National Snakebite Management Guidelines

Kingdom of Eswatini

2021

World Health Organization Eswatini

eswatini antivenom foundation

Foreword

The Ministry of Health (MoH) is committed to implementing the World Health Organization's (WHO) comprehensive approach towards the total elimination of key neglected tropical diseases (NTDs). It is estimated that 500 000 to 1 million deaths are recorded annually because of these diseases. Some of the NTDs cannot be eliminated and instead can be controlled and or prevented. For that reason, the WHO has taken a serious stance and has further encouraged and assisted countries in developing comprehensive strategies to eliminate some of them.

Snakebites are one of the many NTDs that the MOH has noted to pose a serious threat to society. Our annual statistics indicate that our facilities reported over 920 such incidents in the year 2019 -2021. There is also an observation that there is a greater need to improve our case management capabilities, health promotion and surveillance on the issue of snakebites.

It is on this basis that I am greatly honoured to present the Ministry's maiden edition of the National Snakebite Management Guidelines. As aforementioned, snakebite envenoming is a major medical problem in the developing world and in 2018 WHO recognised it as a neglected tropical disease. In 2019, WHO launched the Snakebite Prevention and Control Strategy, aiming to reduce deaths and disabilities from snakebite by 50% by 2030. This document is a culmination of efforts from various experts that form part of the case management advisory group on NTDs in Eswatini. These experts were drawn from the private and public health facilities, academia, external experts, non-governmental organisations, and the WHO country office which has been instrumental in developing these guidelines, the strategy and technical guidance.

Upon realising the devastating effects and damage of this scourge on our society, the Ministry has taken the initiative to make snakebite one of the notifiable conditions in the country and should this policy change be fully implemented, Eswatini will be one of the first countries in the world to achieve this important milestone, in line with the WHO Strategy on snakebite. This will allow the Ministry to fully understand the extent of the snakebite burden in the country. In total fulfilment of this policy shift and strides taken, the Ministry has further committed itself towards ensuring that community health promotion on snakebite prevention and first aid, regional trainings for paramedics, clinicians, nurses and pre-service educators on the management of snakebite shall be carried out soon after the circulation of these guidelines, with the aim to reduce the national burden of snakebite morbidity and mortality.

This document will serve an important tool towards ensuring that our population has access to quality snakebite treatment and care, and thus allowing the Ministry to achieve the objectives of the National Health Sector Strategic Plan 2020-2023 and National Development Strategy 2022. The guidelines will be vital in guiding clinicians in effectively discharging their duties of care and treatment to patients bitten by snakes at all levels of the healthcare system. I am therefore confident that this publication will prove to be of great assistance to all health care workers as it provides the standards and recommendations to move Eswatini forward in achieving a vision of zero deaths and disabilities from snakebite. To achieve this, it is of paramount importance that a multidisciplinary team approach towards ensuring delivery of quality care and treatment services and efficient use of limited resources for the best treatment outcomes for our snakebite victims is embarked upon.

Finally, I would like to take this opportunity to thank the Neglected Tropical Diseases Programme for their astute leadership and guidance in the whole process, similar accolades are deservedly extended to the Snakebite Treatment Task Team and to the efforts of all those who worked on this pivotal document. Special mention and gratitude go to the Eswatini Antivenom Foundation who have over the years been

very supportive to the Ministry, have always rung the bell whenever challenges in the management of snakebites and availability of antivenom have arisen and have further carried out an extensive amount of work in saving lives and limbs from snakebite in the country.

I also wish to extend the Ministry's gratitude to the WHO for their continued and sustained technical and financial support towards the development and implementation of these guidelines.

Dr Simon Zwane
Principal Secretary, Ministry of Healthy

Acknowledgements

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The Ministry of Health greatly appreciates the technical and financial support that has been provided towards the development of these guidelines by the WHO, under the leadership of Dr. Cornelia Atsyor. Special appreciation goes to Dr. Kevin Makadzange (WHO) for his diligent work in the coordination and development of these guidelines.

Specifically, the following lists show the names of all those who worked tirelessly on these guidelines, without whose input these guidelines would not have been possible.

Advisory and Leadership

- Dr. Cornelia Atsyor, WHO Representative, WHO / Eswatini
- Dr. Kevin Makadzange, NTD Focal point, WHO / Eswatini
- Dr. Simon Zwane, Principal Secretary, MoH
- Dr. Vusi Magagula, Director of Health Services, MoH
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- Quinton Dlamini, Programme Manager, MoH – Neglected Tropical Diseases Programme / Malaria
- Sipho E. Shongwe, Chief Environmental Health Officer
- Thea Litschka-Koen, Founder and Chairperson, Eswatini Antivenom Foundation

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- Jerry Simelane, Matron, Good Shepherd Hospital
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- Dr. Sara Padidar, Lecturer, University of Eswatini
- Mudipanu Mbinga, Pharmacist, MOH/CMS
- Dr. Harry Van der Wal, Chief Medical Officer, The Luke Commission
- Echo Van der Wal, Managing Executive Director, The Luke Commission
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- Dr. David Williams, Technical Officer for antivenoms, WHO / Headquarters

Dr. Vusi Magagula
Director of Health

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Abbreviations

20MWBCT	20-minute whole blood clotting test
AV	antivenom
B	bleeding syndrome
BP	blood pressure
EAF	Eswatini Antivenom Foundation
ECG	electrocardiogram
GCS	Glasgow coma scale
HR	heart rate
INR	International Normalized Ratio
IV	intravenous
MOH	Ministry of Health
NSAIDS	non-steroidal anti-inflammatory drugs
NTD	neglected tropical disease
PPS	painful progressive swelling syndrome
PW	progressive weakness syndrome
RBS	random blood sugar
RR	respiratory rate
TID	three times a day
U&E	urea and electrolytes
WHO	World Health Organization

Emergency Contact Numbers to Assist with Snakebite

EVERY SNAKEBITE IS A MEDICAL EMERGENCY, AND IT IS NOTIFIABLE.

