

**SOUTHERN AFRICAN INSTITUTE FOR
COLLABORATIVE RESEARCH AND
INNOVATION ORGANIZATION**



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1. CPD PROGRAMME OUTLINE

1.1. Learning objectives

GENERAL OBJECTIVE

The general objective of the training course is to increase the knowledge of medical professionals on snake bite identification, snake venom and toxinology as well as snakebite first aid and treatment.

SPECIFIC OBJECTIVES

After attendance of the training, participants will:

- Learn how to recognise a snakebite in a victim.
- Learn how to assess the signs and symptoms and recognise the venom type and associated syndrome.
- Learn how to assess the severity of the bite, based on signs and symptoms.
- Obtain a clear understanding of snake venom toxinology and its effects on different target sites in the human body.
- Obtain comprehensive understanding of safe and correct first aid measures to be administered in different snake envenomations.
- Learn which basic, stabilising snakebite treatment measures to administer.
- Learn how to effectively monitor snakebite patients.
- Learn what specialised treatment to provide.
- Learn how and when to administer antivenom and to counter potential side effects, including anaphylactic shock and serum sickness.

1.2. Target audience

This training is relevant and important for every group of medical professionals that may deal with snakebite victims. This includes nurses, clinical licentiates, clinical officers, doctors, surgeons and community health care workers.

The CPD training programme aims to increase the knowledge of the participants on the assessment, monitoring and treatment of snakebite victims.

1.3. Mode of delivery

The training is delivered in lecture form and is given in blended form. Although in-person delivery is preferable, the modules can be taught online as well.

1.4. Assessment and evaluation methods

For the assessment of the training participants, two tests are taken. The first test is a multiple-choice test to assess the knowledge of the participants on the topic of the course. The second test comprises four snakebite incidence scenarios whereby participants are asked questions pertaining to the scenarios.

1.5. Duration of the Programme

The training is a one-day course, which can also be administered as a series of eight, one-hour lectures. The maximum number of participants per training course is 20 participants.

CURRICULUM CONTENT

MODULE 1: SNAKE AWARENESS, ID, SNAKE SAFETY

1. PREVENTION OF SNAKEBITES

1.1. RISK FACTORS

There are various factors which increase the risk of a snakebite. They are:

- Season
- Time of day
- Occupation
- Clothing
- Quality of housing
- Human behaviour

During the training, these will be further elaborated upon to give an understanding when and where snakebite incidences are more likely to occur.

1.2. REDUCING RISK OF SNAKEBITE

Over 80% of recorded snakebite cases are on feet and lower legs. Another 10-15% of bites occur on hands and lower forearms. Therefore, there are two main strategies crucial in avoiding snakebite when in an area with high snake numbers.

- Wear sturdy shoes and trousers when in an area where snakes are common.
- Do not put hands in dark areas.

Further elaboration on snakebite preventive measures is given in the training.

MODULE 2: VENOMOUS SNAKES OF ZAMBIA, THEIR VENOMS AND PATHOPHYSIOLOGY OF HUMAN ENVENOMING

2.1. THE VENOM APARATUS

Venomous snakes are snakes that have developed venom and a venom delivery system. Crudely speaking this consists of a venom gland, where the venom is produced and stored, a venom duct, through which venom is guided and a fang.

2.2. CLASSIFICATION OF VENOMOUS SNAKES

For medical purposes, venomous snakes can be classified based on venom type.

There are three venom types along which the venomous snakes can be sorted. These venom types each have their own target site in the body and manifest differently as well (signs and symptoms). These are further discussed in chapter 4.3.

2.3. MEDICALLY IMPORTANT SPECIES IN ZAMBIA

Medically important snake species are divided into three groups.

- Non-venomous snakes which can cause bodily harm.

- Venomous snakes which give a bite that requires medical attention to avoid infections and necrosis.
- Venomous snakes which give a bite that requires urgent medical attention, possibly treatment with antivenom and that could give a potentially lethal bite to humans.

