants, 2014), about 60 km southwest from Ho Chin Minh City. [ii] This facility, a part of the Vietnamese Army, was inaugurated in 1977, is a breeding centre for various kinds of snake species (10 spp.) as well as it harbours a clinic for treatments of bites from venomous animals. It is the only facility in the province dealing with snakebites. The first visit took place on February 2, 2012. We met with Dr. Vu Ngoc Luong, director of the clinic, and after discussions with Dr Vu, he agreed to put together snakebite statistics for a number of years for our next planned visit to the clinic in 2013. The return visit took place on February 25, 2013 and Dr. Vu handed over the following statistics.

Year	Admitted patients
2002	215
2003	230
2004	246
2005	265
2006	298
2007	248
2008	335
2009	610
2010	607
2011	628
2012	708

Table 1 - Yearly number of patients admitted to the Dong Tam clinic

The data show a considerable increase over the years. According to Dr. Vu there are two main reasons for this. Firstly, due to more widespread information people are aware of the treatment available at the centre, Secondly, Dr. Vu is convinced that there is a real increase of snakebite incidence because of more frequent interactions between humans and snakes. People enter into snake environments due to increased agriculture activities, such as clearing of forests and expansion of plantations.

Species	2012
Snake	***708***
Green pit viper	658
Malaysia pit viper	6
Naja spp	42
Bungarus fasiciatus	2

Table 2 - Envenomation distributed on snake species for the year 2012

The data collected show on huge dominance of green vipers as cause of snakebites (92.9 %). Oral information from Dr. Vu concluded that very few patients had deceased, not any case during the last decade.

Fig. 2 – The main cause of snakebites in Tien Giang province – a Green Pit Viper.
Photo: Sören Eriksson

BA RIA VUNG TAU PROVINCE

Ba Ria Vung Tau Province (1 053 000 inhabitants, 2014) is located on the coast, east of Ho Chin Minh City, roughly about 120 km (linear distance) northeast from Dong Tam Snake Farm.

The first visit was made to Vung Tau City Hospital, February 3, 2012. According to Dr Nguyen Duc Cuong [iii]the hospital receives about 10-12 snakebite patients per year. Most cases are bites from green pit vipers (Trimeresurus sp.) and sea snakes. The latter is due to snake traders bitten during handling. A few bites by Naja kaouthia also come to the hospital each year. Mild envenomation cases are treated at the hospital, but due to the lack of antivenom treatment serious medical case are sent to Cho Ray hospital in Ho Chi Minh City and Ba Ria Provincial Hospital.

The main hospital in this province is Ba Ria Provincial Hospital. The first visit took place on February 3, 2012 where we met with Dr. Truc Thi Chau, head of the department of intensive care of the hospital. According to Dr. Truc the provincial hospital started to treatment of snakebite victims in 2008. Previously the patients were sent to Chao Ray Hospital in Ho Chi Minh City. In 2008 10 patients were admitted to the hospital, while in 2009 the number of patients had increased to 61. The main reason for this increase was the spread of information in the communities about the new treatment at the hospital.

In 2010 it dropped to 45 patients due the lack of antivenom aimed at bites from Calloselasma rhodostoma. During a period for 6 month patients were admitted to Cho Ray Hospital in Ho Chi Minh City.

Antivenoms used at Ba Ria Provincial Hospital are snake antivenom against Thai Cobra (Naja Kaouthia) and Green pit viper (Trimeresurus). The antivenom aimed at Calloselasma rhodostoma is manufactured abroad (Queen Saovabha Memorial Institute, Bangkok).

After the interview a questionnaire about snakebites was handed over the Dr Truc who promised to fill it in to be picked-up by the authors in early 2013.

The second visit took place on February 25, 2013. The questionnaire completed by Dr. Truc comprised the snakebite situation for the years 2011 and 2012. The results from this survey are concluded below.