IMPORTANT PHONE NUMBERS	
Neglected Tropical Diseases Programme, MOH	+268 25053804 or 76286972
Eswatini Antivenom Foundation	+268 7602 5088

REFERRAL CENTRES (24 hours a day)	
Good Shepherd Hospital	+268 7622 0709
Hlathikulu Government Hospital	+268 2217 6327
Mbabane Government Hospital	+268 2411 8000
Raleigh Fitkin Memorial Hospital	+268 2508 4000 or 7845 9299
The Luke Commission	+268 7613 8814 or 7641 7297

EMERGENCY PREPAREDNESS RESPONSE	
National Health Toll Free line	977
SwaziCo Medics - note, this paramedic service requires users to pay a fee	0911

1. Overview of Snakebite Management

Snakebite is a medical emergency, and a multidisciplinary team approach is crucial for good treatment outcomes. Managing snakebite follows a syndromic approach.

This section has been developed as an overview and quick reference for health care workers to understand what they need to do when a snakebite patient arrives. Comprehensive information on how to manage and care for snakebite patients is detailed in Sections 2-6 of this document.

1.1 Snakebite management at the clinic

Aim: urgently stabilise and safely transfer the patient to a facility that can provide comprehensive snakebite treatment

✔ Vital signs
- BP, GCS, heart rate, respiratory rate, oxygen saturation
- RBS

✔ Stabilize the patient
- Airway and breathing: if a patient is in respiratory distress: Ambu bag, oxygen
- Circulation: Insert IV line and give IV fluids into unaffected limb
- If the patient has a tourniquet (see page 18)
- If the patient is in pain, give analgesia (see page 33)
  - Do not administer NSAIDS
- Mark the bite site and the swelling progress, remove constricting clothes and jewellery

✔ If the patient has venom in their eye
- Wash the eye with water.

✔ Transfer the patient (see page 27)
- Call 977 (See also page 2 for more telephone numbers)

1.2 Snakebite management at the health centre or hospital

When a patient arrives, take vital signs and ensure the patient is stable. All snakebite patients need to be admitted as a minimum to a high dependency bed for a minimum of 24 hours

✔ Detailed history

Aim: to determine the snakebite syndrome and if there are any danger signs
- "In which part of your body have you been bitten?"
- "What time were you bitten?"
- "Where is the snake that bit you?" or "What did the snake look like?"
- "How did the bite happen?"
- "How are you feeling now?"
- "Have you ever been bitten before, and did you receive antivenom?"
- Previous medical history / allergies / do you work with snakes?
- Any first aid applied for the snakebite prior to arrival to health facility, how long ago?
  - If a tourniquet has been applied see page 18 before handling the tourniquet

See more on page 6 for further information on history taking in snakebite patients.

✔ Examination and Diagnosing the Clinical Syndrome

Aim: to determine the snakebite syndrome and if there are any danger signs

Table 1*: *Summary of clinical syndromes and common symptoms, associated with venom type and the snakes responsible, as well as indications for administration of antivenom

Clinical syndrome	Venom type	Snakes usually responsible	Most common symptoms	Antivenom indication
Progressive Weakness (PW)	Neurotoxic	• Black mamba, • Snouted cobra	• ophthalmoplegia, • progressive descending paralysis, • respiratory distress, etc	**YES,** polyvalent
Painful Progressive Swelling (PPS)	Cytotoxic	• Mozambique spitting cobra, • Puff adder	• intense pain, • swelling, • discolouration, • bruising, • blistering	**YES,** polyvalent
Bleeding (B)	Haemotoxic	• Boomslang, • Vine snake	• bleeding at the bite site and other mucus membranes	**YES,** monovalent
Mixed Progressive Weakness and Painful Progressive Swelling (PW & PPS)	Neurotoxic and cytotoxic	• Snouted cobra • Rinkhals,	• See PW and PPS as above	**YES,** polyvalent
Mixed Painful Progressive Swelling and Bleeding (PPS & B)	Cytotoxic and haemotoxic	• Puff adder	• As above, plus • extensive swelling and blistering with bleeding	**YES,** polyvalent
Mild to Moderate swelling	Cytotoxic	• Night adder • Stiletto snake	• Swelling not crossing more than one joint (e.g., below knee, below elbow)	**NO**
Asymptomatic	Dry bite or non-venomous snakes	• Non-venomous snakes	No symptoms	**NO**

See page 7 for further information about examining a snakebite patient and diagnosing the clinical syndrome.

✔ Investigations (see page 17)

Aim: to determine if there is bleeding syndrome, and establish baselines

- 20-minute whole blood clotting test (20MWBCT)
- Other tests

✔ Administer antivenom (see pages 21-22)

Aim: to neutralise the venom in the patient's body, and reduce morbidity and mortality from snakebite

- Preparation
- Premedication
- Administration slow IV push
- Patient monitoring for a minimum of 48 hours
- Treatment of adverse events and anaphylaxis

✔ Supportive treatment

Aim: to reduce short to long term morbidity associated with snakebite

- Acute (refer to page 33 for more details)
    - Ventilation
    - Cardiovascular
    - Analgesia
- Ancillary (see page 30 for further details)
    - Wound care
    - Physiotherapy and occupational therapy
    - Psychotherapy

□ **If no antivenom available (see pages 27-29)**

□ Venom Ophthalmia (see page 33)
- One drop of adrenaline (1 in 1000) applied to the eye
- Rinse eye with water
- Apply antibiotic eye ointment
- Refer patient to ophthalmologist

2. Detailed Clinical Assessment and Species Diagnosis

1.1 History taking

A precise history of the time and circumstance of the bite and the progression of local and systemic symptoms and signs is of the utmost importance. This allows you to determine the snakebite syndrome and identify any danger signs.