2.4. NON-VENOMOUS SNAKES

Zambia knows two non-venomous snake species that can cause serious wounds. These are the Southern African Python and the Mole Snake. Both are large snakes with many sharp, recurved teeth. All other non-venomous snakes in Zambia are too small to cause a bite that could have medical impact on a human.

2.5. IDENTIFICATION VENOMOUS SNAKES

Venomous snakes cannot be distinguished from non-venomous snakes based on visible features alone, such as shape of the pupil, shape of the head, etc. To establish whether a snake is venomous and if the venomous is potent enough to harm a human being, it is necessary to learn to identify the dangerous snakes (those snakes that can cause harm and whose bite requires medical care) in a particular area. More often than not, a layman won't be able to identify the snake species and the assistance of a herpetologist or other expert may be required.

2.6. SNAKE VENOMS

Snake venom is modified saliva that a snake uses to kill or subdue its prey. It also aids in digestion of the prey. Snake venom is a transparent liquid, usually colourless to light creamy-yellow. On the skin around the bite area, wound fluid may be mistaken for venom.

2.7. VENOM COMPOSITION

In broad terms, snake venom consists of proteins and peptides. More specifically, snake venoms contain a mix of many components and toxins. More than 90% of the dry weight is protein. The most important venom components that lead to clinical effects are enzymes and polypeptide toxins.

The most important venom components that cause serious clinical effects are pro-coagulant enzymes, cytolytic or necrolysing toxins, haemolytic and myolytic phospholipases A₂, pre- and post-synaptic neurotoxins and haemorrhagins. The effects in human bite victims of these component and of the combinations are presented in the training.

2.8. QUANTITY OF INJECTED VENOM AND DRY BITES

The quantity injected at a bite varies greatly. The quantity is determined by several factors: the snake species, the size of the snake and the level of defensiveness among others.

MODULE 3: EPIDEMIOLOGY OF SNAKEBITES IN ZAMBIA

3.1. DETERMINANTS OF INCIDENCE AND SEVERITY

As snakes bite out of self-defence, a snakebite, logically, follows from risky behaviour. This can be deliberate, such as trying to catch or kill a snake or not deliberate, by accidentally approaching a snake, stepping on or too close to it, or inadvertently cornering it in a small area.

The severity of a snakebite depends on many factors.

- Snake related factors – the factors of influence are: type of snake, size of the snake (and thus venom yield), level of defensiveness.
- Victim related factors – age, size, general health of the patient.
- Bite location – where in the body was the victim bitten – bites in the extremities lead to a much later onset of systemic envenomation than bites close to or on the torso.
- Season – in the hot season snakes are more active, eat more, produce more venom and generally inject more venom per bite.

3.2. OCCUPATIONAL HEALTH HAZARD

Logically, those to work in areas and environments where more snakes are active, are also more at risk of snakebite. Rural farmers, game scouts and rangers, mine explorers, etc are more likely to encounter snakes and suffer snakebites than people living and working in towns and cities, working office jobs. Therefore, wearing effective personal protective equipment such as boots, sturdy shoes, thick trousers are helpful in reducing snakebite cases.

3.3. DEATH FROM SNAKEBITE

Death from snakebite is relatively rare and occurs when a snakebite is left untreated or becomes severely systemic before the victim reaches a well-equipped medical facility. The latter is especially the case with neurotoxic envenomation by which the body is slowly 'shut down' and breathing is stopped.

3.4. CONTRIBUTING FACTORS TO DEATH

There are several factors contributing to fatality derived from a snakebite. The most important ones are:

- Severity of the bite.
- Type of venom injected.
- First Aid and Clinical treatment.
- Allergic reaction to the venom, leading to anaphylaxis. Allergic reactions cause fatality much faster than the venom would.

3.5. TIME IS TISSUE

All efforts after a snakebite incidence should be aimed at reducing the time between the incidence and the administration of effective clinical treatment at a health facility.