During 2011-2012 there were 86 cases admitted to the hospital. Among them 47 men and 39 females. The age structure was 4 cases aged 16-18, 73 cases aged 19-59 and 9 case over 60 years of age. Farming and forestry related occupations accounted for 59 per cent of the cases.

The geographical catchment area was as follows with Tan Thanh district reported the highest rate of snakebites.

District	Tân Thành	Xuyen Moc	ĐĐ	CĐ	LĐ	Bà rịa	Vũng Tàu
Number of cases	22	18	12	11	12	8	3
Percentage	26%	21%	14%	13%	14%	9%	3%

Table 3 - Snakebites distributed between different districts within the Ba Ria Vung Tau Province 2011-2012

The majority of snakebites were caused by the Malayan Pit Viper (Calloselasma rhodostoma) accounting for 56 per cent of the snakebite cases.

Species	Naja kouthia	Trimeresurus spp	Calloselasma rhodostoma	Naja siamensis	Bungarus spp	Other
Number of cases	4	14	48	2	1	17
Percentage	5%	16%	56%	2%	1%	20%

Table 4 - Envenomation distributed on snake species for the years 2011- 2012 at Ba Ria Provincial Hospital

Two of the 86 patients were transferred to another hospital, Cho Ray Hospital, in Ho Chi Minh City – both recovered. One patient at Ba Ria Hospital died, a 73 years old female who was bitten by a *Calloselasma rhodostoma*. After the bite she did not visit the hospital, instead she tried to treat herself – she was hospitalized late and died after 24 hours.

During the visit and the discussions held at the hospital with Dr. Truc (February 25, 2013) some problems were perceived. The most important of these was the lack of antivenom for treatment of bites by the Malayan Pit Viper (Calloselasma rhodostoma). Due to run out of stock and expensive costs for buying foreign produced antivenin a number of patients had to be treated without specific therapeutic antidotes.

In 2014 we received, from Dr Truc, additional snakebite statistics for the year 2013.

Month	**Number**	**Green pit viper** (*Trimeresurus* spp.)	**Malaysia pit viper** (*Calloselasma rhodostoma*)	**Cobra** (*Naja* cf. *koauthia*)	**Unidentified**
2013					
Jan	4	1	2		1
Feb	5	1	2		2
March	5	2	2		1
April	5	1	3		1
May	12	2	5	1	4
June	10	1	2		7
July	9	1	4	1	3
Aug	3	1			2
Sep	4	2	2		
Oct	4	1	2		1
Nov	6	1	2	1	2
Dec	1		1		
Total	**68**	**14**	**27**	**3**	**24**

Table 5 - Snakebite statistics for the year 2013

Figures in table 5 show a slightly higher percentage of bites from the Green pit viper (21 % for 2013 compared with 16 % for the years 2011-2012) and of bites from cobras (4 % for 2013 compared with 2 % for the years 2011-2012). Regarding the cobras, the case during 2011 and 2012 were inflicted by Naja siamensis, while the cases from 2013 were attributed from Naja koauthia. Bites from the Malayan pit viper accounted for 40 % of the cases in 2013, while as much as 56 % during 2011-2012. Nothing is known about the treatment and outcome of the patients during 2013.

Figure 3 – Rubber plantation: a common environment for the Malayan pit viper.
Photo: Sören Eriksson

BINH PHUOC PROVINCE

Binh Phuoc Province (922 000 inhabitants, 2014) is located northwest from Ho Chi Minh City and shares a border with Cambodia. The visit in 2012 took place on February 4-5, with the goal of attaining information from hospitals in the province capital city of Dong Xoai. The authors were able to make a visit to Binh Phuoc Provincial Hospital. Information was received that snakebite treatments no longer were performed at this hospital. Instead they were transferred to Cho Ray Hospital in Ho Chi Minh City, Vietnam's largest city.

