Medical Management

of the

Snakebite Victim

(Namibia)

– A Project of the Namibian Snakebite Interest Group (NSIG) –

Introduction

For a boy, growing up during the 1960s without falling in love with nature, was unthinkable. My father's passion for the wild and the privilege of crisscrossing the country with him on numerous museum expeditions laid the foundation for my avid scientific curiosity. My fascination for reptiles and especially snakes, which started during my high school years, was pursued during my years of medical training where I eagerly studied everything available on snakes and snakebites.

The lack of a medical practitioner dedicated to the management of snakebite in Namibia during 1976, when I qualified as a medical doctor, afforded me the ideal opportunity to combine my medical knowledge with the knowledge of snakes I had acquired earlier. This set the trend for the next 45 years during which I was involved in most of the snakebite cases in Namibia, either directly or in a consulting capacity. Consultation from neighboring countries is not infrequent. The book *Snakes of South West Africa* (later *Snakes of Namibia*), written by my father and me, was published in Afrikaans, English and German in 1983.

During the 1970s, I identified a problem regarding Zebra Snake bites, and my suspicion that the available polyvalent antivenom does not neutralise the snake's venom adequately *in vivo* was confirmed by the SAIMR. An immediate plan of action was implemented to research the issue and to offer an interim surgical solution.

Controversy still surrounds the whole spectrum of snakebite treatment, and the literature available on the subject is often contradictory and anecdotal. This is due to many factors, the most important being that only a few doctors have the opportunity to deal with a sufficient number and variety of snakebite victims to gain experience with the different means of treatment. Understandably, there are even more divergent views on the appropriate *first aid*, since very few will be required to give snakebite first aid more than once or twice during their life. Conclusions are often also drawn from animal experiments or small uncontrolled clinical trials.

Snakebite envenomation can be potentially life threatening and is thus a medical emergency. Always seek expert advice – *See page 11 or 32 for relevant 24/7 contact numbers.*

I had the honor to supervise this updated compilation. The contents represent a combination of my clinical experience together with literature reviews adjusted to our unique Namibian setting regarding snakes and available resources. Over the years hundreds of snakebite lectures were given to diverse groups of people, both professional and lay persons and including all ages. The primary intention of this synoptic *hands-on* guide is to attempt to answer the basic questions that were often asked during question time following the lectures and presentations. It further provides the clinicians with detailed information in a nutshell on the emergency management of snakebite envenomation, including the appropriate use of specific antivenom therapy when indicated.

Any comments that might lead to the improvement and 'fine-tuning' of this booklet are welcome and can be communicated by means of e-mail addressed to snakebitedoc@gmail.com or dr.buys@pjcbuys.com.

Regards

DR PJC BUYS

Dedicated to my father who taught me to love and respect nature and its creatures and to my mother who taught me to love and respect their Creator

PLEASE NOTE: The primary purpose of this publication is to educate and assist clinicians in the emergency management of cases of envenoming and in the appropriate use of antivenom therapy when clinically indicated. The intention is to guide the first aider, paramedic and medical clinician towards current understanding of clinical best practice and does not purport to be an exhaustive review of the literature. Unreferenced material can be attributed to the personal experience of Dr PJC Buys.

Cover illustration: Mr J.J."Koos Kwas" van Ellinckhuijzen

Illustrations: Miss Anienke Buys, Mr D Louw

Photos by F. Theart. francois.theart@gmail.com

First published 2003

Revised 2020, 2021

Contents

Snakebite in Namibia—General Information

First Aid Management of Snakebite

Hospital Management of Snakebite

Snakebite in Namibia—General Information

General

Controversy still surrounds the whole spectrum of snakebite management, and the literature available on the subject is often contradictory and anecdotal. Conclusions are often drawn from animal experiments or uncontrolled clinical trials.

Enlightening Statistics and Data

Venomous versus Non-venomous Snakes

- *World* – Only 300 of the 2 500 – 3 000 species of snakes are dangerous to humans (i.e. 10-12%) [1]
- *Africa* – Only 93 of the 400 species and subspecies are potentially lethal to humans (i.e., 23%) [2]
- *Southern Africa* - Only 20 of the 171 species are potentially lethal [3]
- *Namibia* – Only 14 of the 81 species are dangerous

Degrees of Envenomation following a Venomous snakebite

- *Minimal or no envenomation* - more than 50% of snakebites
- *More serious envenomation* – approximately 25%
- *Antivenom/medical assistance necessary* – approximately 10% of cases reaching larger medical centre [1]

> "Snakes have more right to be terrified of man than man of snakes. But whereas a snake does not know enough to be afraid, a man's fear is usually due to ignorance." *Pope (herpetologist)*

Snakebite Mortality

In 1954, the World Health Organisation (WHO) attempted to assess the danger of snakebite worldwide. A mere 400 – 1 000 annual deaths were calculated for Africa. [2] During 2018 the WHO estimated the worldwide annual snakebites at approximately four million with two million envenomations. Global mortality is between 81,000 and 138,000 and morbidity approximately 400,000 per year. In some countries children are involved in more than 40%. The yearly fatalities for Africa is estimated at about 20,000. [4]

Accurate snakebite statistics for Namibia is, unfortunately, unknown for various reasons: Our vast, sparsely populated country with large rural areas, inadequate transport and communication, the role played by traditional healers, less than optimal clinical records and scattered medical facilities, all lead to lack of reliable snakebite reporting. Fatalities for Namibia may be between 50-100 annually.

What makes a Snake Dangerous for Humans?

How dangerous a snake is, depends on how widely it is distributed, how potent its venom is, how big it is and how often it comes in contact with humans due to its habits and 'attitude'.

For example, the puff adder is very dangerous because of its *wide distribution* – throughout Africa, excluding the rain-forest and extremely arid desert areas – as well as its *potent venom* and *relatively large size*. The Zebra snake *adapts well to populated areas* (urban and rural), often enters human dwellings and many bites are delivered at night. It has a *very complex and potent venom* and is found in central and northern Namibia. The boomslang has a *potent venom*, but is *non-aggressive* and has to be greatly provoked to bite. The black mamba (*very potent neurotoxic venom*), willing to bite, but not aggressive and they do not attack people.

Venomous Snakes Responsible for the most Bites in Namibia

The geographical distribution of snake species varies. Some species are more commonly found in certain areas and will thus lead to a bigger probability of inflicting bites there, than in other areas. However, when considering the *overall bite trend*, the following is found:

- ***Puff Adder*** *(Bitis arietans)* – They are responsible for about 75% of all snakebites in Southern Africa (only 1,5% are fatal).
- ***Zebra snake*** *(Naja nigricincta nigricincta)* This snake is responsible for the majority of bites – In some regions (Central and Northern Namibia)

"Most Lethal" Snake in Namibia

- ***Black mamba*** *(Dendroaspis polylepis)* – The biggest venomous snake in Africa.

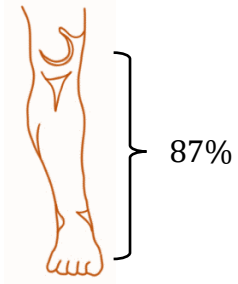
"Most Maiming" Snake in Namibia

- ***Zebra snake*** *(Naja nigricincta nigricincta)* – No *specific antivenom* is yet available. Without speedy removal of envenomated tissue around the bite site, severe tissue-loss, scarring and disfigurement is often the outcome

> "The worst place to get bitten by a snake is **any** place, especially if it's **your** place"

Most Common Bite Area [1]

- Bites ***below the ankle*** 67%
- Bites ***below the knee*** 87%
- Bites on ***hand and wrist*** 8%



Venom Apparatus and Envenomation

General

Cowboys usually carried two revolvers so they command respect—and had a backup in a life threatening situation. Venomous snakes also have a duplicated venom apparatus, venom of a high "caliber" of potency as well as a back-up "magazine" of replacement fangs.

ı apparatus of snakes is complex and re common, not only between the back-fanged and front-fanged groups, but also amongst individual species.

Venom

Venom is highly modified saliva with the primary purpose of *immobilizing* prey, so as to prevent it from escaping and struggling, and also to help promote *digestion*. It is sticky yellow, white or colourless fluid containing a complex mixture of proteins and other substances with toxic and lethal properties. These biologic-active substances comprise ± 90-95% of a venom load (Sanhajariya S, 2018)(Guiterez JM, 2017). The toxic composition of snake venom varies between species and even within some species. A particular species will show a predominance in one or more of these substances, which will determine the major effects of that particular snake's venom. [1,5,6]

Venom Glands and Ducts

In the **back-fanged snakes** one venom gland (i.e. *Duvernoy's* gland) is found on each side of the head directly under the skin above the posteriorly situated fangs at the corners of the mouth. Muscles do not play an important role in compressing the gland - the venom simply oozes into the gland's lumen and down the *grooved fangs* during a *chewing bite*. [1,2]

Front-fanged snakes usually have a main venom gland as well as an accessory venom gland on each side of the head. Muscles play an important role in compressing the glands and thus emptying the venom from the gland's lumen into the *hollow fangs* during a bite. [1,2]

Fangs, Teeth and Sheaths

Most snakes have two rows of **solid teeth** on each side of the roof of the mouth and a similar row on each side of the lower jaw. These are mainly for assisting the grasping, holding and moving of prey into the upper digestive tract.

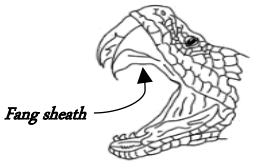
The punctures left by these tooth rows after a bite do not present as a clear-cut pattern - contrary to the claim of some text books - and are quite inadequate in helping to decide if the snake was venomous or not.(1)

The **fangs** are either situated on the front part of the upper jawbone, beneath the snout, in the front-fanged species (e.g. *adders, cobras, mambas*), or further back, beneath or behind the eye, in the back-fanged snakes (e.g. *Boomslang*). In the front-fanged group, the fangs can be either "fixed" in an approximately vertical erected "active" position (e.g. *cobras, mambas*), or, as with the larger adder fangs, folded in their sheaths in an "inactive" horizontal position against the palate, to be erected to an "active" vertical position in preparation to strike (much as a cowboy "drawing" his gun from the holster during a duel!). The *stiletto snake* (also known as the *burrowing* asp or *adder*) has fixed fangs which are positioned horizontally and facing to the back of the upper jaw. It delivers a downward, stabbing bite by a sideways movement of the head. Usually only one fang penetrates the victim.

Back-fanged/Non-front fanged snake

Front-fanged snake (Fixed fangs)

Front-fanged snake (Non-fixed fangs)



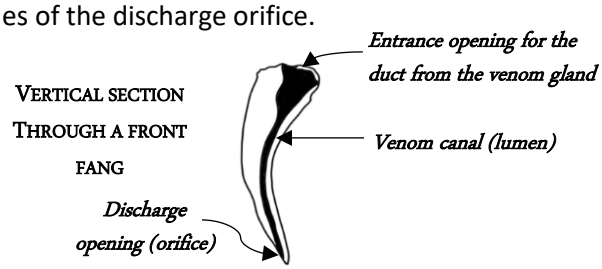
Front-fanged snake (Non-fixed fangs I erected position. Notice fang sheaths)

The fangs of the back-fanged snakes in general appear more 'delicate' than the front-fanged groups. The cobra fangs show less of a curvature than the mambas. Adder fangs are usually large and strongly recurved.

In the **back-fanged group**, the venom flows via an open canal which runs down the front surface of the fang and ends near (but still a distance from) the tip of the fang in a flattered "V". It is here, as well as on the back surface of the fang, that a sharp ridge (the *cutting edge*) is found. These cutting edges facilitate fang puncture and, due to their lacerating action, cause more trauma in the fang wound, thus allowing the venom to come into contact with the torn tissue and facilitating absorption thereof during the "chewing" bite.

Bite marks in themselves – even following a known venomous bite – mean **nothing** in the *absence of symptoms* [1]

In the **front-fanged group**, the venom duct opens into a tear-shaped opening just below where the fang is attached to the upper jaw. This is the entrance to the lumen of the venom canal that is concealed within the fang, and which exists as a narrow slit-like discharge orifice a little way above the tip on the fang's front surface. The venom is injected in a similar way as performing an injection with a hypodermic syringe. For this reason, there is considerably less use for cutting edges (as for the back-fanged snakes). Cutting edges are thus less prominent and usually only found to the sides of the discharge orifice.



Fang replacement occurs at intervals in all snakes throughout their lives and is made possible by the impermanent fixing of the fangs to the upper jaw.