In some venom types, the time between the bite incidence and death can be as short as 90 minutes (Black Mamba), in other venom types there can be days between. Typically, the venom types that affect the interaction between the nervous system and the skeletal muscles would prove fatal within hours in case of a severe bite, while a venom causing blood-clotting problems, may take 48-72 hours for the patient to pass on.

MODULE 4: CLINICAL ASPECTS OF SNAKEBITE

4.1. WHEN VENOM WASN'T INJECTED

In snakebite cases whereby the victim has not been injected with venom, we speak of a non-venomous bite (a bite by a non-venomous snake) or a dry bite (a bite by a venomous snake which has not injected venom). The two are sometimes difficult to distinguish unless the snake was identified. In either case, the treatment will be fairly similar, depending on severity of the bite: wound treatment and observation (unless the snake is confirmed as non-venomous, in which case the patient can be dismissed after treatment of the wound, if any). In venomous snake bites, even when it is assumed that the bite was a dry bite, the patient is kept under observation for a minimum of 12 hours. In cases, a snakebite victim may present with (serious) neurotoxic symptoms, which are in fact fear induced. It is important to conduct tests to separate panic-induced signs and symptoms from those caused by envenomation.

4.2. WHEN VENOM WAS INJECTED

If venom is injected, signs and symptoms may manifest, depending on the type of venom that was injected and the severity of the bite. Often, but not always, bite marks will be present, showing slightly larger puncture wounds from the fangs. (Or clear, large puncture wounds from large adder bites).

4.3. SYNDROMATIC APPROACH TO SNAKEBITE

Except in cases where a dead snake is brought to a hospital or photos of the snake were taken *and* can be reliably identified by hospital staff or snake experts, the identification of the snake responsible for the bite is usually difficult or impossible. What is needed for appropriate clinical management is the reliable identification of a distinctive clinical syndrome based on epidemiological, clinical and laboratory data.

A syndromic approach is recommended in the majority of cases in which the cause of the bite is not certain. This has been developed and used effectively to guide algorithm treatment with poly-specific antivenoms.

Table 1: Syndromes of envenoming

Syndrome	Description	Syndrome name	Abbreviation
Syndrome 1	Marked local swelling and intense pain	Painful progressive swelling syndrome	PPSS
Syndrome 2	Progressive and descending paralysis	Progressive weakness syndrome	PWS
Syndrome 3	Mild or negligible swelling with incoagulable blood	Bleeding syndrome	BS
Mixed syndrome (1+3)	Combination of marked local swelling and intense pain with incoagulable blood	Combination PPSS and BS	PPSS+BS

4.3.1. Painful progressive Swelling Syndrome

Cytotoxic venom type destroys cell tissue and blood vessels, which is very painful. The disruption of blood flow leads to local swelling around the bite site and progresses up the body (towards the heart).

The cell tissue destruction can lead to infections and necrosis. The swelling, in extreme cases, can lead to hypovolaemic shock. It is the most common of the venom types in serious snake bites in Zambia. The associated syndrome is called Painful Progressive Swelling Syndrome (PPS).

Key symptoms: **local pain and swelling.**

Further signs and symptoms that may occur:

- Skin discolouration
- Blistering
- Necrosis
- Hypovolaemic shock

4.3.2. Progressive weakness syndrome

Neurotoxic venom impedes the functioning of the nervous system. The venom of neurotoxic Cobras blocks the receptors at the neuro-muscular junction (post-synaptic). The venom of the Black Mamba works both post-synaptic and pre-synaptic. The associated syndrome is called Progressive Weakness Syndrome (PWS).

Key symptoms: **overall weakening of the victim.**

Swelling at the bite site is relatively rare in Black Mamba bites, limited in non-spitting Cobras but can be moderate in Forest Cobra bites (due to the relatively strong cytotoxic component in this venom).

Pain at the bite site can be mild or strong, depending on the type of snake.