Initial questions to ask

"In which part of your body have you been bitten?"

- Examine where the patient points. There may be evidence that the patient has been bitten by a snake (e.g., fang marks), with signs of local envenoming (e.g., local swelling, bruising or continuing bleeding from the fang punctures).
- The snake may not have been recognized by the victim, if it occurs at night during sleep, or in the dark, or in water. In such cases, suspicion of the diagnosis will depend on typical signs such as fang puncture marks, progressive swelling, bleeding gums or descending paralysis.

"What time where you bitten?"

- Assessment of the severity of envenoming depends on the length of time between the actual bite and when the patient seeks treatment.
- The patient might seek treatment so soon after the bite that symptoms and signs of envenoming have not yet developed. Or the patient may arrive so late after the bite that the only signs are of late complications of envenoming (e.g., gangrene, pneumonia, renal failure, coma).

"Where is the snake that bit you?"

- The snake responsible for a bite may be killed and brought to hospital with the victim.
- If the snake is available, its identification can be extremely helpful but only if there is someone competent who can identify the snake.
- For assistance with snake species identification contact EAF on 76025088.
- If it is obviously a harmless species (or not a snake at all), the patient can be quickly reassured, and discharged from hospital immediately.

"What did the snake look like?"

- Descriptions of the snake by bite victims or onlookers are often unreliable and misleading but it is worth asking about the snake's size, colouring, markings, and behaviour.

"How did the bite happen?"

The circumstances of how the bite occurred and the time when it happened can also suggest a particular species:

- Bites inflicted on sleeping persons at home at night are likely to have been caused by Mozambique spitting cobras,
- Bites in and near rivers, lakes and marshy areas are also most likely to be caused by Mozambique spitting cobras,
- Bites at night are generally caused by Puff adders or Mozambique spitting cobras,
- Black mamba and Night adder bites usually occur during the day
    - despite its name the Night adder usually bites during the day,
- Stiletto snake bites often occur after heavy rainfall.

"How are you feeling now?"

- The patient's current symptoms can point to what type of envenomation the patient is presenting with (for example: faintness or dizziness indicating hypotension or shock; breathlessness indicating incipient respiratory failure).
- See pages 9-13 for a full list of symptoms

"Have you ever been bitten before, and did you receive antivenom?"

- If the patient has been bitten before he/she may have an allergic reaction to the **VENOM**. This must not be confused with anaphylaxis as urgent and large quantities of AV will be required.
- If the patient has received antivenom before, there is an increased risk of anaphylaxis, and the patient should be more closely monitored when receiving antivenom.

Previous medical history, known allergies and people who work with snakes

- Diabetes and HIV can influence wound care and management.
- Existing respiratory conditions (e.g., asthma, TB, COPD) can affect how the patient needs to be ventilated.
- A thorough drug history should be taken.
- Patients who are currently taking anticoagulants (e.g., warfarin, aspirin) could influence clinical presentation and / or blood test results.
- Patients known to have allergic conditions (e.g., penicillin, eczema) should be more closely monitored for adverse events when receiving antivenom.
- People who work with snakes are more at risk of having a severe allergic reaction to the VENOM, because of frequent exposures to snake venoms.

First aid or any treatment already given

- Duration of tourniquet application needs to be determined and any other first aid treatments including traditional and herbal remedies need to be ascertained, as these can influence the clinical presentation.
- There are no known interactions of antivenom with other medicines and herbal or traditional remedies.

1.2 Examination of the patient

A thorough examination of the patient is crucial to determine the progression of local and systemic symptoms and signs and identify any danger signs.

1.2.1 Vital signs

- ✔ Blood pressure
- ✔ Respiratory rate
- ✔ Pulse rate
- ✔ Oxygen saturation
- ✔ Temperature
- ✔ Random blood sugar
- ✔ Glasgow Coma Scale (GCS)
- ✔ 20-minute blood clotting test (20MWBCT, see page 17 for details).