Fang sheaths play an important role in enabling venom flow, either down the groove or into the venom canal of the fang, by connecting the fang entrance lumen to the venom duct. [1]

Venom Injection

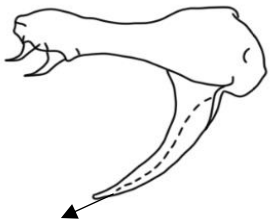
In the majority of bites, the amount of venom injected is not nearly the total amount carried by the snake.The amount of venom injected varies (ranging from nothing - a so called "dry bite" – to practically all the venom). During so-called "defensive" bites – when the snake is not seriously threatened – as little as 10% of the available venom is injected during the first bite. When the snake is agitated or "surprised" – as would be the case in a sudden unexpected encounter – 50% or more of the venom will be injected. The classic *Venom Metering Hypothesis* that snakes can decide how much venom to inject, is lately considered antiquated and replaced by the *Pressure Balance Hypothesis.* It takes approximately one to two weeks for totally exhausted venom stores to be replenished, sometimes less. [1,7]

Biting Behavior

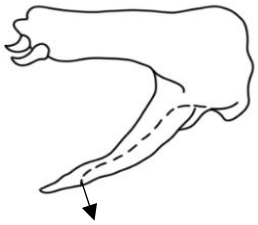
The depth of the bite varies, but may go to full depth of the fangs when the snake is agitated [1]. Also such bites are more common with *back-fanged snakes* and *cobras*. A period of holding on with alternate tensing and relaxing of the muscles overlying the venom glands is the norm. "Chewing" during a back-fanged bite assures increased venom infiltration by these more primitive fang structures. This holding period usually lasts 5-10 seconds, but may be considerably longer in the case of an "enraged" snake. The latter also holds true for an enraged *adder* – which might also deliver several bites in quick succession – although a single stabbing bite is the norm. The *mamba's* biting behavior is similar to that of the adder's, although it is most unusual for a mamba to retain hold. Thus, full fang penetration is the norm for the back-fanged snakes, all front-fanged species – except the mambas – and occasionally even for the adders, whose 'normal' bite involves one to two thirds of the total fang length. For first-aid purposes, full fang penetration in most species and at least half fang depth for a puff adder must be assumed. [1]

Spitting Cobras

The 'spitting' process can be compared to the squirting of fluid from the needle of a syringe when the plunger is forcefully pushed into the cylinder. The fangs from front-fanged 'spitters' differ only internally from the 'non-spitters' – the venom canal of the former makes an 'L'-shaped bend directly behind the discharge orifice. This results in the venom leaving the discharge orifice at a right angle to the perpendicular surface of the fang, spraying it forward and upward, as opposed to the discharge of venom in a straight line parallel to the surface as in non-spitters. The venom can be sprayed to a distance of up to 3 meters – not an accurate, 'aimed' action. [1]



The venom canal of the non-spitting cobras leaves the discharge orifice in a straight line



The venom canal of the spitting cobras forms an L-shaped bend at the discharge orifice

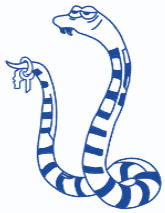
Preventive Measures

Knowledge of Snakes

Do not miss the opportunity to study snakes from close-up when you are in the vicinity of a snake park. Sufficient literature is also available to obtain more information on snakes. Familiarize yourself with the frequently encountered dangerous snakes in your area. This is also relevant for first-aiders, paramedics and doctors who should not only see themselves as helping snakebite victims, but also as potential victims themselves. In a series of 1 067 snakebite incidents, Chapman [1] pointed out that in 55% of cases, the treating doctor required a reasonable knowledge of snakes in order to identify them correctly,

"Prevention is better than cure"
Prevention is still the most important and effective way of dealing with snakebite

"The best medicine a person has if he has been bitten by a snake, is his car keys". - BEACH



either by examining the snake or by the description given of the snake, to provide the optimum treatment.

Hazardous Seasons and Times

- Snakes are most active with the onset of the rainy *season* (especially if preceded by a long dry period), spring and late autumn.
- The most risky *time* for snakebite is the twilight hours (half an hour before total darkness and the first hour or two after dark).
- During the *mating* season in early spring, snakes are more active and irascible.
- As the snake grows, it needs to shed the nonexpanding outer layer of its skin. The snake's growth rate, and not time of the year, determines the frequency of this *sloughing* – as often as 10 to 15 times a year in juveniles and one to four times in adults. As the superficial layer over the eyes (the caps) separates from the deeper layer, the eyes turn a milky blue – described as the snake is "in the blue". During this time the snake appears frustrated and more aggressive because of the cloudy, impaired vision. [2]

In and around the House

- *Make dwellings unattractive for snakes*:
  Creeping plants, shrubs and hedges against walls (especially near windows that can open), garden and building refuse, compost heaps, aviaries, chicken coops, rockeries, fishponds and loose stones and firewood serve as good hiding places for snakes, as well as homes for rats, mice, lizards, frogs, etc., preyed on by snakes [2]
- *Prevent snakes from entering dwellings/beds:*
  Place mesh screens in front of open windows and outside doors, close holes in walls and ceilings, raise beds above the ground and use a mosquito bed-net to prevent snakes (and other "creepy crawlies") from entering your bed
- *Snake Repellents:*
  Up till now, there are NO effective chemical product, substance (including oil, Sulphur, diesel, petrol, Jeyes Fluid®) or plant that repels our Southern African snakes. It is a hoax. [3]

In the Bush

- *Protective clothing and lighting at night:*

More than 85% of snakebites occur below the knees: Wear boots and long loose-fitting, "baggy" trousers of thick material when possible. Unfortunately a large percentage of bites occur at night, particularly in third-world rural areas, where people walk barefoot without proper clothing or a torch-light. Sunglasses provide eye protection against spitting cobras

- *Sleeping:*
  Do **not** sleep directly on the ground, wherever possible. Inspect the campsite during daylight hours for potential sleeping areas – clear of holes/burrows in the ground and away from thick vegetation and rock piles. They are not only good hideaways for snakes, but also for rodents and other animals snakes prey on.

- *Watch where you step and what you touch:*
  Do **not** step **over** rocks and logs, but rather **onto** them. Look where you place your hands while climbing or lifting objects. If you want to lift rocks or logs, first lift the side **furthest** from you, cautiously inspect under it and then continue.
- ***When you encounter a snake:***

THINK 'Traffic Light'…

If you are VERY CLOSE → **STOP!**

Stand absolutely still. Most snakes will flee. Snakes ignore objects that are not moving

If you **WAIT** and they don't move away …

→ retreat SLOWLY *while keeping the snake in view. Make sure you don't trip over something while walking backwards!*

If you are a FEW METRES AWAY → **GO!**

WALK away - *no need to run; snakes never chase people*

- *Do not handle snakes* if you do not know how to or if there is no real need to do so.
- *Never pick up a snake that looks dead!* Some snakes pretend to be dead, especially when a person comes across them unexpectedly and they have no chance to flee. [2]
- *If a snake has to be killed*, do it with one well-placed blow: Wounded snakes are extremely dangerous and even a fatally injured one can bite and kill. If you are close enough to kill it, it is close enough to hurt you. [2]

Make your presence known by using good solid footsteps. The snake will sense the vibrations and get out of the way

Snakes are not out to get you; hiding behind rocks and trees, waiting to pounce on an unsuspecting passer-by

Is the Snake Venomous or not?

GENERAL

What is the difference between **VENOMOUS** and **POISONOUS**? To put it shortly: If a snake bites you and you develop signs and symptoms (caused by the venom), that means the snake is *venomous*. If you bite a snake and you develop signs and symptoms, the snake is *poisonous* (not caused by the venom).

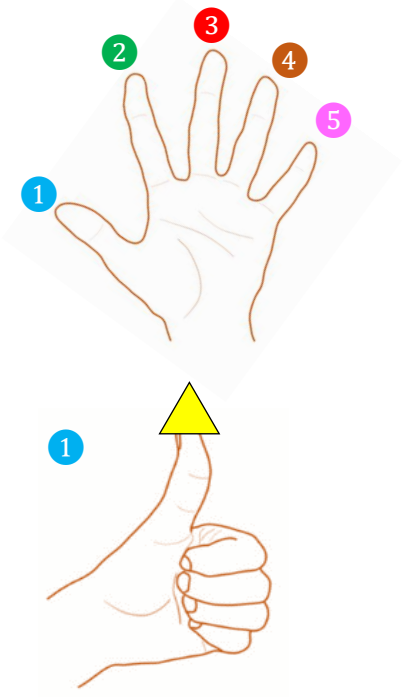
The majority of African snakes – nearly 80 percent – are harmless to man [2]. To try and distinguish between a venomous and non-venomous snake by means of appearance only, is nearly impossible.

GUIDELINES

No hard and fast rule can be laid down which would be accurate in every case—there is always the exception to the rule. A few guidelines, which will be accurate in most cases, are the following:

- There is usually no reason to fear of any Namibian snake which has stripes down the length of its body, although, to a certain degree these can in fact be venomous and even bring about death in the aged, young children and persons suffering ill health.

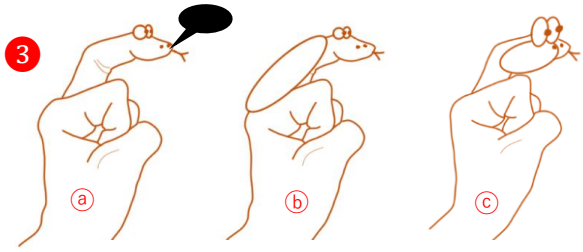
To make it easier to remember Namibia's dangerous snakes, I will assign a group of venomous snakes to each of your fingers as a mnemonic. *If the snake you see fits into one of these five groups… BEWARE!*



- The **thumb** is short, thick and strong. Short, thick, broad snakes with *triangular* heads, are mostly venomous *(e.g., the Puff adder, Horned adder and Many-*
- Any snake that "spits" its venom, is venomous *(e.g., the Zebra snake, Mozambique spitting cobra, Black-necked spitting cobra and Black spitting cobra)*

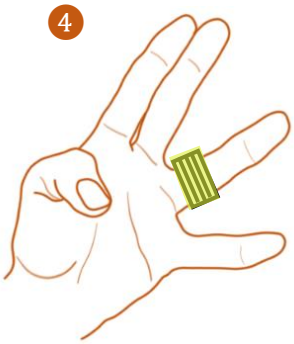
Imagine the **index finger** looks like a *WATER-PISTOL*, "squirting out" the water (venom)

- The **middle finger** *(3rd finger from left or right)* is the longest finger and
- represents the *3 groups* of larger snakes. The *front part of the body is often reared* and it makes a *hood*, narrower in case of the *Black mamba*—which has a black lining of the inside of the mouth—and wider in the cobras, e.g., the *Cape cobra* and *Anchietae /Angolan cobra*). If the snake *inflates its throat* and has *big eyes*, it is most likely a *Boomslang.*



The *"Dangerous Triplets"*
THE BAD, THE WORST AND THE UGLY…

- Most snakes with rings, bands or stripes across the body are venomous *(e.g., the Zebra snake and Anchietae cobra - the banded phase),* although some may be too small to inflict a severe bite, *e.g., the Cape coral snake.*



The **ring finger**, for obvious reason, represents this group of venomous snakes.

- The **pinkie/little finger**, the smallest of the fingers. This is to remind you that one should not under-estimate small snakes, young snakes; although they may not be able to inject large volumes of venom, the venom is just as – if not more – potent than the adult snake.

Make a *'Mental Note'* of what the snake, that bit you, looks like—it could be helpful for the doctor who will be treating you.

If possible, bring the snake (that inflicted the bite) along for positive identification—however, *do not go after it* when still alive or wounded!

Make use of **SNAKE HANDLERS ON CALL** *(SEE PAGE 33)*

DEAD OR ALIVE!
BUT, FIRST…SURVIVE!

Clinical Notes on Snakebite

- *Please see pages 9-11*

Dealing with Snakebite

Dealing of snakebite should not be seen as compartmentalised phases of treatment, but rather as a continuous spectrum of medical aid. The distance covered along this therapeutic path will only be determined by the experience, expertise, knowledge and training of the person administering aid. This spectrum begins at one end with *preventive measures*, and moves through the *snakebite incident* via *first aid* to the *medical facility* (hospital or clinic) where the treatment is continued by persons probably better medically qualified and in a more better equipped environment, to the other end of the spectrum where the victim either recovers or dies.

Bad first aid can aggravate a bite and even kill.
Good first aid saves lives

FIRST AID

- **First** things **First** in **First** aid…
  - **A**rea: Ensure that the zone around the bite victim is safe to enter – the snake may still be there!
  - **B**abies, children and pregnant mothers bitten by a snake are ABSOLUTE EMERGENCIES
  - **C**ommunicate to the victim while establishing his/her vital signs →

    A.B.C. (Airway, Breathing, Circulation)
  - **C**ontinue monitoring
- Things that are **R.I.G.H.T.** and SHOULD be done:
  - **R**eassure and calm patient. Give non-opioid painkillers if available and necessary
  - **I**mmobilize the victim and the bite area. Keep the latter—if it happens to be a limb—approximately at the level of the heart
  - **G**et help – local and from nearest medical facility. Get victim ASAP to a…
  - **H**ospital or clinic and…
  - **T**ime: Do NOT waste time to get there, but do not convey an 'out-of-control' behavior:

    "Make haste slowly!"
- Things that are **W.R.O.N.G**. and should NOT be done:
  - **W**rap – do not wrap the bite area or apply a tourniquet
  - **R**un – keep still and NO hysterical behavior
  - **O**BS (pronounced *O'bées* = *'Old Brown Sherry'*!) – NO *alcohol* to the victim: It stimulates the cardiovascular system that accelerates spreading of the venom
  - **N**ick – NO cutting the bite area and also NO sucking, squeezing, massaging, applying heat or cold or rubbing-in anything such as Potassium permanganate ($KMnO_4$) *alias* 'Condy's Crystals', or Magnesium sulphate ($MgSO_4$) *alias* 'Epsom Salt' or 'Engelse sout'! All these only result in more tissue damage
  - **G**un – NO 'stun gun', battery, spark-plug, ignition coil electric shocks. These are proven USELESS and DANGEROUS!

THUS:

- Stay **calm**
- **Do not tamper** with the bite site or limb
- **Do not waste time** getting the victim to a medical facility
- **WHILE monitoring the victim**, gather the following information to convey to the doctor at the receiving end – **B.I.T.E.S.**
  - **B**ite – site, time, place
  - **I**dentity of snake – WhatsApp photo
  - **T**reatment – which was received following the bite
  - **E**xtra – additional information that will help the receiving doctor *(comorbid disease, current medication, allergies, etc.)*
  - **S**ymptoms & **S**igns As observed/measured by the first aider

In the absence of local symptoms or signs—following a snakebite—systemic symptoms and signs will not develop

A Danger sign of impending respiratory failure is if the victim cannot blow out a match held at arm's length

Caution: A person may, because of fright and emotional shock, simulate many of the signs and symptoms of early envenomation

It is important to remember that, after being bitten by a venomous snake, up to 50% of patients will show no sign of envenomation (the so called "dry bite"). Of those envenomated, >50% will develop only mild signs/symptoms of envenomation [8,9]. Clinical signs, following a bite, may develop within minutes (mamba) [9] or even after 48 hours (boomslang). [3] Therefore all snake bite patients should be reassessed regularly and may only be discharged if no signs/symptoms develop within 6-12 hours (adults) and 24 hours (children). [4] Bite victims should be informed to come back *immediately* if any bleeding or other symptoms/signs develop [11].