4.3.3. Bleeding Syndrome

Haemotoxic venom impairs the blood clotting mechanism via consumption coagulopathy. The venom removes (consumes) fibrinogen from the circulation. This causes disseminated intravascular coagulation (the venom attacks clotting factors II and X). The hemorrhagins in the venom compromise the lining of the vascular system. The thinning of the blood and the weakening of the lining of the vascular system leads to internal and external bleeding from any mucous surface of the body. The associated syndrome is called Bleeding Syndrome (BS)

Key symptoms:

- Mild to no swelling at the bite site.
- Mild to no pain at the bite site.
- Symptoms often delayed (up to hours!) or from mucosa only. Active bleeding from bite marks, nose, gums and other mucous membranes.
- Look for signs of respiratory distress or shock.

During the training, participants learn how to identify the venom type injected, the associated syndrome and how to assess the severity. Further, possible systemic effects and long-term effects are taught. This understanding guides the treatment.

4.4. SIGNS AND SYMPTOMS OF VENOM OPHTHALMIA

Venom ophthalmia does not require antivenom administration and doesn't lead to death, unless severely neglected (infections).

Signs and symptoms

- Intense pain in eye (within seconds) and eye redness
- Chemosis (eye lids may swell if the venom affects the eye lids).
- Corneal erosion with possible bacterial complications (indicated by pus)

- Photophobia

MODULE 5: CLINICAL MANAGEMENT OF SNAKEBITES

5.1. STAGES OF MANAGEMENT

There are 3 stages of snakebite management. The first and most effective is the prevention of snakebite. The second and third are the first aid and clinical treatment. The latter two are further discussed in this chapter.

5.2. FIRST AID IN SNAKEBITE

5.2.1. Principles of first-aid

First aid is the immediate action deployed to help someone who is ill or injured before that person is taken to a health facility or before an ambulance arrives. First aid is not medical treatment. Medical treatment is given by a properly trained medical practitioner only. First aid has three goals, all starting with a P (the three Ps of first aid). These are:

- Preserve life
- Prevent worsening
- Promote recovery

Everything that a first aider does, is aimed at fulfilling these three Ps. This is not different in snakebite first aid. With correct first aid measures, the chances for the bite victim to survive will increase and a worsening of their condition is, if not prevented, at least slowed down. However, in snakebite, incorrect first aid is worse than no first aid and many measures, believed to be effective, in fact worsen the condition of the victim. This includes all forms of traditional healing which not only isn't effective but, in most cases, also causes more harm and in all cases delays effective and safe medical treatment.

In the first aid module, participants learn the safe and effective first aid measures to administer per syndrome.

5.3. CLINICAL ASSESSMENT

5.4.1. Rapid primary clinical assessment and resuscitation

If a patient is brought in, a clinical assessment is made and resuscitation performed if necessary. Once the patient is stable, the other methods under "Immediate medical treatment" are applied.

5.3.2. Detailed clinical assessment

- History
 - How did the bite occur?
 - Where on the body is the patient bitten?
 - What was the time of the bite?
 - Can you describe the snake? Is there a photo? A dead snake brought in?
 - What measures have already been taken? Previous treatment by doctor, clinic, traditional remedy?
 - Has the patient been bitten by a snake before? Give details?
 - Has the patient received antivenom before?
- Physical examination
 - Bite marks rarely give a conclusive determination of envenomation. Fangs are often small and may not stand out compared to other teeth, for example.

- Check if there are parts of teeth embedded in the flesh and carefully remove them.
- Ask patient for all signs and symptoms and if possible, times when these started. Do not ask: “does this hurt”, but more open questions such as “how do you feel?”, “what else do you feel?”. Check for any onset of respiratory distress, slurred speech, ptosis and other initial signs indicating neurotoxic envenomation.

5.5. IMMEDIATE MEDICAL TREATMENT

General treatment measures of any snakebite victim.