We were able to receive data for the year 2011 (04-01-2011 to 22-12-2011) which concluded that 39 patients had entered the hospital during 2011. Some had stayed at the hospital for a few days, some patients had been discharged at own risk, while 11 patients had been transferred to other facilities, i.e. Cho Ray hospital. No records of the offending snakes or the outcome of these patients were available.

From an additional telephone interview with Dr. Nam, Binh Phuoc, we received the information that a small clinical trial had taken place at Binh Phuoc Provincial Hospital for treatment of four patients bitten by the Malayan Pit Viper. This trial was based on a antivenom developed by Dr Kiem [iv] - not by the Institute of Vaccines and Medical Biologicals (IVAC) in Nha Trang. Altogether 30 doses had been supplied to the hospital with financial support from abroad. After the 30 doses the trial didn't continue, due to lack of money and competence at the local hospital.

During our stay we were able to arrange meetings with a snake trader and a traditional healer. The snake trader, Nguyen Xuan Phuong [v], had many decades of experiences of handling snakes and an extensive knowledge of conditions concerning snakes and humans in the province. According to him, his own experiences to a high degree reflects the situation for many other citizens and families. In 1992 his wife was bitten by a Green Pit Viper, but she did not visit the hospital. Instead she took the bus to a traditional healer for treatment with herds and other remedies.

In 2007 Mr Nguyen's brother was bitten by a cobra (Naja kaouthia) while collecting snakes. This was a very serious case so they decided to take a taxi to Cho Ray Hospital in Ho Chi Minh City for treatment. He had to pay 6 million VND (close to 300 US dollar) for his treatment during the one week stay at the hospital. Many Vietnamese are not able to pay for such treatment. Instead they visit traditional healers. According to Mr Nguyen it is more common to visit healers than a hospital.

With assistance by Mr Nguyen Xuan Phuong, the authors were able to get in contact and visit and interview a traditional healer in the outskirts of Dong Xoai. The healer, Mr Nguyen Thanh Hong, 80 years old, had been living in the province since 1980, when he moved from Long An province. For one year he had worked at the Alternative Medical Hospital in Ho Chi Minh City. His interest in snakebites developed during the Vietnam War due to the large number of snakebites among soldiers. Initially he learned this business from a Chinese healer.

Usually around 50-60 snakebite patients come to his 'clinic' each year. It is mainly poor people due to the low treatment costs, usually corresponding to 2-10 UD dollar.
Another group is minority peoples who are outside the official health care system.

About 50 per cent of the snakebite victims come from the local community, and a further 30-35 per cent from surrounding communities within the Binh Phuc province. The rest, 15-20 per cent, comes from neighbouring provinces. This traditional healer was the only one left in the province. The most common sources of snakebites are Malayan pit vipers, cobras and Green pit vipers.

DONG NAI PROVINCE

Dong Nai Province (2 769 000 inhabitants, 2014) is located east and northeast of Ho Chi Minh City. The first visit to Dong Nai Province Hospital was made on February 6, 2012. A meting was held with the head of the Poison Control Department, Dr. Nguyen Buc Thinh. He informed that the hospital started to treat snakebite patients, by using antivenom, during 2011 and that capacity building in this field was ongoing. Previously patients had been remitted to Ho Chi Minh City.

We agreed upon making a revisit in 2013 - it took place on 26 February, 2013, and during that visit Dr Nguyen handed over data for 2012 (table 6). He also informed that various efforts were made, through media, to inform the citizens about the new possibilities to treat snakebites at the hospital.

Snake species	2012	2013
Green pit viper (*Trimeresurus spp*.)	34	29
Malaysia pit viper (*Calloselasma rhodostoma*)	7	8
Cobra (*Naja spp.)*	7	3
King cobra (*Ophiophagus hannah*)	1	0
Banded krait (*Bungarus fasciatus*)	1	3
Unidentified	18	14
Total	**68**	**57**

Table 6 - Snakebite patients treated during 2012 and 2013 at Dong Nai Province Hospital

In 2014, Dr Ngyuen sent us the data for 2013. It showed on a decline in snakebites received at the hospital, but still green pit-vipers accounted for about 50 per cent of the cases (2012: 50 %; 2013; 50, 9 %).