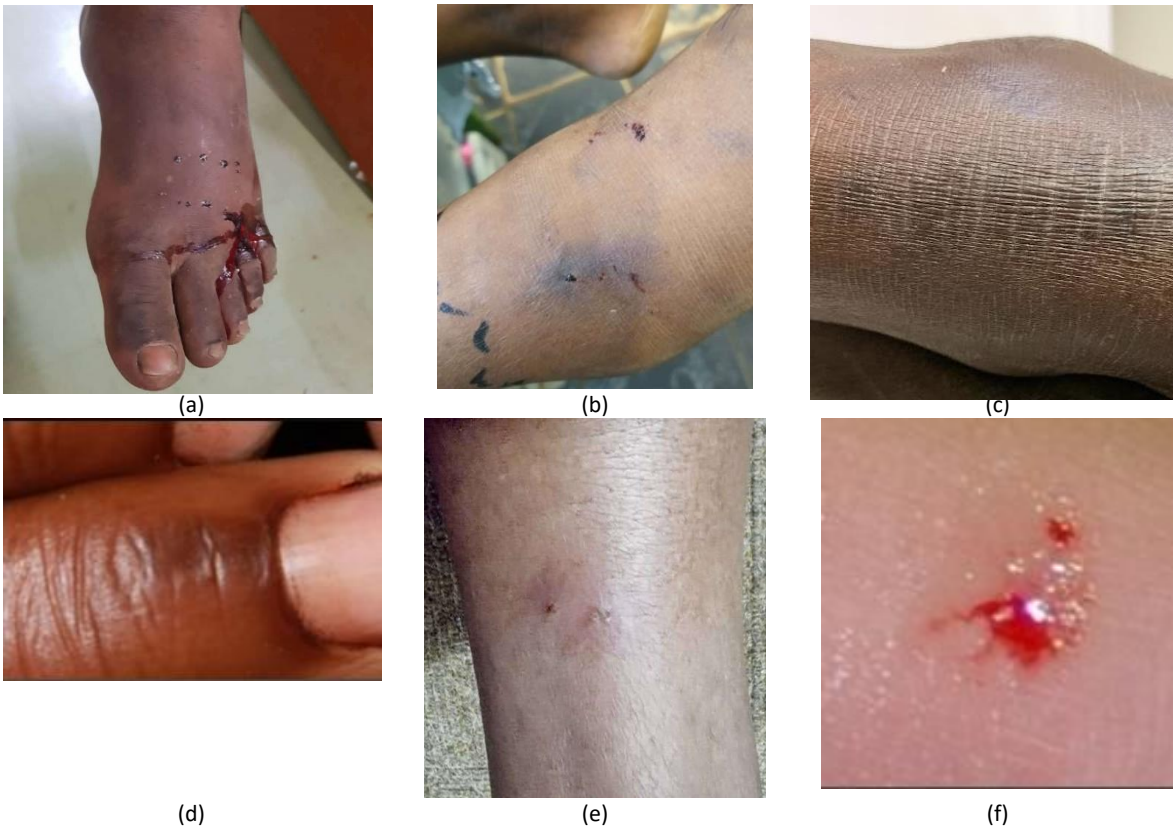
Table 2: Reference range for normal vital signs

Normal Vital Signs				
Age	HR (beats per min)	BP (mmHg)	RR (breaths per min)	SPO_2
Premature	120-170	55-75/35-45	40-70	
0-3 month	100-150	65-85/45-55	35-55	
3-6 month	90-120	70-90/50-65	30-45	
6-12 month	80-120	80-100/55-65	25-40	>94%
1-3 years	70-110	90-105/55-70	20-30	
3-6 years	65-110	95-110/60-75	20-25	
6-12 years	60-95	100-120/60-75	14-22	
>12 years	55-85	110-135/65-85	12-18	

1.2.2 Bite site examination

The absence of visible fang marks does not exclude snakebite. Often, with the black mamba, there is no evidence of a distinct puncture wound, and a tiny scratch from a Boomslang is enough to cause a serious reaction as the venom is extremely potent. There may be slight bruising, or the puncture wound may resemble a pimple.

Two or more distinct, separate puncture marks suggests a bite by a venomous snake. The pattern of fang punctures is very rarely helpful as marks made by accessory fangs, palatine maxillary and mandibular teeth may complicate the pattern and there may have been multiple bites and scratches. The greater the distance between the fang marks, the larger the snake.

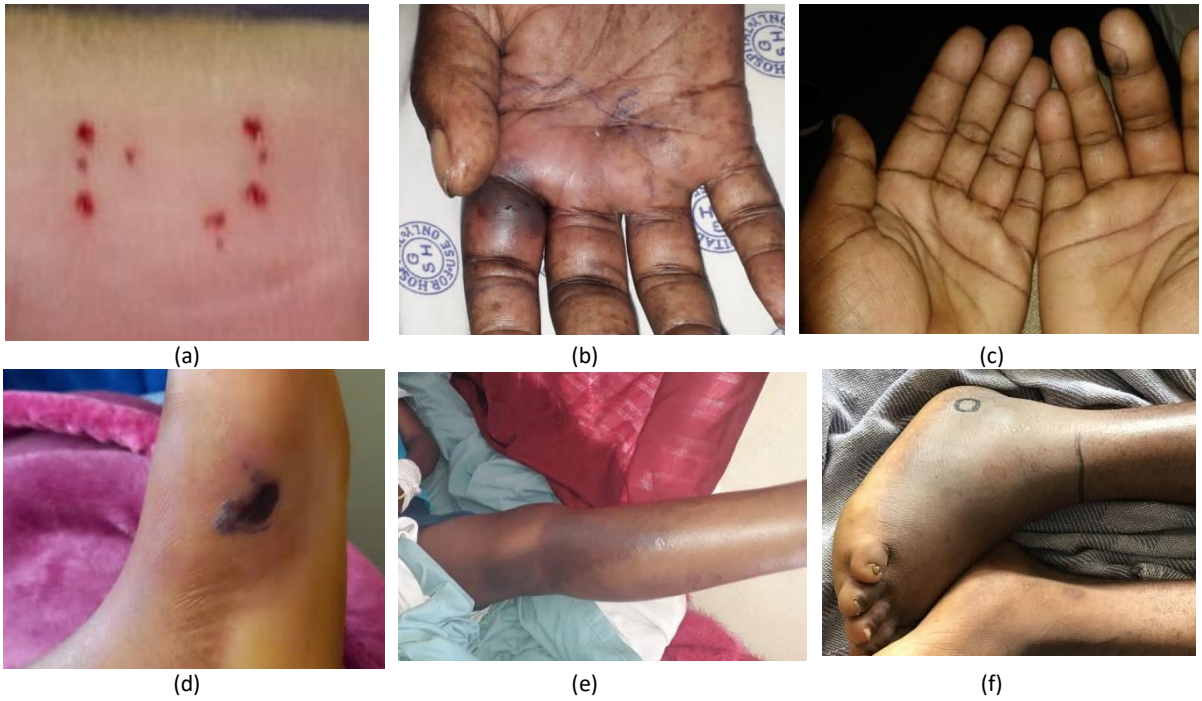


(a) (b) (c)