- Place the patient on cardiac and vital signs monitors.
- In case oxygen saturation is <94% on room air, administer supplemental oxygen. In case of severe neurotoxic envenomation, a bag-valve mask may be required.
- Obtain good intravenous access (instal a canula, drip line and drip bag with normal saline solution (especially in Painful Progressive Swelling Syndrome to curb hypovolaemic shock).
- Prepare resuscitation equipment (airways, ventilation, shock and anaphylaxis)
- Provide analgesia (paracetamol, IV). In case of confirmed Painful Progressive Swelling Syndrome mild opiates such as tramadol can be administered, but not in case of neurotoxic envenomation as such exacerbate the neurotoxic picture). Non-steroidal agents are not administered as they can worsen bleeding risks and renal failure in cytotoxic or mixed-syndrome bites.
- Tetanus toxoid 0.5 ml intramuscular is indicated in all snake bites.
- Limb is slightly elevated (heart level or slightly above).
- Initial treatment with antibiotics is contra-indicated unless cuts have been made by traditional healers.
- In patients with neurotoxic envenomation and progressive paralysis, early intubation and mechanical ventilation is recommended along with administration of antivenom according to the specifications. In severe cases, ventilation may be required for several days, even after administration of antivenom.
- In patients in stable condition and without indications for antivenom administration, a minimum of 12-hour period of observation is recommended.

5.6. MONITORING

A pitfall in snake management is not timely recognising clinical decline. Observation is one of the most crucial aspects of snakebite management. The following monitoring aspects at the emergency unit are recommended:

- Continuous end-tidal O₂ or pulse oximetry.
- Respiratory rate, heart rate, blood pressure and level of consciousness – every 30 minutes
- Peak flow measurements if neurotoxicity is possible – every 30 minutes
- Urine output – every hour
- Longitudinal and circumferential measurements of a swollen limb – every hour

5.7. INVESTIGATIONS / LAB TESTS

Apart from observation of signs and symptoms, several tests are recommended.

- 20 Minute Whole Blood Clotting Test (20MWBCT)
- Full Blood Count
- Blood coagulation test (lab)
- Other Biochemical and haematological tests

5.8. ANTIVENOM TREATMENT

5.8.1. What is antivenom?

Antivenom is the only fully effective medication against snake venom. It is obtained by purifying the immunised blood plasma of inoculated host animals, usually horses. In Zambia, the available and safe antivenom to use is PANAF Premium which is effective in bites from Puff Adder, Gaboon Adder, Black Mamba and all Cobras.

5.8.2. Indications for antivenom treatment

Indications for the use of antivenom are provided by the snake species and the severity of the bite. Therefore, a balance is struck between snake identification and syndromic approach.

Is the snake positively identified as: Puff Adder, Gaboon Adder, Black-necked Spitting Cobra, Mozambique Spitting Cobra, Snouted Cobra, Anchieta's Cobra, Brown Forest Cobra or Black Mamba, then antivenom should be seriously considered.

If the snake is not positively identified, the syndromic approach is taken, using the signs and symptoms to identify the syndrome and its severity.

In the table below the indications for antivenom are presented per syndrome.

Painful Progressive Swelling syndrome (PPSS)	
Extensive or rapidly progressive swelling: if the swelling reaches:	Bite on foot
	Ankle within 1 hour
	Knee within 3-4 hours
	Groin within 8 hours
	Torso
Bite on hand	
Wrist within 1 hour	
Elbow within 3-4 hour	
Shoulder within 8 hours	
Torso	
Swelling progression is > 10 cm / hour	
Progressive Weakness Syndrome (PWS)	
Neurotoxicity	
<u>5 Ps</u>	<u>5 Ss</u>
Pain at bite site	Swallowing difficulties
Paraesthesia of tongue and lips	Slurred Speech
Ptosis	Sweating
Pupillary abnormalities	Secretions
Descending flaccid paralysis	Salivation
If there is 1 P and 2 Ss or 1 S and 2 Ps observed, antivenom should be administered.	
Further, if descending flaccid paralysis has set in or in case of cardiovascular abnormality; marked respiratory effort or lack thereof, hypotension, shock, arrhythmia, abnormal electrocardiogram, antivenom is administered.	
Bleeding Syndrome (BS)	
Spontaneous systemic bleeding	
Incoagulable blood (20MWBCT)	

5.8.3. Inappropriate use of antivenom

Monovalent Boomslang antivenom is produced using the venom of Boomslangs. This antivenom is only effective in the treatment of Boomslang bites.