Snake venom is highly modified saliva which contains a complex mixture of proteins (>90% of the dry weight) [9], enzymes, toxic, non-toxic and other substances with potential lethal properties. Envenomation can produce cytotoxic, neurotoxic, haemotoxic, myotoxic and cardiotoxic effects and various combinations, depending on the composition of the specific venom. This 'toxic cocktail' varies between different snake species, also within the same species [12,13]. The amount of venom to be injected varies from nothing to all in store – it takes approximately 2–3 weeks to replenish a totally exhausted venom store.

The bite mark is rarely the classic two-fanged puncture mark – more often only a single mark or a scratch. There are numerous solid teeth in both the upper and lower jaw of all snakes (venomous and non-venomous), also accessory fangs that can produce puncture and scratch wounds. The fangs of front-fanged snakes are usually hollow structures which inject the venom like hypodermic needles through the skin into the deeper tissue. The more primitive back-fanged boomslang venom apparatus consists of fangs that are grooved on their front surfaces. The venom flows via these open grooves into the tissue. Increased absorption of the venom is facilitated by the torn tissue because of the lacerating action of the sharp cutting edges of the fang tips during the 'chewing bite' [8].

The *physical penetration* of a sharp object (thorn, needle, fang, sting) through a person's skin results in a penetrating wound or a scratch. This may elicit varying degrees of immediate pain/discomfort, bleeding and some minor surrounding discolouration (red, blue, purple). Without envenomation or introduction of toxic substances, these signs and symptoms will not increase, but gradually subside. Should envenomation take place however, the signs and symptoms increase in intensity and extent; local swelling usually begins within 10-20 minutes (and may become extensive following adder and spitting cobra bites) with painful regional lymph node enlargement within 30-60 minutes. Blistering (blood- or fluid-filled) may appear (first near the fang marks) within 12-24 hours [9]. For systemic symptoms and signs, see **Tables 1 & 2**. The distress and emotional trauma accompanying a snake bite may cause anxiety and hysteria. This may further complicate the clinical picture. This is also true for concomitant alcoholic intoxication of the patient.

Patients *with* signs/symptoms of envenomation should be observed in hospital for at least 24 hours after symptoms and signs have abated, or for at least 24 hours after the last dose of antivenom has been administered; all patient parameters should have returned to normal [14,15].

When a patient claim to have been "bitten", the clinician is usually confronted by one of three scenarios:

1. Bitten by an *identified* snake
2. Bitten by an *unidentified* snake
3. Bitten, injured, stung by an *unknown* animal *(snake, spider, scorpion, bee, wasp, centipede, tick, etc.),* or object *(stick, thorn, sharp object, etc.)*

1. PATIENT EVALUATION [13,14]

Table 1 ASSESSMENT OF THE SNAKEBITE PATIENT

History

"B.I.T.E.S."

1. **B**ite *(Site, time, place)*
2. **I**dentity *(Of Snake)*
3. **T**reatment received *(First Aid, etc.)*
4. **E**xtra Information *(Comorbid disease, current medication, allergies, etc.)*
5. **S**ymptoms & **S**igns

- BEWARE -
SEVERE ENVENOMATION!

1. Confirmed bite by dangerous snake
2. Widely spaced fang punctures
3. Multiple strikes
4. Early onset of signs and symptoms
5. Urine: No output or very dark

Assessment

PRIMARY SURVEY

1. Splints and/or bandages – *See Antivenom, "Commandment 10"*
2. *"A.B.C."*
   Airway → *Secure*
   Breathing → *O_2 and/or ventilate*
   Circulation → *IV line (Normal Saline/Ringers)*
   -TREAT POSSIBLE HYPOVOLEMIC SHOCK –
3. Monitor PR, BP, O_2 saturation
4. Check the availability of polyvalent antivenom

SECONDARY SURVEY

Local

- Fang puncture mark(s), swelling, regional lymph nodes, bleeding
- Peripheral regional pulses
- Pain

Systemic

- **General** *(cold/sweat/cyanosis)*
- **CVS** *(PR, BP, ECG)*
- **Respiratory** *(RR, O_2 saturation, peak flow)*
- **Urinary** *(output and Dipstix)*
- **Neurological** *(chronologically descending – "head-to-toe") = **$(FP)_1$, D_5P_1***

→ **F**orehead Furrowing
→ **P**tosis *("look up!" – drooping of eyelids)*
→ **D**iplopia *(double vision)*
→ **D**ysarthria *(speech difficulty)*
→ **D**ysphonia flex *(decrease in voice pitch)*
→ **D**yspnoea *(breathlessness)*
→ **D**ysphagia *(inability to swallow)*
→ **P**aralysis [28]

Investigations & Observations

OBSERVATIONS

General

PR, BP, RR, Peak flow, Urine output

Neurotoxicity

→Consciousness Level *(GCS)*
→ Ptosis *("look up!")*
→ Pupils *(size and reaction to light)*
→ Open mouth *("stick out tongue!")*
→ Neck: Inability to flex *("broken neck sign")*
→ Can patient swallow?
→ Deep breaths *(paradoxical breathing?)*
→ Peak flows
→ Respiratory rate
→ *O_2* saturation

INVESTIGATIONS

Ward

- HGT
- Urine Dipstix
- Hb
- 12-Lead ECG

Blood

- FBC, diff. count, CRP
- Peripheral smears
- U&E LFT
- CK
- TroponinT
- Clotting profile, INR D-dimer, Fibrinogen
- TFT
- Random Cortisol
- Blood crossmatch

Urinalysis

- Proteins
- Haemoglobin

Wound Swab (MCS)

These **INVESTIGATIONS AND OBSERVATIONS** *should be performed for all envenomated bites with systemic and/or local signs and symptoms*

DOCUMENTATION, OBSERVATION & LABORATORY TEST FREQUENCY → **DICTATED BY THE PATIENT'S CONDITION**

SNAKE HANDLERS may develop ***acute anaphylaxis*** following contact with venom (bite or spit) [16,17,18]

2. MANAGEMENT

2.1 General Treatment (Applicable to *all* snakebites)

- **Resuscitation and Stabilization**
- **Immobilisation & Elevation** *(approximately to the level of the heart)*
- **Tetanus toxoid** - IMI
- **Prophylactic antibiotics (for *spitting cobras* and *adders*** [19,20,21,22,23,24,25] **)**: *Cefriaxone* **or** *Amikacin plus Amoxyclavulanic acid* **or** *Piperacillen-tazobactam*—See 2.2.7 page 17.
- **Analgesics** - NO Opioid *(respiratory depression)* or NSAID *(bleeding tendency)*
- **Refer** *all* snakebite patients with local and/or systemic signs/symptoms of envenomation to an expert/someone with experience/knowledge [9,26]

Snakebite in CHILDREN and PREGNANCY should be treated as ABSOLUTE EMERGENCIES!

2.2 Definitive Treatment (Please obtain *expert advice*)

Definite treatment comprises of *antivenom administration, surgical intervention, symptomatic treatment or all of these*. This is combined with *continuous re-evaluation*.

The treatment of choice will depend on the *clinical picture, whether the snake was identified or not* and the *nature of the bite*. Four or more of the following indicate an 80% chance for active intervention: **Age** <14 years; **delay to admission** >7 hours; **white cell count** > 10 x 10^9/L; **platelets** < 92 x 10^9/L; **haemoglobin** < 7g/dL; INR > 1.2 [27]

2.2.1 Snake Identified → Treat as for each individual snake. See **Table 2**

- FREQUENT VENOMOUS SNAKE BITES ENCOUNTERED IN NAMIBIA - Stiletto Snake *(Atractaspis bibronii)*, Puff Adder *(Bitis arietans)*, Zebra Snake *(Naja nigricincta nigricincta)*, Horned Adder *(Bitis caudalis)* Mozambique Spitting Cobra *(Naja mossamibica)*, Black Mamba *(Dendroapis polylepis)*, Cape Cobra *(Naja nivea)*
- LESS FREQUENT VENOMOUS BITES - Anchieta Cobra *(Naja anchietae)*, Boomslang *(Dyspholidus typus viridi)*, Péringuey Adder *(Bitis peringueyi)*, Shield Cobras *(Aspidelaps spp.)*

Table 2 — VENOMOUS SNAKEBITES IN NAMIBIA

SNAKE	PRESENTATION	DEFINITIVE TREATMENT
Stiletto Snake *(Artractaspis bibronii)*	**Cytotoxic and mildly neurotoxic** ***Local*** • Moderate to intense pain • ONE fang mark • Blue/purple discoloration • Painful swollen regional lymph glands. • Limited local necrosis ***Systemic*** • Dry mouth • Nausea and vomiting	• No Antivenom • No debridement • Symptomatic management [9]

Puff Adder *(Bitis arietans)*	**Cytotoxic +/- systemic symptoms**
	Local
	• Swelling - *severe*
	• Pain - *severe*
	• Discoloration *(red, purple, blue)*
	• Blistering (*lymphatic)*
	• Compartment syndrome *(very rare)*
	• Gangrene & necrosis
	Systemic
	• Arrythmias, bradycardia
	• Hypotension
	• Hypovolemic shock *(insidious!)*
	• Bleeding tendency *(even cerebral)*
	• Oedema *(extravasation)*
		• Elevation *(± to the level of the heart)*
		• Polyvalent Antivenom: If any local/systemic signs/ symptoms of envenomation
		  • *40-60ml IV*
		  • *Repeat with 20ml hourly for persistent/reappearing* ***systemic*** *signs/symptoms (cardiovascular compromise or bleeding)*
		  • ***Local*** *signs/symptoms: The efficacy of antivenom in preventing/limiting local necrosis is controversial – give within 3-6 hours following the bite*
		• Compartment Syndrome: ***See page 15***
		• Late debridement post-demarcation (usually 5-7 days) [9,26,28]. See p. 27 "Surgical Intervention in Snakebite".

Zebra Snake *(Naja nigricincta)*	**Mainly Cytotoxic**
	Local
	• Pain at bite site – *severe*
	• Swelling – *moderate to severe*
	• Discoloration – *around bite site*
	• Necrosis - *spreads rapidly in a plane between skin and deeper-lying muscles. The subcutaneous necrosis spreads considerably further than the overlying skin discoloration*
	Systemic
	• No neurological symptoms
	• Rhabdomyolysis
	• Capillary leak/hypoalbuminemia
	• Coagulopathy
	• Intravascular haemolysis
	• Hyponatremia, hypoglycemia (Pituitary apoplexy?)
	• Acute renal failure
	DEATH FOLLOWING A BITE IS UNCOMMON IN ADULTS, BUT *BABIES ARE AN* ***ABSOLUTE EMERGENCY***
		• Symptomatic management. NO antivenom
		Refer to snakebite expert!
		(See p. 27 "Surgical Intervention in Snakebite")
		• **Emergency surgery** - radical debridement
		Remove all non-viable tissue until normal bleeding tissue is observed. Only exceptions may be the face and genitals → perhaps a less aggressive approach monitored by an expert plastic surgeon → PLEASE contact / refer IMMEDIATELY!
		  • Never do a primary closure
		  • Vacuum dressings
		  • Wound inspection in theatre
		  Every 24-48 hours for further necrosis and debridement until the area is without necrosis
		  • Secondary closure, with or without skin graft
		• **Systemic**
		- *URINARY OUTPUT AT LEAST 2ML/KG/HOUR UNTIL CK <1000 U-*
		  • *Aggressive fluid management (crystalloids)*
		  • *Consider adding, furosemide*
		  • *Blood transfusion: Give FFP, blood* (if necessary)
		  • *Antibiotics*
		  • *Corticosteroids* [26]
		  • *Vit K: CHILD: See p.17; 2.2.6. ADULT: 10mg IV daily for first 3 days if any suspicion of systemic envenomation*
		  • *Do ALL blood tests* **(Table 1)** *daily* [29,30,31]

Venom spat in Eyes → Venom Ophthalmia

Pain, swelling of eyelids, conjunctivitis, possible secondary infection and corneal damage

- *Immediately* wash spat venom from face, neck and hands and *rinse the eyes* with copious amount of water or other bland solution. Open, close and roll the eye during irrigation. Single application of local anaesthetic eye drop - if available - will assist irrigation
- *Antibiotic/steroid eye ointment (E.g., Maxitrol®) and cover with an eye pad*
- *Referral* to ophthalmologist *- NO diluted antivenom in the eyes* [8,9] -

Black-necked Spitting Cobra—*Naja nigricollis* (Distribution: Zambezi-region, Ruacana) and **Black Spitting Cobra—***Naja nigricincta woodi* (Distribution: Namibia South of Rehoboth to North-West Cape): Bites occur seldom. Management is the same as for the Zebra Snake.

Mozambique Spitting Cobra *(Naja mossambica)*

Mainly Cytotoxic

Local
- Pain at bite site – *severe*
- Swelling – *moderate to severe*
- Discoloration – *around bite site*
- Necrosis - *severe*

Systemic
- Drowsiness – *occasionally*
- Respiratory suppression

Venom ophthalmia
- Pain
- Eyelid swelling
- Conjunctivitis
- Corneal damage
- Secondary infection

- **Polyvalent antivenom** seems to be effective if given shortly after the bite (within 3-6 hours)
  - *100-120ml IV*
  - *Repeat with 20ml hourly for persistent/reappearing* ***systemic*** *signs/symptoms*
- **Emergency surgical debridemen**t (Although delayed surgical intervention is advocated by Tilbury and Vermaak *et al* [32,33]). See p. 27 "Surgical Intervention in Snakebite".
- **Eye ophthalmia** – *treat as for Zebra Snake [9]*

Black Mamba *(Dendoaspis polylepis)*

Mainly neurotoxic

(pre-and post-synaptic involvement)

Local
- Swelling and pain - usually mild

Systemic
- Paralysis
  - *progressive descending*
  - *progression to respiratory Failure*
- Paraesthesia – *tongue and lips*
- Vomiting
- Chest and limb pains
- Increased salivation
- Tremors and *fasciculations*
- Autonomic nervous system stimulation
- Cardiac dysrhythmias

"Triad"

(Indicators of severe envenomation)

1. Pins & needles
2. Profuse sweating
3. Aggressive salivation or metallic taste

- **Polyvalent antivenom**
  - If *any* signs/symptoms of envenomation
  - At least 80ml IV

    Continue monitoring ...
  - Repeat with 20ml hourly if neurotoxic symptoms deteriorate
    - *early after the bite*
    - *and if there was improvement on previously given polyvalent*

Polyvalent antivenom *DOES NOT OVERCOME* the effect of *pre-*synaptic damage and DOES NOT ALWAYS PREVENT progression of neurotoxic effects - Antivenom *only decreases the time course of paralysis*

IT IS THUS *CRITICALLY IMPORTANT* TO GIVE *ADEQUATE* DOSES OF ANTIVENOM AT THE *EARLIEST* SIGN OF NEUROTOXICITY TO PREVENT EXTENSION OF THE PARALYSIS

- **Respiratory support** (intubation, ventilation, ICU) IS THE *ONLY* LIFESAVING MODALITY in neurotoxic snake envenomation
- **NO NEOSTIGMINE** should be administered [9,10,14,34]

Horned Adder *(Bitis caudalis)*

Cytotoxic

Swelling, pain, local necrosis

- NO antivenom
- Late surgical debridement if necrotic areas develop (5-7 days) [1]. See p. 27 "Surgical Intervention in Snakebite".