(d) (e) (f)

Figure 1: Bites from highly venomous snakes, all pictures taken in Eswatini; (a) bite from a Puff adder; (b) two clear fang marks by a Mozambique spitting cobra; (c) severe envenomation by a Black mamba. No clear fang

mark, only slight bruising; (d) severe envenomation by a Black mamba the bite site only showing a tiny spot with no bruising; (e) dry bite by a Boomslang (f) severe envenomation by a Boomslang



(a) (b) (c)

(d) (e) (f)

Figure 2: Bites from non-venomous and venomous snakes, all pictures taken in Eswatini; (a) typical bite from a non-venomous snake; (b,c) typical bite from a Stiletto snake; (d) bite from a stiletto snake 3 days after envenomation; (e,f) typical bite from a Night adder.

1.2.3 Symptoms of neurotoxicity

Snakebite neurotoxicity presents as a descending paralysis. In Eswatini, these bites are caused by the Black mamba and Snouted cobra. Respiratory muscle paralysis with imminent respiratory failure is suggested by dyspnoe, distress, restlessness, sweating, exaggerated abdominal respiration and cyanosis. Coma is usually the result of respiratory or circulatory failure. **Such patients will die unless ventilated artificially.**

1.2.3.1 Symptoms of neurotoxicity from Black Mamba bites

Bites usually occur during the day, and symptoms present rapidly.

General

- Pain at the bite site can be absent, minimal, or mild.
- Swelling will be absent, minimal to mild in most cases.

Early signs symptoms:

- bitter taste in the mouth,
- paraesthesia of the tongue, lips, mouth and the bite site,
- severe thirst and dry mouth, increased / severe **sweating**,
- nausea and vomiting, dull pain in the abdomen,
- increased salivation which might be very thick and "stringy", hoarseness,
- chest tightness (similar to asthma),
- flushed face, **gooseflesh**.

Any of the early signs and symptoms of neurotoxicity may still appear despite the application of a tourniquet.

Intermediate symptoms:

General weakness, ptosis, slurred speech,

- dysphagia,

- inability to open or clench the jaw,
- inability to protrude tongue,
- difficulty to cough,
- **fasciculations**,
- broken neck syndrome, flaccid paralysis - limbs hang limp,
- respiratory distress or weakness, headache, ataxia

Late signs and symptoms:

- Light-headedness, vertigo, dizziness, warm / cold skin, shock, hypotension, pupillary abnormalities,
- paradoxical respiration,
- hypotension, tachycardia, bradycardia,
- victim is conscious but cannot respond,
- altered mental state causing hallucinations and confusion,
- abnormal or morbid excitement,
- paralysis of sphincters causes incontinence of urine and faeces,
- quiet period with a fixed stare before coma sets in, recurrent episodes of paralysis despite antivenom treatment.
- **As respiratory distress increases, the patient becomes anxious and restless, sweaty, and cyanosed and will die unless ventilated artificially.**

1.2.3.2 Symptoms of neurotoxicity from Snouted cobra bites:

Bites are uncommon, and neurotoxicity presents slightly differently and later than with bites caused by the Black mamba.

Early signs symptoms:

- Typically, there is local pain and swelling, much more so than with the black mamba, which may involve more than half the bitten limb. (Blisters may form many days later but there will be little or no necrosis).
- Vomiting and continuous gagging is an early systemic symptom.
- Very dry mouth,
- Classical neurotoxic symptoms appear as early as 30 minutes after the bite and can evolve to the point of fatal respiratory paralysis within 2-16 hours of the bite, despite the use of antivenom and mechanical ventilation.

Intermediate symptoms:

- There are no specific intermediary symptoms.

Late signs and symptoms:

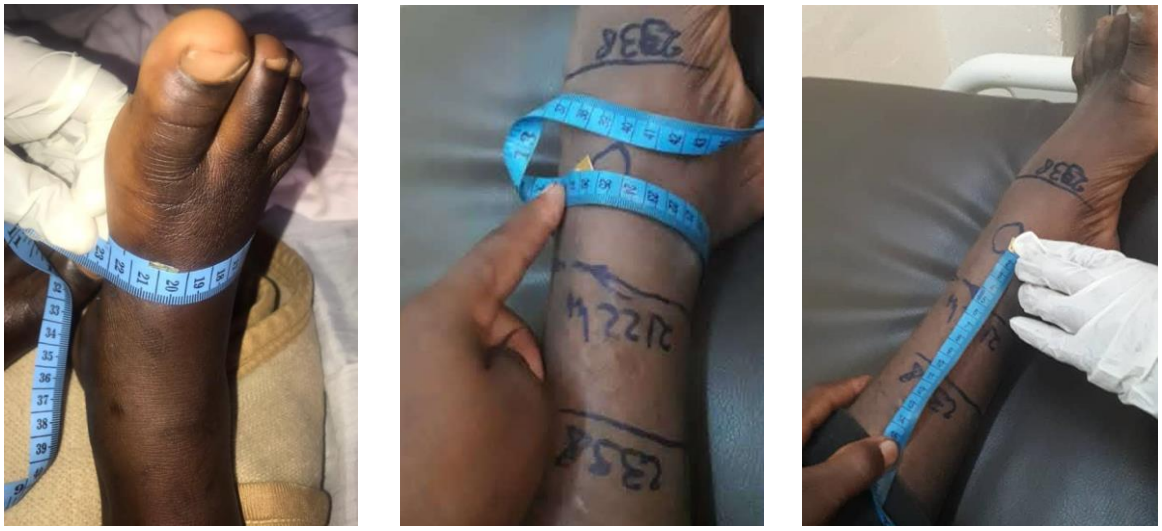
- There are signs of progressive descending paralysis, starting with ptosis, external ophthalmoplegia (causing diplopia, i.e., double vision).
- Weakness of the muscles innervated by the cranial nerves cause the victim to be unable to open the mouth, clench the jaws, protrude the tongue, swallow, protect the airway from secretions, speak, flex the neck, and eventually cannot breathe.
- When the respiratory muscles become affected, the pattern of breathing is initially abdominal or “paradoxical” (the abdomen expands during inspiration due to contraction of the diaphragm).
- **As respiratory distress increases, the patient becomes anxious and restless, sweaty, and cyanosed and will die unless ventilated artificially.**