Polyvalent antivenom is produced using the venom of a group of snakes who can give a potentially lethal bite. The antivenom is only effective against their venom.

- Antivenom should not be used in bites by snakes, other than those mentioned on the package of the antivenom. It will have no effect.
- Antivenom should not be used in mild bites.

- Antivenom should not be used to treat snake venom ophthalmia.
- Antivenom should not be used as a prophylaxis.
- Antivenom should not be administered in lower than recommended doses.
- Antivenom should not be administered by giving a test dosage to check for allergic reactions.

5.8.4. How long after the bite can antivenom be expected to be effective?

Painful progressive Swelling Syndrome

Antivenom is effective to stop the destructive tissue destruction by the venom in the first 5-6 hours after the bite. Thereafter, the damage has been done and isn't reversed by antivenom administration. Antivenom is effective, even after days, if systemic symptoms and complications occur.

Progressive Weakness Syndrome

In severe neurotoxic envenomation, antivenom needs to be administered as quickly as possible as it will be lifesaving. This usually means within a few hours after the bite. However, even longer after the bite, the effects of the venom can be halted and reversed by the administration of antivenom.

Bleeding Syndrome

The monovalent antivenom of the Boomslang can be effective in stopping and reversing the effects of the venom, even days after the bite occurred and with the patient in a critical condition. This antivenom has NO effect on the haemotoxic effects of snakes with a mixed cytotoxic and haemotoxic venom.

5.8.5. Antivenom reactions

Prediction of antivenom reactions

Due to the production process of antivenom and the fact that the medication is derived from horse plasma, the administration of antivenom can trigger adverse reactions in the patient, varying from mild, such as a rash to anaphylaxis and anaphylactic shock.

Further:

If a patient, after prophylactic treatment, has an adverse reaction this reaction can be treated. Thereafter, administration of antivenom can be continued. If a new adverse reaction occurs, further antivenom administration is contraindicated.

Treatment with antivenom and of acute antivenom reactions

During the course, participants learn how to safely administer the correct quantity of antivenom while monitoring for its effect and for adverse responses.

Treatment of long-term adverse antivenom reactions

Serum sickness can occur 1-4 weeks after treatment with antivenom.

Symptoms are nephritis-like: blood in the urine, decreased urine output, swelling of face and (part of the) limbs and high blood pressure. Treatment consists of administration of oral steroids.

5.9. RECURRENCE OF ENVENOMING

Venom can, in some cases, be trapped in the lymphatic system and cause a recurrence of envenomation. Therefore, in bites with envenomation, the patient is advised to be kept under observation at least 12-24 hours after recovery.

5.10. CRITERIA FOR REPEAT ADMINISTRATION ANTIVENOM

Painful Progressive Swelling Syndrome

A second dose of 2 ampoules of antivenom are administered if:

- the swelling continues to progress within 1 hour after the administration of antivenom.

Repeat if necessary.

Progressive Weakness Syndrome

A second dose of 4 ampoules of antivenom are administered if:

- If the neurotoxic symptoms aren't improving within 30 minutes.

Repeat if necessary.

Bleeding Syndrome

A second dose of 1 ampoule of antivenom are administered if:

- If blood remains incoagulable 6 hours after antivenom administration.

Repeat if necessary.

5.11. SUPPORTIVE / ANCILLARY TREATMENT

Supportive and ancillary treatment is species specific.

Gaboon Adder bites

Gaboon Adders have a mixture of cytotoxic, neurotoxic, haemotoxic venom with a cardiotoxic component. The cardiotoxic effects may include Electrocardiogram changes such as a prolonged QT interval, inverted T-waves and supraventricular tachycardia. Supportive treatment may be required and may even include a temporary pacemaker installation to prevent cardiac arrest.