Cape Cobra *(Naja nivea)* **& Anchieta's Cobra** *(Naja anchietae)*

Neurotoxic

(post-synaptic involvement)

Local
- Swelling and pain - usually mild/moderate

Systemic
- Descending paralysis

(without fasciculations, sweating or muscle spasm due to the post-synaptic action of the venom. NO pre-synaptic involvement)

NB - *respiratory acidosis* (hypoventilation) must be corrected before giving neostigmine [32]

- **Polyvalent antivenom**
  - If any signs/symptoms of envenomation 60ml IV

    Continue monitoring ...
  - Repeat with 20ml hourly for persistent/reappearing **systemic** signs/symptoms
- **Respiratory support** (intubation, ventilation, ICU) IS THE *ONLY* LIFESAVING MODALITY in neurotoxic snake envenomation
- **NEOSTIGMINE** *(if muscle paralysis)*

  Neostigmine 2,5mg IV (children 0,05mg/kg)

  with ...

  Glycopyrrolate 0,6 mg IV (children 0,01mg/kg)

  or ...

  Atropine 0,5 mg IV (children 0,01mg/kg)

Repeat half of the above dose 2-4 hourly, if there is improvement of muscle strength /ptosis, until neuroparalysis is reversed. [10]

Peringuey Adder *(Bitis peringueyi)* **& Mountain Desert Adder** *(Bitis xeropaga)*	**Cytotoxic and mildly neurotoxic** ***Local*** • Moderate/severe pain • Bluish discolouration • Painful swelling at bite • Painful regional lymphadenopathy ***Systemic*** • Unsteady gait • Dry mouth • Nausea & vomiting • Bitter taste • Paresthesia lips/tongue • Generalized convulsions may occur ***Eyes*** External ophthalmoplegia, mydriasis, ptosis, inability to focus	• NO antivenom • Symptomatic management [1]

Boomslang *(Dispholidus typus)* **& Twigsnake** *(Thelotornis capensis oatesii)*	**Haemotoxic**
	Consumption coagulopathy/DIC
	Potent but slow-acting venom
	Local
	• Signs of a 'chewing bite'; sometimes slight oozing of blood
	Systemic
	• Early severe headaches, nausea and vomiting
	• Diffuse bleeding from all mucosae - *externally and internally; can be fatal if untreated. Fatalities among children have been reported in under 12 hours [19]*
	1st Symptoms may only start after 8 hours and more serious symptoms after 24 – 48 hours
		• **Monovalent Antivenom for *Boomslang***
		  • If indicated
		  • 20 ml
		  • Repeat dose in 2-4 hours if bleeding continues. *[9,10,35,36]*
		» NO Antivenom for Twigsnake «
		• ***Boomslang* and *Twigsnake***
		  • Blood products (FFP, Full blood, Platelet concentrate, cryoprecipitate, etc)
		» NO heparin, fibrin stabilizing/fibrinolytic drugs, thrombolytics« [8,9]

2.2.2 Snake Unidentified

Treatment depends on the severity and the specific signs and symptoms present - See table 3 [14]

PLEASE CONTACT AN *EXPERT* IN SNAKEBITE MANAGEMENT *URGENTLY* FOR ADVICE - PHONE OR WHATSAPP

Mr. F Theart ***+264 81 290 0343, WhatsApp®***

Table 3 SNAKEBITE: UNIDENTIFIED SNAKE *(ALSO SEE PAGE 19)*

CLINICAL PICTURE	RECOMMENDED DEFINITIVE TREATMENT

(I) Progressive descending paralysis
THINK:
Black Mamba *(Dendoaspis polylepis)*,
Non-Spitting Cobras
	• Give **Polyvalent** antivenom
	  • 80ml IV
	  • Repeat 20 ml hourly if neurological picture deteriorates and previous dose resulted in improvement
	• Respiratory support as necessary
	Intubate, ventilate, ICU

(II) Severe bleeding
THINK:
Boomslang *(Dyspholidus typus veridi)*,
Twigsnake *(Thelotornis capensis oatesii)*
	• Give **Monovalent** antivenom
	  • 20ml IV
	If there is an improvement, it was probably a Boomslang ...
	  • Repeat 10ml hourly if necessary
	If there is no improvement, it was probably not a Boomslang ...
	• Give blood products (FFP, Full blood, Platelet concentrate, cryoprecipitate, etc) if indicated

(III) Painful and progressive local and regional signs/symptoms (with or without systemic involvement) *THINK:* Puff adder *(Bitis arietans),* *Zebra Snake (Naja nigricinta n.)* Mozambique Spitting Cobra *(Naja mossambica)* Horned adder *(Bitis caudalis)*	In the early stages following the bite, ALL FOUR of the major culprits *(Puff adder, Zebra snake, Mozambique Spitting Cobra and Horned Adder)* may cause very similar clinical pictures around the bite area • ***Give Polyvalent antivenom (80-100ml)*** • ***REFER the patient to an expert ASAP*** *The decision, on whether to do an emergency debridement in this scenario, should be reserved for a clinician that is experienced in the treatment of Puff Adder and Zebra Snake bites*
(IV) Painful mild local and regional signs/symptoms *with or without* mild neurological involvement *THINK:* Minor Adders, Stiletto Snake *(Atractaspis bibronii)*	• NO antivenom • Symptomatic treatment

2.2.3 ANTIVENOM *(Also see page 26)*

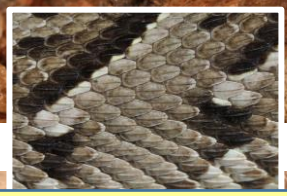
Under NO circumstances should antivenom be administered outside of a setting equipped for the treatment of anaphylaxis *(drugs, equipment, trained staff, ICU facilities, etc.)* [14,15]

ALL Antivenom mentioned in this booklet (except otherwise specified), whether monovalent or polyvalent, are from the SOUTH AFRICAN VACCINE PRODUCERS (SAVP). The use of **polyvalent antivenom in Namibia** is restricted to severe envenomation by *Puff Adder, Black Mamba, Cape Cobra, Anchietae Cobra and Mozambique Cobra.* The **monovalent antivenom** is indicated for severe envenomation by the *boomslang.* Do **not** use polyvalent antivenom for the *minor adders, Stiletto Snake, Boomslang, Twig/Bird Snake or Zebra Snake.*

ANTIVENOM ADMINISTRATION – OUR *"10 COMMANDMENTS"*

1. The patient should be on a continuous ECG, BP and O_2 saturation monitor
2. Secure large bore IV line
3. All resuscitation equipment (airway, ventilator and circulatory management) prepared and available; Adrenaline 0,5ml (1:1000) – *drawn up and available for immediate IM administration in case of severe anaphylaxis* [12,13,14].
4. Patients at risk for anaphylactic reactions (atopic, asthma, previous serum exposure) should be pre-treated with Adrenaline - ***however, be very cautious in babies and pregnant women:***
   - 4.1. ADULT - Adrenaline 0,25ml (1:1000) (1mg/ml) SC [9,10]
     (Avoid in IHD, uncontrolled HPT and Arrhythmias [10]*- rather give Solucortef 200mg IVI stat)*
   - 4.2. CHILDREN - Adrenaline 0.005mg/kg SC [10]
     Adrenaline significantly reduced severe reactions to antivenom by 43% up to 1 hour and by 38% up to 48 hours after antivenom administration [37]
5. Dilute the antivenom by adding to 200ml Saline
   Children must receive the same amount of antivenom as adults; be careful of fluid overload - dilute to maximum of 10ml/kg [12]
6. Give slowly IV over 10 -15 minutes
7. Should any signs of Allergy/Anaphylaxis develop → discontinue IMMEDIATELY and treat adverse reaction [14,15]. If the reaction was mild and resolved quickly following treatment, consider further slow administration of antivenom [14,15].
8. If the patient does not develop anaphylaxis after the first dose of antivenom, he/she will not develop it after subsequent, even larger dose given immediately thereafter [8].
9. Pregnancy is not a contra-indication to antivenom administration [8,9].
10. Pre-applied splints, bandages, or tourniquets (as part of the first-aid management/transport) should ONLY be left *in situ* with a *confirmed* non-spitting cobra or mamba bite *warranting antivenom administration;* after giving IV antivenom, release slowly/remove. If symptoms/signs reappear or worsen - give more antivenom. In all other scenarios release slowly under supervision and direct monitoring [38].