1.2.4 Symptoms of cytotoxicity

Cytotoxicity usually presents with **pain and swelling**, with or without bruising, bleeding, or blistering. Local swelling, caused by cytotoxic snakes, like the adders and spitting cobras, are usually visible within two hours of the bite, but there have been exceptions to this rule.

The following two steps are crucial in differentiating between severe cytotoxicity (painful progressive swelling) and mild to moderate swelling:

Step 1	Immediately and clearly draw a ring around the bite site with a permanent marker and record the time. Remove any constricting clothes or jewellery. For tourniquet removal (see page 18)
Step 2	The patient should be monitored every 30 minutes until the swelling stops. Record the symptoms as well as the progress of swelling and the time.



(a) (b) (c)

Figure 3: Record progress of swelling every 30 minutes, even after AV administered; (a) measure the circumference of the unbitten limb; (b) measure the circumference of the bitten limb; (c) measure and mark the progress of the swelling over time.

1.2.4.1 Symptoms of cytotoxicity from Mozambique spitting cobra bites:

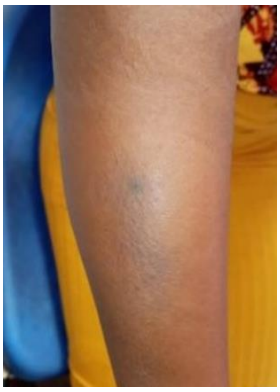
Local swelling and discolouration are often the earliest signs of envenoming. This area will later be depressed compared with the swelling around it. Blisters are formed around the darkened necrotic area approximately 72 hours after the bite. There may be "skipping legions", areas of necrosis separated by strips of apparently normal skin caused by proximal spread of venom in lymphatic vessels. Patients may become drowsy due to hypovolaemic shock but swelling may be caused or aggravated by a venous tourniquet or traditional remedies.

1.2.4.2 Symptoms of cytotoxicity from Puff adder bites:

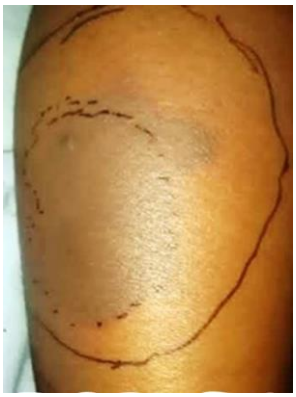
In addition to the above symptoms for Mozambique spitting cobra, a bite from a Puff adder may present with significant blistering, bruising, or bleeding / oozing at the bite site in addition to significant swelling. General shock (due to extravasation and bleeding) usually develops insidiously and if unnoticed and untreated, could result in death. This sudden, and often fatal collapse is frequently found in a patient who seemed to be "recovering and doing quite well". Patients may become drowsy due to hypovolaemic shock.

Table 3: Differentiating Painful Progressive Swelling (PPS) from Mild to Moderate Swelling

	PPS and bites that can lead to necrosis	Mild to Moderate Swelling
Bite specifics	● Bites on fingers or toes (with swelling) ● Bites on limbs of babies and small children (with swelling)	
Swelling	● Extensive swelling (more than half the bitten limb) ● Rapidly progressive swelling, defined as: ○ Swelling extends more than 5 cm per hour. ○ Swelling of the whole hand or foot in 1 hour after envenomation. ○ Swelling extends to elbow or knee in 3-4 hours after envenomation. ○ Swelling of whole limb in 8 hours after envenomation.	● Progress less than 5 cm / hr ● Mild swelling: ○ Localised to bite site, and ○ does not cross any joint ● Moderate swelling ○ swelling does not cross more than one joint
Skin	● Discolouration, ● bruising or ● blistering of the skin	● No discolouration or blistering **Note:** Stiletto snake bites are classified as mild to moderate, but can cause discolouration and a small blister at the bite site (see Figure 2).