The venom contains a thrombin-like enzyme that depletes serum fibrin levels, rendering the blood incoagulable. It further has severe haemorrhagic activities as it causes widespread damage to the microvasculature. This particularly affects the lungs and gastrointestinal tract.

Puff Adder bites

In severe envenomation, significant haematological effects may manifest. This may necessitate administration of blood products (whole blood, packed red cells, platelets, cryoprecipitate and fresh frozen plasma. In these bites it is advised to monitor with TEG/ROTEM or INR.

Non-spitting Cobras

These are the neurotoxic cobras. In cases of a mild presentation of progressive weakness, where antivenom is contra-indicated or not available, or a positive response to the appropriate dose of AV is not achieved, the administration of glycopyrrolate (0.6 mg IV), followed by neostigmine (2.5 mg IV) every 30 minutes up to a maximum of 10 mg neostigmine over 24 hours, should be considered. Never administer neostigmine in Black mamba bite victims. It will exacerbate the symptoms

Boomslang and Twig Snakes

A TEG test may be conducted when the administration of monovalent antivenom isn't effective in a Boomslang bite or in bites by a confirmed Twig Snake. This test is also useful in identifying coagulopathy in a suspected Boomslang bite before the patient presents symptoms, to aid in the decision to give antivenom. It also aids in assessing the effectiveness of antivenom and guide on further doses. It also guides on the use of plasma products, cryoprecipitate and platelet concentrations. Heparin and antifibrinolytic agents (such as tranexamic acid) are contra-indicated.

5.12. TREATMENT OF THE BITE AREA

Wound management

Wounds are caused by cytotoxic venom or cytotoxic venom components. As the venom is active for 5 to 7 days, wound management is initially conservative and mostly involves observation. No cuts to remove necrotic tissue are made within this period as the boundary between dead and viable tissue is not yet determined.

Bacterial infections

Bacterial infections directly resulting from snakebites are rare and are usually secondary results. Broad spectrum antibiotics are administered if:

- The skin is open.
- Blisters are forming.

- Necrosis sets in.
- If pre-treatment by a traditional healer has included making cuts.

If a bacterial infection occurs, a sample is preferably cultured to determine which antibiotic is required.

Necrosis

Necrosis can occur in cytotoxic bites (Painful Progressive Swelling and Mixed syndrome bites). However, the severity of the bite and the snake species influence the need for surgery. Generally, Puff Adder bites will lead to less extensive, but deeper necrosis compared to bites from Mozambique Spitting Cobras. The latter will produce more extensive, but less deep necrosis. In less serious bites, necrosis may be shallow and will scab off by itself over time.

Compartment syndromes and fasciotomy

Compartment syndromes are very rare in snakebite and restricted to severe envenomation by Puff Adders (<2%) and Gaboon Adders.

A severe snakebite with Painful Progressive Swelling Syndrome will present similarly to compartment syndrome (Puff Adder and Gaboon Adder bites) In South Africa, compartment syndrome has occurred in less than 2% of all bites. To confirm compartment syndrome, a Stryker instrument test is conducted. Alternatively, an ultrasound can give conclusive differentiation between true and pseudo compartment syndrome.

In the course, participants will learn which steps to undertake in case of suspected compartment syndrome.

Thrombocytopenia

The venom of Puff Adders and Gaboon Adders may cause a significant drop in blood platelets. In addition, some components of the venom cause platelet aggregation.

This may result in bleeding, but this is limited, presenting as purpura and ecchymosis.

5.13. REHABILITATION

Rehabilitation is mostly relevant for cytotoxic bites with Painful Progressive Swelling Syndrome. Cell tissue destruction may lead to (extensive) scarring and loss of mobility due to nerve and muscle damage. Rehabilitation mainly consists of physiotherapy to regain as much mobility as possible in the affected limb.