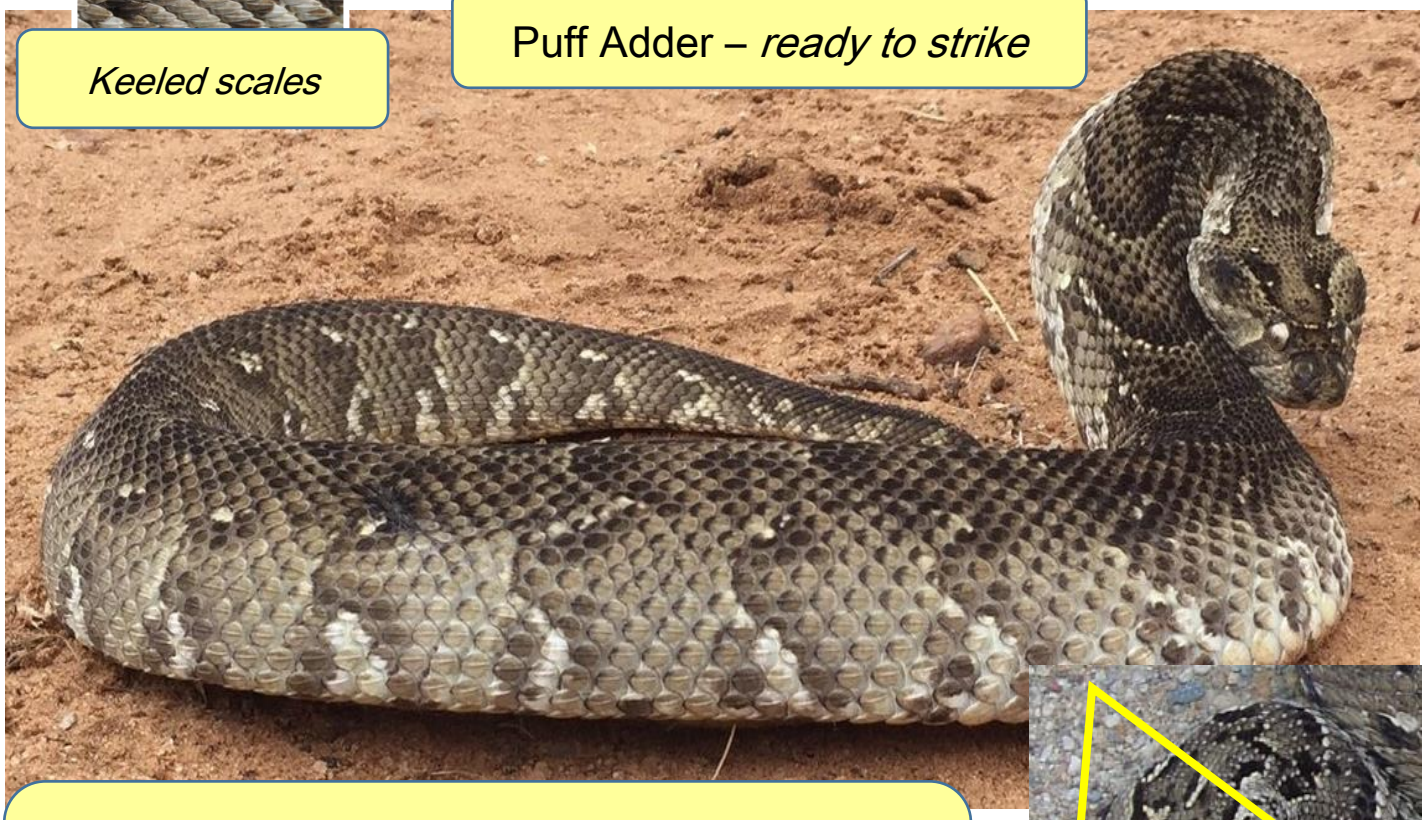
Puff Adder *(Bitis arietans)*

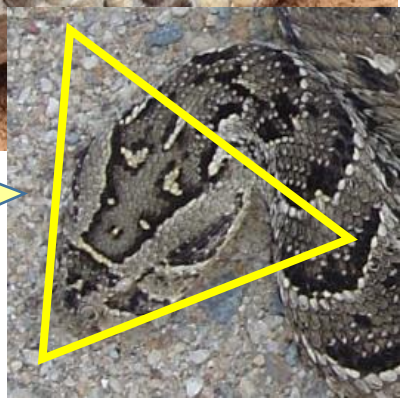


Keeled scales

Well camouflaged

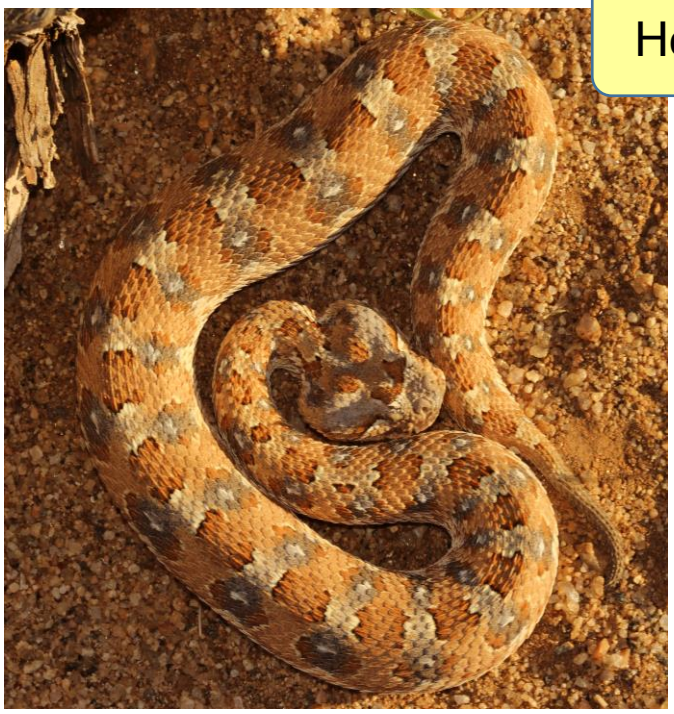
Puff Adder – *ready to strike*



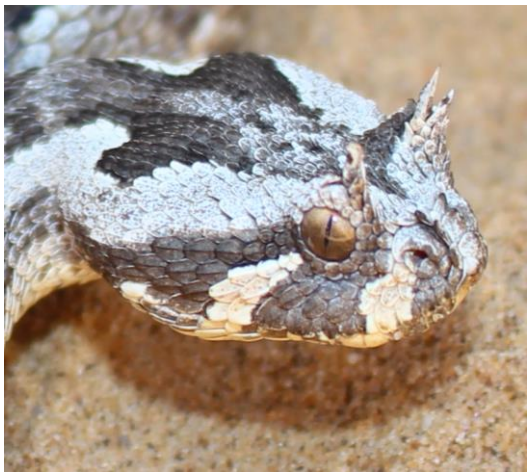


Puff Adder – *Short, stubby, triangular head, distinct from rest of body. Backward-pointing darker chevrons on back (first photo). Light line between eyes. May hiss/puff when disturbed.*

Horned Adder *(Bitis caudalis)*



Many-Horned Adder *(Bitis cornuta)*

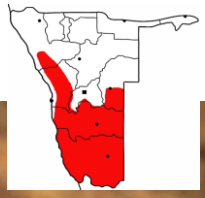


Peringuey's Adder *(Bitis peringueyi)*

Peringuey's Adder –
eyes on top of head

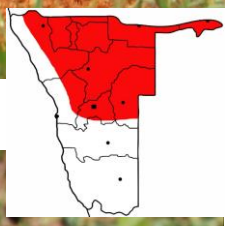
Zebra Spitting Cobra *(Naja nigricincta)*

Cape Cobra *(Naja nivea)* - *adult*



Cape Cobra
Juvenile with dark throat band

Anchieta's Cobra *(Naja anchietae)* – *plain phase*



Anchieta's Cobra - *banded phase*

Mozambique Spitting Cobra

(Naja mossambica)

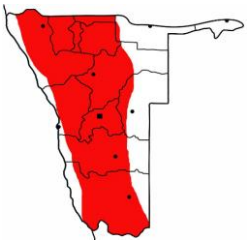
Black Spitting Cobra

(Naja nigricincta woodi)

Large *'nose shield'* (rostral scale)

Speckled Shield-nosed Cobra *(Aspidelaps scutatus)*

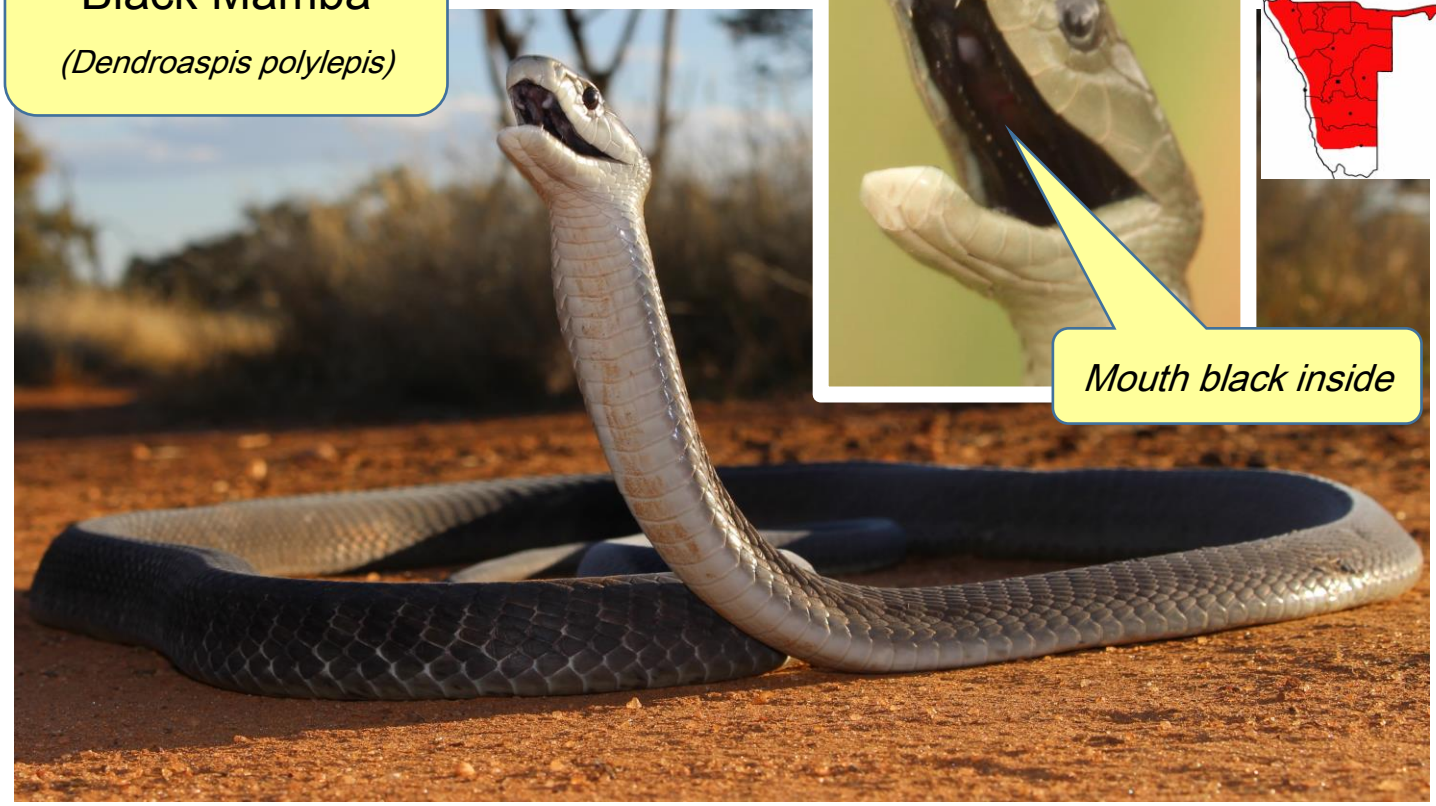
Cape Coral Snake *(Aspidelaps lubricus lubricus)*



Kunene Coral Snake *(Aspidelaps lubricus cowlesi)*

Black Mamba

(Dendroaspis polylepis)

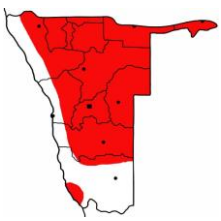


Mouth black inside

Stiletto Snake

(Atractaspis bibronii)

Horizontal fang



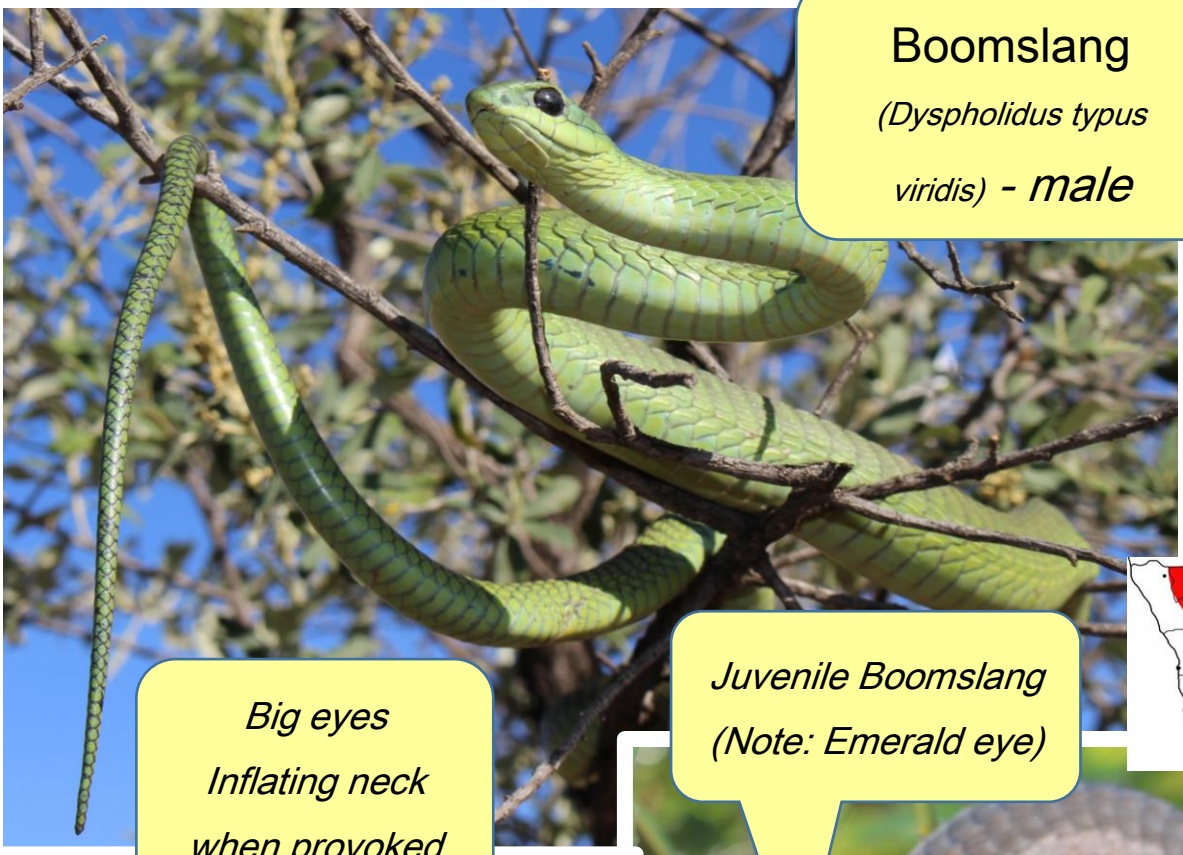
Blunt ending tail with sharp point

Small head, indistinct from neck

Minute eyes

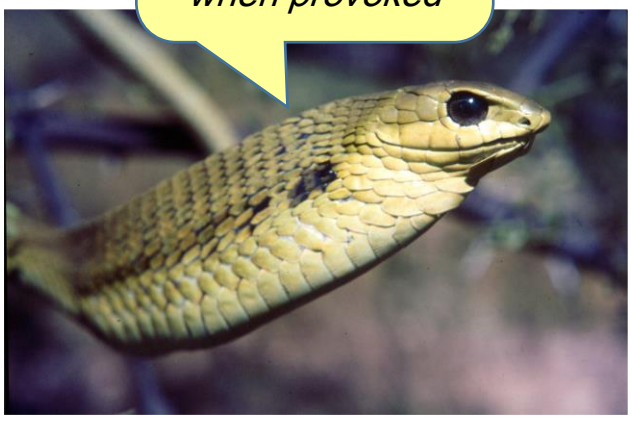
Boomslang

(Dyspholidus typus viridis) - *male*



Big eyes
Inflating neck when provoked

Juvenile Boomslang
(Note: Emerald eye)



Twig Snake

(Thelotornis capensis oatesii)

2.2.4 INDICATIONS & METHODS FOR INTUBATION AND VENTILATION

*Literature is very non-specific regarding guidelines in the airway management of the snakebite victim. Following are **guidelines** incorporating available snakebite literature in combination with airway management guidelines and personal experience.*

Indications

1. Inability to maintain airway patency
2. Inability to protect airway against aspiration

i.e., Bulbar Palsy with inability to swallow, no gag reflex and increased secretions

3. Ventilatory compromise (respiratory muscle weakness leading to paradoxical ventilation)
4. Failure to oxygenate (due to aspiration or respiratory arrest)

   Oxygen saturation<90% (equivalent to PaO_2 <60% mmHg) despite high flow oxygen
   Blood gasses = respiratory acidosis (hypoxia PaO_2 <60% mmHg with $PaCO_2$ > 45 mmHg

5. Anticipation of deterioration in respiration that will lead to the need for intubation [39].

Method

*REMEMBER → Although paralyzed, your patient is **awake and very anxious**! Explain what you are going to do in detail and step by step. Reassure the patient and remember that everything you are saying/discussing is heard and comprehended by the bite victim.*

1. A RAPID SEQUENCE INTUBATION ("Crash Induction") should be done

   The choice of drugs will be determined by the clinical condition of the patient…

   a. Induction agent
      - *Unstable* (CVS) → ketamine 1-2mg/kg IVI
      - *Stable* → propofol 1mg/kg (TITRATE) IVI

   b. Muscle relaxant
      - Start with ¼ dose of suxamethonium (if necessary)
      (Normal dose: Adult = 1mg/kg, children = 2mg/kg)

REMEMBER TO KEEP THE PATIENT SEDATED POST INTUBATION!