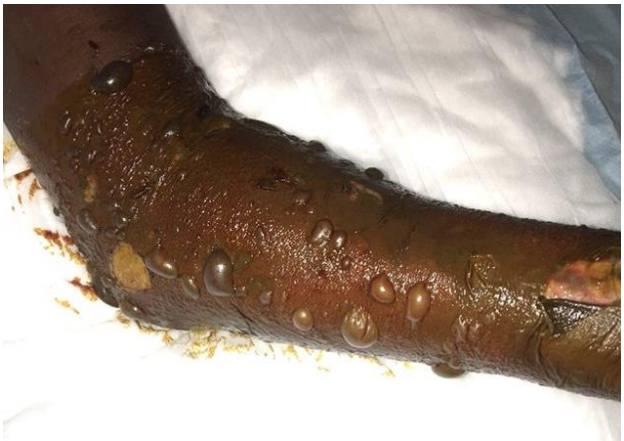
(a)



(b)

(c)

(d)



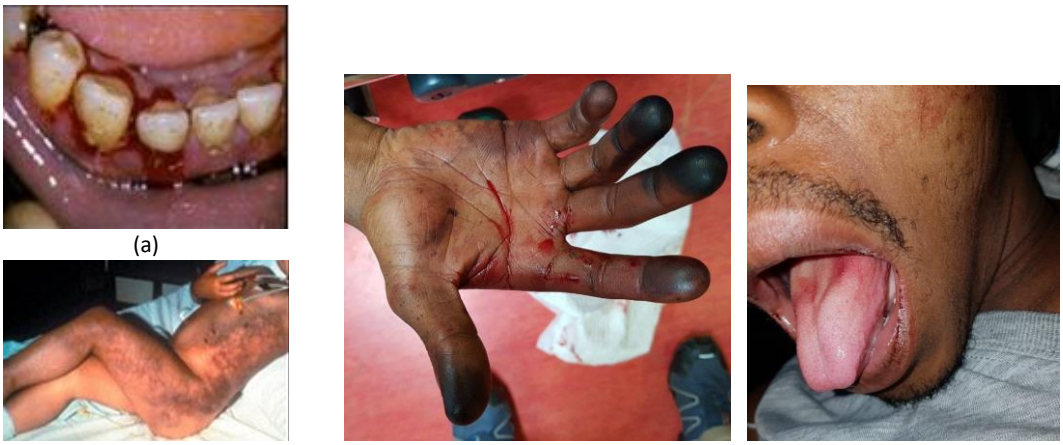
(e)

Figure 4: All pictures taken in Eswatini; (a) Mozambique spitting cobra 2 hours after envenomation. Swelling, typical bruised area, no bleeding from bite site; (b) Mozambique spitting cobra 12 hours after envenomation. Typical bruised area "dam" with blisters forming around the discoloured area; (c) Mozambique spitting cobra bite 5 days after envenomation with clearly defined necrotic area and blisters around the typical "dam"; (d) Puff adder bite 5 hours after envenomation. Typical random blistering with bleeding from the blisters and bite site; (e) severe Puff adder bite 4 days after envenomation with random blisters on the bitten limb.

1.2.5 Symptoms of haemotoxicity

Symptoms and signs of severe systemic envenoming from the two haemotoxic snakes (Boomslang and Vine snakes) **can be delayed for 15 hours or more**.

- Most often there is negligible local swelling.
- **Main symptom: Persistent bleeding** from the fang marks, other recent wounds and venepuncture sites suggest that the blood is in-coagulable (haemotoxic envenomation by the Boomslang or Vine snake).
    - The gums should be examined thoroughly as these are usually the first sites of spontaneous systemic bleeding.
    - Perform 20MWBCT (see page 17) to determine if blood is incoagulable. In this situation, contact EAF: 7602 5088 for the monovalent antivenom.
- **Other symptoms** can include nausea, vomiting, colicky abdominal pain, headache, bleeding from old and recent wounds such as venepuncture, **bleeding from the gums and nose**, hot and cold fever, increased sweating, spontaneous gingival bleeding, epistaxis (nosebleed), haematemesis (vomiting blood), melaena (black "tarry" faeces associated with gastrointestinal haemorrhage), subarachnoid or intracerebral haemorrhage, and haematuria (blood in urine).
- **Late signs and symptoms:** Extensive **ecchymoses**; mental confusion, yellow vision due to blood in the eyes, hypotension, multiple organ failure, convulsions, unconsciousness, and coma.



(a) (b) (c) (d)

Figure 5: Haemotoxic envenomation (a) bleeding of the gums; (b) extensive ecchymosis; (c) Boomslang bite to the base of the index finger; (d) Boomslang bite bleeding of the tongue

3. Monitoring of Snake-Bitten Patients

All snakebite patients need to be admitted to hospital and observed in a high dependency bed as a minimum for 24 hours. If your facility does not have a high dependency bed or an ICU bed, refer to a facility that has this capacity (see page 2 for a list of facility telephone numbers).

Patients bitten by snakes should, be observed in hospital for at **least 24 hours after the bite**, unless bleeding syndrome is suspected (see page 29).

For bleeding syndrome patients, monitor for **at least 48 hours after the bite.**

Table 4**: **Monitoring parameters and frequency for patients bitten by a snake

Monitoring frequency	
Suspected / confirmed neurotoxic bites	
Continuous	● O_2 saturation & pulse rate
Every 10 minutes	● Respiratory rate (count for a full 60 seconds) ● BP ● GCS ● Any new signs or symptoms
Suspected / confirmed cytotoxic bites	
Every 30 minutes	● Record progression of swelling including: distance from puncture site to furthest point of swelling, circumference of affected limb and unaffected limb, ● Note new **local** signs or symptoms (e.g., discoloration, bruising, blistering, bleeding) ● Note new **systemic** signs or symptoms (e.g., severe dry mouth, gagging, nausea, signs of neurotoxicity)
Every 4 hours	● Vital signs (see page 7)
Suspected / confirmed haemotoxic bites	
Every 4 hours	● Vital signs (see page 7) ● 20MWBCT ● Development of any symptoms
Asymptomatic bites	
Every 4 hours	● Vital signs (see page 7) ● Development of any symptoms

Note: For patient monitoring during and immediately after administration of antivenom, see page 21

4. Diagnosis of the Snakebite Syndrome

Managing snakebite follows a syndromic approach. There are five syndromes: progressive weakness (PW), painful progressive swelling (PPS), bleeding (B), mixed PPS & B, and mixed PW & PPS. Table 5 below provides an overview of the signs and symptoms associated with each snakebite syndrome.