5.14. DISCHARGE ADVISE AND ASSESSMENT

Painful Progressive Swelling Syndrome

If the patient is free of systemic signs and symptoms and remaining wound treatment can be conducted poly-clinically, the patient can be discharged after 12 hours of further observation. If antivenom was administered, alert the patient about the possibility of serum sickness. Once the wound is fully healed, physiotherapy is scheduled.

Progressive Weakness Syndrome

When the patient is fully recovered and free of any neurotoxic signs and symptoms, the patient can be discharged after 12 hours of observation. If antivenom was administered, alert the patient about the possibility of serum sickness and schedule a date for a final check-up.

Bleeding Syndrome

When the patient is fully recovered and the blood is fully coagulable, the patient can be discharged after 12 hours of observation. If antivenom was administered, alert the patient about the possibility of serum sickness and schedule a date for a final check-up.

5.15. MANAGEMENT OF VENOM OPHTHALMIA

The severity of cobra spit ophthalmia mostly depends on the first aid given. The faster the venom was rinsed out with water or any other bland fluid, the less likely any clinical intervention is required.

Treatment consists of:

- Rinsing with clean water
- Examine eye (especially if there 2 or more-hour delay in treatment): slit lamp and fluorescein staining.
- Anaesthetic eyedrops to ease the pain and blepharospasm (usually sufficient)
- If no corneal erosion: antibiotic eye drops or ointment.
- If corneal erosion present: antibiotic eye drops or ointment, mydriatic, eye-pad, daily examinations until cleared.

QUALIFICATION OF THE COURSE DEVELOPER AND TRAINER

QUALIFICATIONS

Name	Marcel van Driel
Profession	Director of Snake Safety Zambia. Snake Safety Zambia is the registered brand name under which MaDri Consultancy Limited delivers the training courses.
Legal status in Zambia	Zambian residency permit holder (NRC: 647823/99/3)
Qualifications	<p>Training certificates</p> <ul style="list-style-type: none"> • Advanced Snakebite treatment Snakebite Assist, Johannesburg, South Africa 2023 • Master herpetologist Amphibian Foundation, USA, 2022 • Snakes and Snakebite treatment African reptiles and venom, Johannesburg, South Africa 2020 <p>Achievements in the field of snakebite</p> <ul style="list-style-type: none"> • Developed the <i>National Guidelines for the Prevention and Management of Snakebite in Zambia</i> Ministry of health 2024 • Developed snakebite input for the <i>Zambian National Medical Guidelines</i> Ministry of health 2024 • Trained 28 Clinical Officers in snakebite treatment CHAZ 2023 • Trained 34 Clinical Officers and Community Healthcare Volunteers in snakebite management OnCall Africa 2024 • Trained 12 medical Doctors in snakebite management Several doctors from private hospitals 2024 • Trained 30 Clinical officers in Kalumbila area Trident Foundation Limited 2023 • Trained 80 staff in Snake Safety and snakebite treatment Trident Foundation Limited 2022 and 2023 • Trained 42 staff in Snake Safety and snakebite treatment First Quantum Minerals limited 2023 • Trained 40 staff in Snake Safety and snakebite treatment Africa parks 2024 • Trained 60 staff and community members in Snake Safety and snakebite first aid Mushingashi Conservancy 2024 • Trained 83 staff and community members in Snake Safety and snakebite first aid Mushingashi Conservancy 2025 • Trained 60 staff in snake safety and snakebite first aid Conservation Lower Zambezi 2024 • Trained more than 400 individuals in snake safety and snakebite first aid Snake Safety Zambia 2022-2025 • Advised medical professionals in more than 450 snakebite cases on humans and pets in Zambia, Malawi and Zimbabwe 2023-2025 <p>Publications</p> <ul style="list-style-type: none"> • Van Driel, M. (2023) <i>“Snakes and First Aid in Snakebite in Zambia”</i> (ISBN: 978-9982-18-021-4) • Berg, P. et al. (2024) <i>“Snakebite envenoming in Africa remains</i>

		<p><i>widely neglected and demands multidisciplinary attention”</i></p> <p>Further qualifications in attached CV</p>
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