2. IF INTUBATION IS NOT POSSIBLE (difficult airway, lack of intubation skills, etc.), a laryngeal mask airway (LMA) can be used as an emergency bridging device until intubation with an endotracheal tube can be done
3. A CUFFED ENDO/NASOTRACHEAL TUBE OR TRACHEOSTOMY remains the only definitive way of securing an airway as the patient in this setting will probably require days to weeks of ventilation. [28,40].

2.2.5 COMPARTMENT SYNDROME & FASCIOTOMY

A tensely swollen, immobile, cold and seemingly pulseless limb may suggest the possibility of increased compartmental pressure. However, the classical signs of an Intracompartmental Pressure Syndrome (IPS) may be problematic to assess in snakebite victims and many unnecessary, dangerous and debilitating fasciotomies are performed. Fasciotomy is generally falling out of favour as part of the treatment of snake bitten limbs. [41].

- The most reliable test to confirm IPS is by direct measurement of the Intracompartmental pressure (e.g., using a *Stryker pressure needle*) or by demonstrating intramuscular swelling by means of ultrasound [28].
- Even with a properly performed fasciotomy, envenomated muscle may not be saved. Animal studies have suggested that muscle sufficiently envenomated and swollen to cause IPS, may already be irreversibly damaged by the *direct effect* of the venom [42].
- Among 105 cases of rattle snakebites in the USA, the 28 patients on whom fasciotomy was carried out showed no advantage in morbidity, but spent on average 2 extra days in hospital [43].
- Fasciotomy should not be contemplated until haemostatic abnormalities have been corrected, otherwise the victim may bleed to death.
- Early treatment with antivenom remains the best way of preventing irreversible muscle damage [44].
- ***Fasciotomy to relieve IPS should not be confused with the debridement which is indicated in Zebra Snake bites***
- See p. 27 "Surgical Intervention in Snakebite".

Treatment of the paediatric snakebite victim provides a unique challenge. Their large body surface area, less protein to bind the circulating venom, smaller extracellular fluid volume and high venom to body mass ratio, make small children particularly susceptible to severe envenomation and higher mortality. Obtaining an accurate history is often also problematic. The initial clinical picture may be misleading as children are more resilient than adults and take longer to decompensate. However, they can deteriorate quite rapidly. It is thus critical to monitor children closely and they should never be left unattended. [24,25,45].

Antivenom

The dosages of most drugs are adjusted according to the weight or age of the patient. Antivenom is an important exception to this rule: the snake injects the same amount of venom into all victims, whether being an adult, a small child, or a baby. A specific volume of antivenom neutralizes a corresponding volume of venom. Thus, the recommended neutralizing antivenom dose should stay the same, regardless of the age or weight of the snakebite victim.

CHILDREN NEED TO RECEIVE THE SAME AMOUNT OF ANTIVENOM AS ADULTS.

- ***Antivenom (AV)*** should be diluted with saline to a maximum of 10 ml/kg. to avoid fluid overload. (For example: *Child 15kg, (15x10 = 150ml max). Bitten by Cape Cobra. Treatment = 6 vials = 60ml. 60ml AV + 90ml Saline = 150ml)* [8,14.45].
- Children show a high incidence of acute adverse reactions following SAVP polyvalent administration. [18,46]. Low dose, *subcutaneous* ***adrenaline*** (0.005mg/kg SC) is recommended to all children *prior* to the administration of antivenom (See dosages chart—last page).
- ***Prednisone*** (1 mg/kg) for five days, following the administration of the antivenom, reduces the risk for developing delayed serum sickness. [37,45].

Adrenaline for Anaphylaxis in Children

If no response to *IM adrenaline*, *IV boluses* of 0.1ml/kg of 1mg adrenaline diluted to 10ml (with saline) may be given.

Antibiotic prophylaxis

Children that are bitten by *spitting cobras* and *adders* should be started on immediate antibiotic cover—See 2.2.7

Zebra snakebite in small children→AN ABSOLUTE EMERGENCY

- Children **must** be *admitted to an ICU or High Care facility* and **must** be managed by a *Multi-Disciplinary Team* (Paediatrician, Snakebite expert and Surgeon).
- The following **venom pathologies** are encountered in children following Zebra Snake envenomation
    - Local necrosis, rhabdomyolysis, coagulopathy and hypoalbuminemia are usually present.
    - *Have a high index of suspicion for:*
        - A severe inflammatory response, with tachycardia and increased temperature.
        - Intravascular haemolysis with anemia and thrombocytopenia.
        - Hyponatremia and hypoglycemia.
- *It is imperative* that **all children bitten by *a Zebra Snake*** should be assumed to suffer from abovementioned venom pathologies. Vigilant monitoring, a high index of suspicion and pro-active management and planning is *sine qua non* to the outcome of the envenomation.
    - Even if the child appears stable, ***immediate aggressive fluid resuscitation*** must be initiated. DO NOT WAIT FOR THE LABORATORY RESULTS—Fluid resuscitation can be adjusted later, according to the laboratory results.
        - A *urinary catheter* is mandatory. U*rine output* of >2ml/kg/hour should be maintained.
        - In view of probable hyperkalaemia and hyponatraemia initial fluid resuscitation should be started with normal saline solution. [47,48,49].
        - *Initial Saline bolus* of 20ml/kg, followed by maintenance (saline plus 5% dextrose) per 24 hours: →100ml/kg saline for first 10kg *plus* 50 ml/kg (10-15kg) *plus* 20ml/kg (>15kg).
        - *FFP, colloids or albumin* may be considered as volume expanders, given as boluses of 10-20ml/kg 6 hourly.
        - When adequately hydrated, *Furosemide* may be given as a last resort (1-2mg/kg stat)
        - Aggressive fluid therapy until **CK < 1000U/L.** [47,48,49,50].
    - ***Glucocorticosteroids:*** *Dexamethasone* 1 mg/kg IV once; followed by 1mg/kg/day IV divided q4-6hr (not to exceed 16 mg/day) **OR** *hydrocortisone* 2-4mg/kg 6 hourly IV.
    - ***Tetanus toxoid.***
    - Empirical ***antibiotics*** (see 2.2.7).
    - ***Paracetamol*** 15mg/kg 6 hourly.
    - ***Vit K:*** *Children <1year* = 1 paediatric amp (2mg) IV once daily for the first three days post bite. *Children > 1 year (and adults)* = 10mg IV daily for the first three days post bite. Start as early as possible in all children. [Personal communication Prof. C Pieper]

- The following **Special investigations** should be requested:
  - *Ward:* Urinary dipstick, haemoglucotest.
  - *Laboratory:* Full blood count, differential count with peripheral smear, U&E, Liver function tests, Clotting profile, d-dimers, s- fibrinogen, s-Creatine Kinase, Thyroid function and random s-cortisol.
  - *Echo-cardiogram*: Access cardiac function.

Repeat tests depending on initial results and the clinical condition of the patient.

2.2.7 ANTIBIOTIC PROPHYLAXIS

Antibiotics were not previously recommended following snakebite. Studies in Kwa -Zulu Natal, Taiwan and India suggest that snakebite causing cytotoxic effects (adders, Stiletto Snakes and cobras), especially spitting cobras, are more prone to secondary infection and prophylactic antibiotics are indicated. [19,20,21,22,23,51,52].

VICTIMS that are bitten by *spitting cobras* and *adders* should be started on immediate antibiotic cover:

- *Ceftriaxone* (CHILDREN <50KG = 50-80mg/kg IV once daily, CHILDREN >50KG & ADULTS = 1-2g IV once daily).

OR…

- *Amikacin* (CHILDREN & ADULTS = 15-20mg/kg IV once daily, maximum 1.2g/day) **PLUS** *Amoxyclavulanic acid* (CHILDREN <3 MONTHS/<4KG = 25/5mg/kg IV 12 hourly, CHILDREN >3 MONTHS/>4KG = 25/5mg/kg IV 8 hourly, CHILDREN >50KG & ADULTS = 1000/200mg IV 8 hourly).

OR…

- *Piperacillen-Tazobactam* (CHILDREN 2-9 MONTHS = 80mg/kg IV 8 hourly, CHILDREN >9 MONTHS/<45KG = 100mg/kg IV 8 hourly, CHILDREN >45KG & ADULTS = 4,5g 8 hourly IV).

References

1. Visser J, C. D. (1978). *Snake and Snake-bite.* Cape Town, South Africa: Purnell and Sons (SA) (PTY) LTD.
2. Spawls S, B. B. (1995). *The Dangerous snakes of Africa.* Southern Book Publications, Halfway House.
3. Marais J, (2004) *A Complete guide to the Snakes of Southern Africa*. 2nd ed. Cape Town: STRUIK
4. *World Health Organisition*. (2019, April 09). Retrieved 05 10, 2019, from Snakebite Envenoming: http://www.who.int/news-room/fact-sheet/detail/snakebite-envenoming
5. Sanhajariya S, D. S. (2018). Pharmacokinetics of Snake Venom. *Toxins , 10* (73).
Snake Venom. (2016). Retrieved 09 16, 2018, from Wikepedia: https://en.wikipedia.org/wiki/Snake venom
6. Gutierrez JM, C. J. (2017). Snakebite Envenoming. *Nature Reviews/ Disese Primers , 18*, 1-20.
7. Young BA, L. C. (2002). Do snakes meter venom? *BioScience , 52* (12), 1121-1126
8. Buys PJC. (2003) *Medical management of snakebite in Namibia*.1st ed. Windhoek: Gamsberg Macmillan.
9. Guidelines for the prevention and management of snakebite in Africa. 2010. *World Health Organization*. http://apps.who.int/iris/bitstream/10665/204458/1/9789290231684. (Accessed 1 May 2017).
10. Müller GJ, 2012. Snake bite in southern Africa: diagnosis and management. *CME*, Volume 30 No 10, 362-391.
11. Engelbrecht A. (2012) Management of common animal bites in the emergency centre. *Continuing Medical Education*; 30(11): http://www.cmej.org.za/index.php/cmej/article/view/2566/2642 (Accessed 26 August 2017).
12. Snake Venom. https://en.wikipedia.org/wiki/Snake_venom. 2016. Wikipedia (Accessed 23 January 2018).
13. Casewell NR, Simon C. Wagstaff, Wüster W, Cook DAN, Boltona FMS, Kinga SI, Plad D, Sanzd L, Calveted JJ, Harrison RA. Medically important differences in snake venom composition are dictated by distinct postgenomic mechanisms. *PNAS* 2014; 111(25): http://www.pnas.org/content/111/25/9205.short (Accessed 23 January 2018).
14. White J, 2013. *A Clinician's Guide to Australian Venomous Bites and Stings*. 1st ed. Australia: National Library of Australia.
15. Strydom M. (2014) Snake Bite Management. Department of Pharmacology. University of Pretoria. *University of Pretoria Archived Website*. https://www.google.com.na (Accessed 8 May 2017).
16. Pitt C. Snake farm manager dies from black mamba bite. *News 24 2018*, http://www.news24.com/SouthAfrica/News/snake-farm-manager-dies-from-black-mamba-bite-20181001. (accessed 07 October 2018).
17. Beltz K. Allergic reaction to snake venom caused death, *Times Free Press 2011*. https://www.timesfreepress.com/news/story/2011/feb/01/allergic-reaction-to-snake-venom-caused-death/40983/. (accessed 07 October 2018).
18. Blaylock RSM, Tilbury CR, Branch WR. 2002. Anaphylaxis following exposure to snake venoms in South Africa. Current Allergy & Clinical Immunology 15(2): 65-68.
19. Wagener M, N. M. (2017). Wound infections secondary to snakebite. *South African Medical journal , 107* (4).
20. Chen CM, W. K. (2011). Bacterial infection in association with snakebite: A 10 year experience in a northern Taiwan medical center. *Journal of Microbiology, Immunology and Infection , 44* (6), 456-460.
21. Garg A, S. S. (2009). Wound infections secondary to snakebite. *J Infect Developing Countries , 3* (3), 221-223.
22. Dabor R, G. J. (2020). Antibiotic therapy for snakebite envenomation (Letter to the Editor). *Journal of Venomous Animalsand Toxins including Tropical Diseases , 26*.
23. Huang LW, W. J. (2019). Wound Infections secondary ro snakebite in central aiwan. *Journal if Animals and Toxins including Tropical Diseases , 18* (3).
24. Sankar J, N. R. (2013). Factors affecting outcome in children with snaker envenomation: a prospective observational study. *Arch Dis Child , 00*, 1-6.