HO CHI MINH CITY

Ho Chi Minh City, formerly named and still referred to as Saigon, is Vietnams largest city with a population of 7 818 000 inhabitants in 2014 (as reported by the Ministry of Natural Resources and Environment). *Cho Ray Hospital* is the largest general hospital in Vietnam. A meeting took place with Professor Tran Quang Binh, Head of Department of Tropical Diseases on February 27, 2013.

The hospital admits patients from the city but also some severe snakebite patients from a few surrounding provinces. A few months prior to the visit we were in contact with professor Tran who promised to compile snakebite data for the planned meeting. Professor Tran handed over the data on February 27.

Snake species	2011	2012
Green pit viper	426	494
Malaysia pit viper	96	109
Naja kouthia	47	53
Naja siamensis	79	71
Rhabdophis subminiatus	4	2
King cobra (Ophiophagus hannah)	15	5
Bungarus fasciatus	0	0
Bungarus spp	9	6
Another snake	207	185
Total	**883**	**925**

Table 7 - Snakebite patients admitted to Cho Ray Hospital in 2011 and 2012.

There is a dominance of Green pit viper bites (48.2 % in 2011 and 53.4 % in 2012). As 207 snakes in 2011 and 185 snakes in 2012 were not identified, it is likely that a number of these are to be blamed on the Green pit viper as well. Two cobra (Naja) subspecies accounts for 14. 3 % in 2011, while the figure for 2012 is 13.4 %. The correspondent figures for the Malayan pit viper are 10.9 % and 11.8 %.

Oral information stated that most patients come from the Ho Chi Minh City, that includes 24 urban and rural districts. A smaller number of patients also come from some surrounding provinces (also dealt with earlier in this paper).

We don't have any figures of mortality or other epidemiological data. According to professor Tran there is an increase of snakebites due to people moving into fringe environments, i.e. suburbs until recently consisting of rural areas, implying snake habitats.

SUMMARY

This study deals with the snakebite situation in a few selected provinces in the southern part of Vietnam. The clinic in the Tien Giang Province has seen a considerable increase in patients bitten by snakes, from 215 in 2002 to 708 in 2012. According to the responsible doctor there is a real increase in snakebites due to increased interaction between humans and snakes. It is possible that increased awareness among citizens that treatment is available partly can explain an increase of patients seeking treatment at the clinic. We don't know about the relations between these two explanations.

A significant result is the overwhelming dominance of bites from the Green pit vipers, while cobras, the Malayan pit viper and a krait are minor causes of snakebites.

Compared with the clinic at Dong Tam Snake Farm, treatment of snakebites at Ba Ria Provincial Hospital is of a more recent origin, starting in 2008. The number of snakebite patients has increased, but in 2010 the number of admitted patients dropped due the to lack of antivenom at the hospital. A very striking result is that the main cause of serious snakebites is the Malayan pit viper, which accounted for 56 % of the cases treated at the hospital during 2011 and 2012. In 2013 this snake accounted for 40 per cent of the cases identified, but it could be higher or lower as in 35 % of the cases the snake was not identified. Thus, a rather small geographical distance shows on considerable geographical differences in snakebite pattern.

Vung Tau City Hospital also receives a smaller number of snakebite cases (10-12) per year. If serious, the patients are sent to Ba Ria Provincial Hospital or to Cho Ray Hospital in Ho Chi Minh City. A few of the cases at Vung Tau City Hospital are from sea snakes due to snake traders bitten during handling.

Only one visit was made to the Binh Phuoc Province, bordering Cambodia. Figures were received for one year only (2011) when 39 patients were admitted to Binh Phuoc Provincial Hospital in the provincial capital of Dong Xoai. No records of the offending snakes or the outcome of these patients were available. Previously a small clinical trial had taken place at the hospital based on domestic development, but was cancelled due to lack of money and competence at the hospital. All serious snakebite cases are sent to Cho Ray Hospital in Ho Chi Minh City.

In this province a traditional healer received about 50-60 snakebite victims each year. The main reason such 'business' still can continue are economic factors, i.e. bitten people can not afford treatment at hospitals. Another contributing factor may be lack of information and education.

Dong Nai Provincal Hospital, located in Long Khanh town, in Dong Nai Province, started with to treat snakebite patients in 2011. It shows on a dominance of bits from the Green pit viper, i.e. around 50 %. As in Dong Nai Province, the Ho Chi Minh City area is dominated by bites from the Green pit viper, 48.2 % in 2011 and 49.5 % in 2012 respectively. Cho Ray hospital receives a large number of snakebites patients, most of whom are from Ho Chi Minh administrative districts, while also receiving serious snakebite cases from surrounding provinces. This co-operation is the result of initiatives of responsible medical doctors in the provinces, not the result of a common national policy.

Snakebites are an important medical issue in southern Vietnam. Based on this study the number of snakebite patients admitted to clinics and hospitals per year in the investigated provinces were roughly 1700-1800 cases. We can assume that an unknown number of snakebite victims, of various reasons (lack of information, costs of treatment etc), do not receive medical treatment. In Binh Phuoc province still many people visit a traditional healer, a phenomenon previously observed from rural parts in northern Vietnam (Eriksson, 2008).

One problem is the lack of a domestic manufactured antivenom aimed at bites from the Malayan pit viper. Ba Ria Provincial Hospital has been lacking antivenom aimed at this viper. The antivenom needs to be imported from abroad, which is a costly purchase from the producer in Thailand.

Based on this limited study there is no real basis for estimating the number of snakebite cases admitted to Vietnamese hospitals. If only extrapolating the data (population and admittance to clinics/hospitals) in this study for the whole of Vietnam we should reach around 11 300 admitted [vi]snakebite victims each year to clinics and hospitals.

In reality there are many differences between provinces and cities, due to environmental and zoogeographic differences (such as differences and density of snake species), access to and the propensity to visit clinics and hospitals, rural versus urban areas etc.

This study reveals obvious provincial disparities in snakebite patterns, i.e. species involved, both from a limited geographical view (the provinces in this study) and compared with a few previous studies dealing with northern Vietnam.

Finally, there is a need to build a national strategy to deal with this important medical issue. It must be remembered that such efforts need to compete with many other major medical and health issues in a rapidly developing nation such as Vietnam. A first step could be to develop a reporting system on a national basis which later on can be used for various strategies in various part of Vietnam. [vii] There is also a need to investigate variations in snakebite patterns and treatment in other parts of Vietnam. That includes differences in bio-geographical environment and occupational patterns.

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[i] Since 2004 two kinds of snake antivenoms have been produced at the institute, one against the Naja kaouthia (cobra) and another against the green pit viper (Trimeresurus albolabris). This implies that snakebites from two main offenders can be treated with domestically developed antivenom. IVAC produces antivenom on commercial basis, but has no national policy role in supplying and distributing it to clinics and hospitals.
[ii] Interview with Dr. Vu Ngoc Luong, February 2, 2012
[iii] Interview February 3, 2012
[iv] Dr. Kiem was the principal investigator of the project titled "Research the technical process to manufacture anti venom serum of the King Cobra snake", which was funded by the Department of Science and Technology in Ho Chi Minh City.
[v] Interview February 7, 2012.
[vi] The population, in 2014, in the investigated provinces and Ho Chi Minh City were 14 265 000 and for Vietnam about 92 000 000. The admittance rate is based on 1750 patients per year in the investigated provinces.
[vii] Discussions held with doctors (not accounted for in this paper) at hospitals in central and north Vietnam indicates regional differences in snakebite treatment, including access to snakebite antivenom.