25. Wang JD, T. Y.-C. (2009). Venomous snakebite and antivenom treatment according to protocol for pediatric patients in Taiwan. *J. Venom. Anim. Toxins incl. Trop. Dis , 15* (4).
26. Blaylock RS. (2005) The identification and syndromic management of snakebite in South Africa. *SA Fam Pract*, 47(9), 48-53.
27. Wood D, Sartorius B, Hift R, (2017) Classifying snakebite in South Africa: validating a scoring system. *SAMJ*, 107 (1), 46-51.
28. Wood D, Webb C, De Meyer J. (2009) Severe snakebites in Northern KwaZulu-Natal: treatment modalities and outcomes. *S Afr Med J*; 99(11):814-818
29. Standard Treatment Guidelines, *Management of Snake Bite;* Quick Reference Guide (January 206)) Ministry of Health & Family Welfare Government of India.
30. Antoon JW, Chakraborti C. Corticosteroids in the treatment of alcohol-induced rhabdomyolysis. *<ayo Vli Proc* 2011; 86(10): 1005-1007 30. Sauret JM, Marinides G, Gordon K. Rhabdomyolysis. *Am Fam Physician* 2002; 65(5): 907-913.
31. Keltz E, Khan FY, Mann G. Rhabdomyolysis. The role of diagnostic and pronnostic factors. *Muscle Ligaments Tendon J* 2013; 3(4): 303-31
32. Tilbury CR, (1982). Observations on the bite of Mozambique spitting cobra (Naja mossambica mossambica). *South African Medical Journal*, 61(9) 308-313.
33. Vermaak SS, Visser A, Le Roux TLB, (2010) A deadly bed partner: m'Fesi (Mozambique spitting cobra). *SA Orthopaedic Journal*, 9(4) 58-62.
34. Simpson, ID, Jacobsen IM, (2009) Understanding and treatment of Neurotoxic Snakebite in the Developing world: Air Today or Gone Tomorrow! *Indian Journal of Emergency Paediatrics*, 1(1) 15-24.
35. Schrire L, M. G. (1996). *Diagnosis and treatment of Southern African snake bites, and other animal envenomations.* SAVP(Pty)Ltd.
36. *Poisoning, Chapter 19, Boomslang monovalent antivenom.* (2018, Dec 6). Retrieved Sept 03, 2020, from National Department of Health - South Africa (SOP): www.health.goc.za>category>526-poisoning
37. De Silva HA, Pathmeswaran A, Ranashina CD, Jayamanne S, Samarakoon SB, Hittarage A, et al. (2011) Low-dose adrenaline, promethazine, and hydrocortisone in the prevention of acute adverse reactions to antivenom following snakebite: a randomized, double-blind, placebo-controlled trial, *PLoS Med*. May;8(5): e1000435.
38. Avau B, Borra V, Vandekerckhove P, De Buck E, (2016) The treatment of snakebite in a first aid setting: a systematic review. *PLOS; Neglected Tropical Disease*; 10(10): https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5066967 (Accessed 18 June 2017).
39. Lafferty KA. Dillinger R, Rapid Sequence Intubation. *Medscape 2017*; http://emedicine.medscape.com/article/80222-overview. (accessed 19th May 2017).
40. Lewis RL, Gutmann L. Snake venoms and the Neuromuscular junction. *Medscape* 2004; http://www.medscape.com/viewarticle/487281_5. (accessed 17 May 2017).
41. Cumpston KL. (2011) Is there a role for fasciotomy in Crotalinae envenomations in North America? *Cli Toxicol (Phila). 19(5)351-65.*
42. Garfin SR, Castilonia RR, Mubarak SJ. *(1984) Rattle snakebites and surgical decompression: results using a laboratory model.* Toxicon 22:177-82.
43. Darracq MA, Cantrell FL, Klauk B, Thornton SL. (2015) A chance to cut is not always a chance to cure – fasciotomy in the treatment of rattlesnake envenomation: A retrospective poison center study. *Toxicon. 101:23-6*
44. Warrel DA. (2010) World Health Organisation; *WHO Library Cataloguing-in-Publication data* (NLM classification: WD 410; Guidelines for the management of snakebites; pp. 1-150.
45. Nimorakiotakis B, W. K. (2014). Special considerations in paediatris snakebite management. In D Williams, *Clinical Management of snakebite in Papau New Guinea* (p. 270).
46. Pattinson JP, Kong VY, Bruce JL, Oosthuizen GV, Bekker W, Laing GL, Wood D, Brysiewicz P, Clarke DL. Defining the need for surgical intervention following a snakebite still relies heavily on clinical assessment: The experience in Pietrmatitzburg, South Africa. *SAMJ 2017; 107 (12).*
47. Miller, L. (2018). *Clinical manifestations and Diagnosis of Rhabdomyolysis*. (S. J. Targoff IN, Editor) Retrieved from Up to date: https:www.uptodate.com/contants/clinical-manifestations-and-diagnosis-of-rhabdomyolysis#H31738287
48. Park Y, S. J. (2018). Clinical Characteristics of Rhabdomyolysis in Children: Single Center Experience. *Child Kidney Dis , 22* (2), 52-57.
49. Miller, L. (2018). *Clinical manifestations and Diagnosis of Rhabdomyolysis*. (S. J. Targoff IN, Editor) Retrieved from Up to date: https:www.uptodate.com/contants/clinical-manifestations-and-diagnosis-of-rhabdomyolysis#H31738287
50. Saaiman EL, Buys. PJC. (2019). Spitting cobra (Naja nigricincta nigricincta) bites complicated by rhabdomyolysis, possible intravascular haemolysis and coagulopathy. *South African Medical Journal , 109* (10).
51. Blaylock, R. (1999). Antibiotic use and infection in snakebite victims. *South African Medical Journal , 89* (8), 874-876.
52. Tsaia YH, H. W. (2017). Necrotizung fasciatis following venomous snakebites in a tertiary hospital of southwest Taiwan. *International Journal of Infectious Diseases* (63), 30-36.

SNAKEBITE

CLOSE MONITORING

ASSESSMENT
High index of suspicion:
- Neurological symptoms/signs
- Hypovolaemia
- Rhabdomyolisis

TARGETED HISTORY
- Bite (site, time, place)
- Identity of snake
- Treatment received (First aid, etc.)
- Additional information (comorbid disease, current medication allergies. etc.)
- Symptoms and signs

Envenomation?

NO → Observe 6 hours → NO ENVENOMATION
→ *discharge*
→ *Inform patient regarding possible late bleeding*

YES

Life Threatening?

YES →
- Arrhythmias
- Respiratory paralysis
- Hypotension
- Severe bleeding
- Cardiovascular collapse
- Anaphylaxis

→ Resuscitate and Stabilize

NO →
- Pain, swelling, blisters
- Nausea/vomiting
- Ptosis/ophthalmoplegia

INITIAL TREATMENT
- IV line
- Tet Tox
- Antibiotics
- Analgesics
- Wash wounds
- Immobilize and elevate

Specific Treatment based on Snake Identification

SPECIFIC TESTS
- 20 min WCT
- U-dipstix
- FBC, platelets, blood smear
- U&E, LFT, CK, TropT
- D-dimer, fibrinogen myoglobin, haptoglobin
- TFT
- Cortisol

Identified → Follow guidelines *"Specific snakebite treatment"* pp 3-5

Unidentified → *Get **EXPERT** opinion*

Review the common snakes in the region where the bite occurred to assist in identifying the most likely match to the following clinical syndromes

PAINFUL AND PROGRESSIVE SWELLING WITH OR WITHOUT SYSTEMIC INVOLVEMENT

Consider: *Puff Adder. Zebra Snake, Mozambique Spitting Cobra, Horned Adder*

Bitten at night, inside dwelling

YES → **Geographical distribution**

NO → *- Snake unidentified! -* ***Consider:*** *Puff Adder or Horned Adder* → **Polyvalent antivenom** *60 - 80ml IV.* **REFER to an EXPERT → Possible late debridement**

SEVERE BLEEDING

Consider: *Boomslang, Twig Snake*

Monovalent antivenom
20ml IV, repeat 10ml IV hourly prn
Supportive treatment

PAINFUL MILD SWELLING WITH OR WITHOUT MILD NEUROLOGICAL INVOLVEMENT

Consider: *Minor adders. Stiletto Snake*

NO antivenom
Symptomatic treatment

PROGRESSIVE DESCENDING PARALYSIS

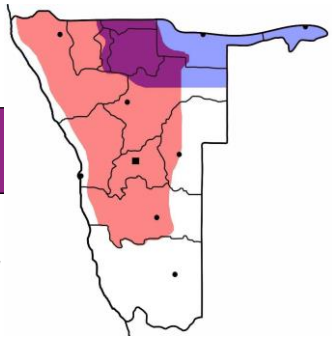
Consider: *Black Mamba, Non-spitting cobras*

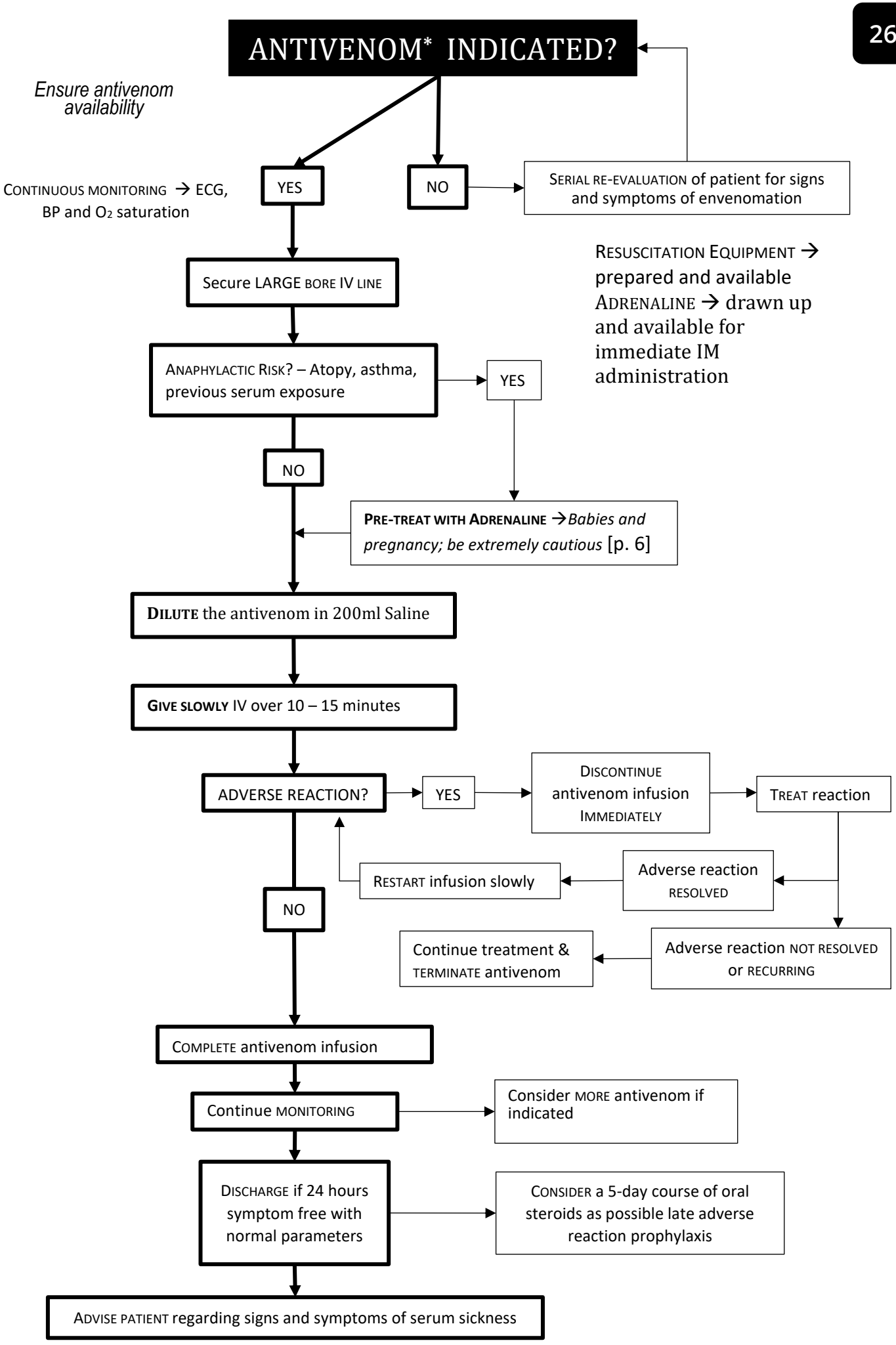
Polyvalent antivenom
80ml IV, repeat 20ml IV hourly prn
Respiratory support
Neostigmine

Zebra Snake ***only*** → Treat as for **Zebra Snake**

Mozambique Spitting Cobra ***only*** → Treat as for **Mozambique Spitting Cobra**

Both Zebra Snake and Mozambique Spitting Cobra → **REFER to an EXPERT**
Polyvalent antivenom *80 - 100ml*
Emergency debridement
(Treat as for Zebra Snake)





ALL antivenom mentioned (except otherwise specified), whether monovalent or polyvalent, are from the SOUTH AFRICAN VACCINE PRODUCERS (SAVP)

SURGICAL INTERVENTION IN SNAKEBITE

SNAKE (ENVENOMATED BITE)	BITE SITE	FASCIOTOMY	DEBRIDEMENT
Adders **(Major and Minor)** *Bitis arietans* *Bitis caudalis* *Bitis cornuta*	Limbs (feet, hands)	± • ONLY for PROVEN Compartment Syndrome • More often in neglected/poorly managed cases	± • IF indicated • Wait→ 7-10 days
	Other	-	
Zebra Snake *Naja nigricincta nigricincta* **&** **Mossambique Spitting Cobra** *Naja mossambica*	Limbs (feet, hands)	± • ONLY if indicated • Especially children and neglected cases	+ • ASAP • Manage as an Emergency
	Other (Genitalea, head, face)	-	± • 1st Wait and monitor • Surgery:- Be more conservative

+ DO - DO NOT ± DO ONLY IF INDICATED

SNAKEBITE RECORD CHART — NAMIBIA —

ADULT

CASE NUMBER

General Information

VICTIM			SNAKE & BITE		DOCTORS	
Surname			Bite date		Referring	
First name			Bite time			
DOB	Gender M F		Nr of bites		Treating	
Contact details						
			Snake ID			

Serial Observations & Results

Date													
Time													
Time after bite (minutes)													

Local/Regional

Pain (0-10)													
Sweating (Y/N)													
Bleeding/oozing (Y/N)													
Nodes tender/swollen (Y/N)													
Necrosis/ulceration (Y/N)													
Regional peripheral pulse (+/-)													

General

Pulse rate													
Blood pressure													
Respiratory rate													
Temperature													
Oxygen saturation													
Headache (Y/N)													
Nausea/vomiting (Y/N)													
Generalized pain (0-10)													
Hypersalivation (Y/N)													
Tongue fasciculations (Y/N)													
Other:													

Neurological signs

Level of consciousness (GCS)													
Ptosis (Y/N)													
Pupil size (mm) L R													
Pupil reaction to light (Y/N)													
Ophthalmoplegia (Y/N)													
Drooling (Y/N)													
Slurred speech (Y/N)													
Neck flexion (+/-)													
Limb weakness (Y/N)													
Ataxia (Y/N)													
Loss of tendon reflexes(Y/N)													
Paradoxical breathing (Y/N)													
Respiratory failure (Y/N)													
Peak flow rate													

Coagulation signs

Persistent bleeding (Y/N)													
Haematuria (Y/N)													
Active bleeding (Y/N)													

Renal signs

Urine output (ml) ***minimum = 2ml/kg/hour***													

Laboratory tests

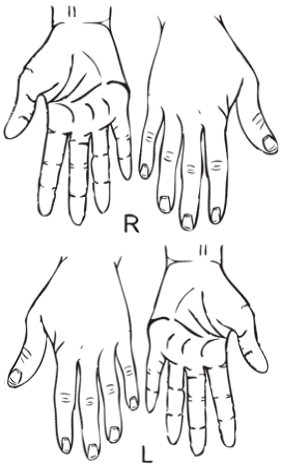
FBC													
Peripheral blood smear													
U&E													
LFT													
CK													
s-/u-Myoglobin													
s-Haptoglobulin													
Clotting profile													
d-Dimer													
s-Fibrinogen													
TFT													
s-Cortisol (random)													
Blood glucose (random)													
Wound swab MCS													

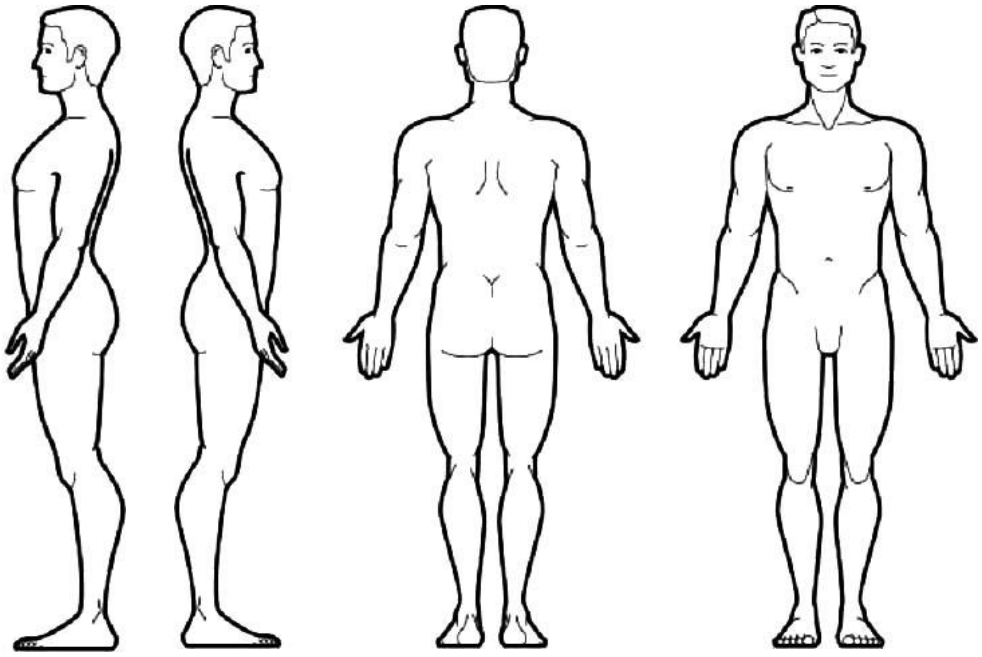
Antivenom

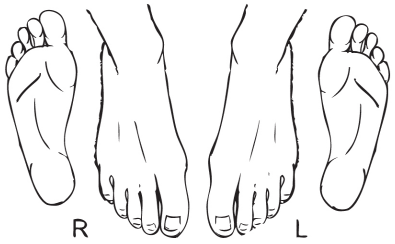
Amount (ml)													
Adverse reaction(s)													

Other treatment

Discharge Date		Comments
Discharge Time		
Discharge Doctor		
Follow-up		







Hospital Sticker

SNAKEBITE RECORD CHART — NAMIBIA —

CHILD

CASE NUMBER

General Information

VICTIM		SNAKE & BITE		DOCTORS	
Surname		Bite date		Referring	
First name		Bite time			
DOB	Gender M F	Nr of bites		Treating	
Contact details					
		Snake ID			

Serial Observations & Results

Date													
Time													
Time after bite (minutes)													

Local/Regional

Pain (0-10)													
Sweating (Y/N)													
Bleeding/oozing (Y/N)													
Nodes tender/swollen (Y/N)													
Necrosis/ulceration (Y/N)													
Regional peripheral pulses (+/-)													

General

Pulse rate													
Blood pressure													
Respiratory rate													
Temperature													
Oxygen saturation													
Headache (Y/N)													
Nausea/vomiting (Y/N)													
Generalized pain (0-10)													
Hypersalivation (Y/N)													
Tongue fasciculations (Y/N)													
Other:													

Neurological signs

Level of consciousness (GCS)													
Ptosis (Y/N)													
Pupil size (mm) L R													
Pupil reaction to light (Y/N)													
Ophthalmoplegia (Y/N)													
Drooling (Y/N)													
Slurred speech (Y/N)													
Neck flexion (+/-)													
Limb weakness (Y/N)													
Ataxia (Y/N)													
Loss of tendon reflexes(Y/N)													
Paradoxical breathing (Y/N)													
Respiratory failure (Y/N)													
Peak flow rate													

Coagulation signs

Persistent bleeding (Y/N)													
Haematuria (Y/N)													
Active bleeding (Y/N)													

Renal signs

Urine output (ml) ***minimum = 2ml/kg/hour***													

Laboratory tests

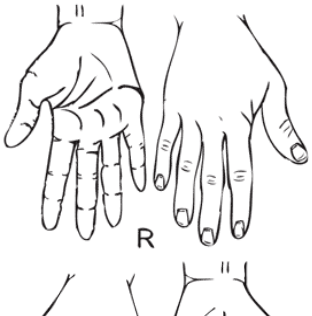
FBC													
Peripheral blood smear													
U&E													
LFT													
CK													
s-/u-Myoglobin													
s-Haptoglobulin													
Clotting profile													
d-Dimer													
s-Fibrinogen													
TFT													
s-Cortisol (random)													
Blood glucose (random)													
Wound swab MCS													

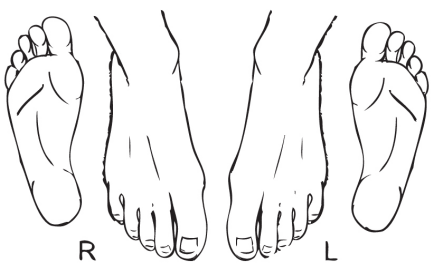
Antivenom

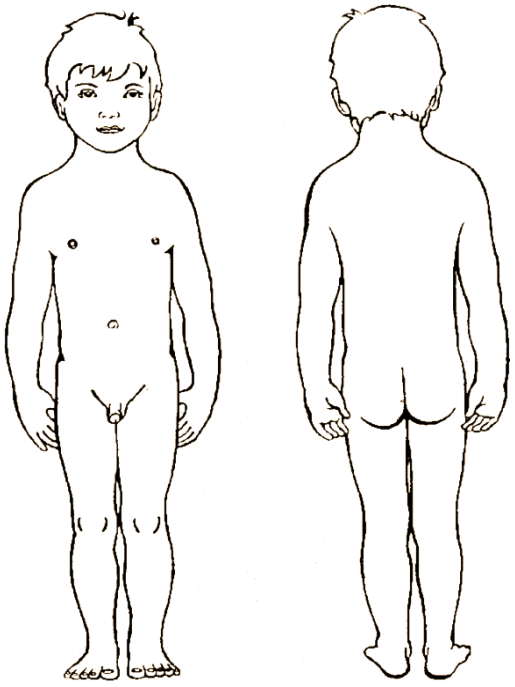
Amount (ml)													
Adverse reaction(s)													

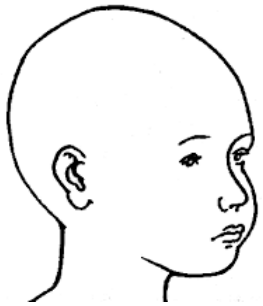
Other treatment

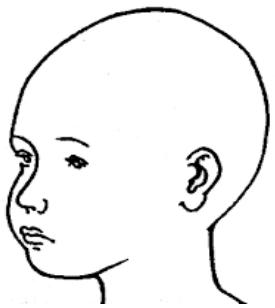
Discharge	Date	Comments
	Time	
	Doctor	
Follow-up		











Hospital Sticker

Dosages

Adrenaline – Pre-treatment

(Avoid in ischaemic heart disease, uncontrolled hypertension and arrhythmias)

Adult*	0,25ml (1:1000) (1mg/ml) SC						
Child	***0,005mg/kg*** → *Dilute 1mg adrenaline to 10ml = 0,1mg/ml*						
	<10kg (0,05mg)	→ Dilute 1mg to 5ml with saline	→ *Dose 0,25ml SC*	**20-30kg** (0,15mg)	→ Dilute 1mg to 2ml with saline	→ *Dose 0,3ml SC*	
	10-15kg (0,075mg)	→ Dilute 1mg to 4ml with saline	→ *Dose 0,3 ml SC*	**30-40kg** (0,2mg)	→ No dilution	→ *Dose 0,2 ml SC*	
	15-20kg (0,1mg)	→ Dilute 1 mg to 2 ml with saline	→ *Dose 0,2 ml SC*	**>40kg* adult dose**	→ No dilution	→ *Dose 0,25 ml SC*	

Antivenom

(Dilute with 200ml Saline – Children maximum 10ml/kg) **S&S = Symptoms and Signs*

Puff adder	40-60ml Polyvalent IV	Repeat 20ml hourly prn
Black mamba	80-100ml Polyvalent IV	Repeat 20ml hourly until S&S* stop
Non-spitting cobras	60ml Polyvalent IV	Repeat 20ml hourly until S&S* stop
Mozambique spitting cobra	100ml Polyvalent IV	Repeat 20ml hourly prn
Boomslang	20ml Monovalent IV	10ml 6 hourly until S&S* stop

Anaphylaxis

IV Fluid Bolus *Repeat if no response (Crystalloid, e.g. Ringers)*

Adult	1-2 litres rapidly
Child	20ml/kg

Adrenaline *Repeat every 5-15 minutes if no improvement (0,01mg/kg IM. 1:1000 = 1mg amp)*

>12 years	0,5ml IM	**ADULT** *With severe anaphylaxis (marked hypotension/ bronchospasm/ cardiac arrest), adrenaline should be given IVI (dilute 1mg amp to 10ml). Titrate 1ml IV against response*	**CHILD** *If no response to IM adrenaline, IV boluses of 0,1 ml/kg of a 1mg adrenaline diluted to 10 ml (with saline) may be given (i.e. 1ml of solution for every 10kg body weight).*
6-12 years	0,3ml IM		
2-5 years	0,2ml IM		
<2 years	0,1ml IM		

Salbutamol *Nebulized bronchodilator, especially severe bronchospasm and if on beta blockers*

>6 years	5mg every 15-20 minutes
<6 years	2,5mg every 15-20 minutes

Promethazine *H1 Antihistamine*

Adult	25mg IM or slowly IV 12 hourly
Child	0,25mg/kg IM (max 25mg) or slowly IV 12 hourly *(Avoid if < 2 years old)*

Hydrocortisone *Corticosteroid*

Adult	200mg slowly IV	
Child	6-12 yrs	100mg slowly IV
	1-6 yrs	50mg slowly IV
	<1 yr	25mg slowly IV

Neostigmine Test

Drug	Adult dose	Child dose	'Shortcut for Children'
Neostigmine	2,5mg IV	0,05mg/kg IV	*2,5mg Neostigmine or 1mg of Atropine each diluted to 10ml, gives a dose of 1ml for every 10kg*
Glycopyrrolate	0,4-0,6mg IV	0,01mg/kg IV	
Atropine	0,5mg IV	0,01mg/kg IV	

Antibiotics

See page 23

CONSERVATION THROUGH EDUCATION

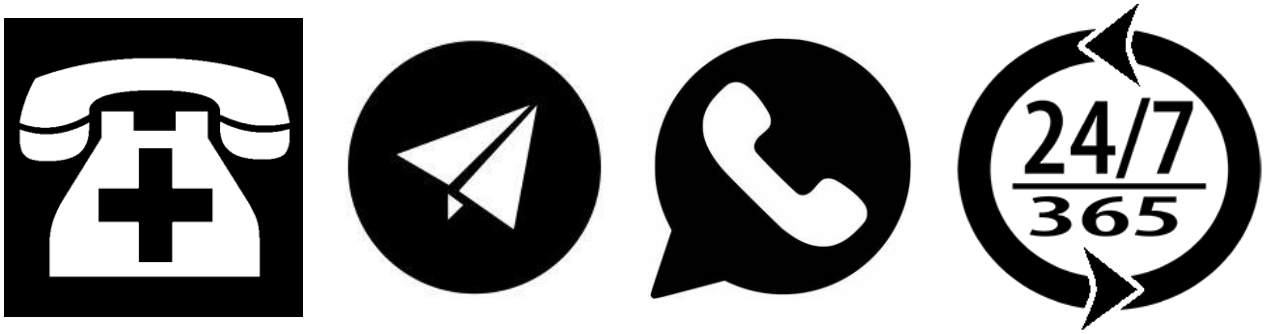
SNAKES OF NAMIBIA

Francois	081 290 0343	(Windhoek)
Kosie	081 447 9117	(Windhoek)
Eugene	081 216 5057	(Windhoek)
Jacques	081 831 8864	(Windhoek)
Leevi	081 248 2602	(Windhoek)
Marco	081 657 7695	(Windhoek)
De Wet	081 034 3057	(Grootfontein)
Curt	081 129 2811	(Katima)
Alex	081 394 0174	(Otavi Region)
Barbara	081 822 8601	(Otavi Region)
Phillip	081 128 0202	(Tsumeb)

francois.theart@gmail.com
WWW.SNAKESOFNAMIBIA.COM

NSIG

NAMIBIAN SNAKEBITE INTEREST GROUP



Mr F (Francois) Theart ***+264 81 290 0343***