Table 5: Overview of the presenting symptoms for each snakebite syndrome.

Species responsible	Symptoms: Not all signs and symptoms will necessarily develop, even with severe envenomation.
Progressive Weakness (PW) Caused by neurotoxic venom	
Black mamba *Imamba*	If envenomation has occurred, the symptoms usually manifest within **15 minutes** to **2 hours** following the bite. ● Pain at the bite site can be absent, minimal, or mild ● Swelling will be absent, minimal to mild in most cases ● **Bitter taste in the mouth** ● Paraesthesia of the bite site, tongue, lips, and mouth and later the whole body ● Severe thirst and dry mouth, increased salivation ● increased / severe sweating ● Gooseflesh ● General weakness, nausea, and vomiting ● **Fasciculations** ● **Ptosis** ● **Slurred speech** ● Chest tightness (like asthma)
Snouted cobra *Phemphetfwane*	If envenomation has occurred, the symptoms usually manifest **within 15 minutes to 6 hours** following the bite. Bites are uncommon or unconfirmed as a neurotoxic envenomation is usually attributed to the Black mamba. ● There is **local pain and swelling**, much more so than with the Black mamba, which may involve more than half the bitten limb ● **Vomiting** and continuous **gagging** is an early systemic symptom ● External **ophthalmoplegia** (causing diplopia, i.e., double vision) ● **Descending paralysis** ● **As respiratory distress increases, the patient becomes anxious and restless, sweaty, and cyanosed and will die unless ventilated artificially.**
Painful Progressive Swelling (PPS) Caused by cytotoxic venom	
Mozambique spitting cobra *iMfeti*	● Accounts for most venomous bites in Eswatini. ● **Intense pain** (strong, dull, or sharp) within minutes after the bite intensifies. ● Local **swelling** commences within minutes, gradually becoming more severe. ● **A darkened area (bruising) develops at the bite site, indicating necrosis.** ● **Blistering** can occur at the bite site after 36 hours ● **Necrosis occurs in 90% of bites and tissue destruction is usually severe but superficial.** Necrosis usually involves only the skin and subcutaneous connective tissues. ● **No bleeding complications.** **Compartment syndrome will never be a complication.**
Puff adder *Libululu*	● **Intense pain** (strong, dull, or sharp) within minutes after the bite intensifies. ● **Rapid local swelling** commences within minutes, gradually becoming more severe. ● **Bleeding from the bite site**, in gums, nose, blood, vomit and urine. The bite site area appears red, purple, blue or darkly discoloured. ● **Blood blisters may develop randomly 6-48 hours after envenomation.** With time, necrosis is common. ● Hypovolaemic shock is a potential complication.

	● **Compartment syndrome in 2% of cases only.**
Mixed PPS & PW	
Rinkhals *Phemphetfwane*	The Rinkhals is found in the cooler, middle and highveld regions of Eswatini. Bites are rare and symptoms include: ● Mild to moderate pain and local swelling. ● Possible neurological symptoms (vertigo, blurred vision, Paralysis of the tongue and vocal cords). ● Bites from the Rinkhals are classified as mixed PPS & PW, with cytotoxicity (PPS) being the predominant symptom.
Snouted cobra *Phemphetfwane*	**See Snouted cobra list above** ● A bite from a Snouted cobra is predominantly neurotoxic (PW) with some cytotoxicity (PPS).
Mixed PPS & B	
Puff adder (Libululu)	● See Puff adder list above.
Bleeding (B) Caused by haemotoxic venom	
Boomslang *Indlondlo* Vine snake *Lununkhu*	● These snakes are not aggressive, and bites are very rare. Their venom is extremely potent, and a glancing bite or scratch can lead to envenomation. ● Abnormal 20MWBCT (see page 17). ● **Persistent bleeding** from fang marks and bite site, ● Minimal pain or swelling ● Spontaneous bleeding from other mucous membranes (e.g., gums, nose etc) ● Haemorrhagic shock and headache

5. Investigations

4.1 20-minute whole blood clotting test (20MWBCT)

Incoagulable blood is a cardinal sign of consumption coagulopathy from envenoming by puff adders, Boomslang and Vine snake. For clinical purposes, the 20WBCT has proved reliable. This is a simple, rapid, "all-or-nothing" test of blood coagulability can be done at the bedside and correlates well with fibrinogen concentration.

20MWBCT	This test is done for all snake bites, and will **exclude bleeding syndrome**
 	● Draw 2ml of blood and place into a clean container (e.g., non-heparinized glass or borosilicate specimen bottle) ○ Glass vessels may not activate coagulation if they have been cleaned with detergent or are wet. ● Leave tube undisturbed for **exactly** 20 minutes ○ If left for longer than 20minutes the clot can become unstable and erroneously suggest coagulopathy. ● Tilt container to determine if the blood has clotted. ○ If blood has not clotted, this may indicate bleeding syndrome. ○ Contact EAF on 7602 5088 immediately if the blood has not clotted, for monovalent antivenom. ● Repeat this test every four hours when bleeding syndrome is suspected or diagnosed.

4.2 Other investigations

If available, the following laboratory tests are helpful in the diagnosis and monitoring of snakebites:

FBC	● Look for thrombocytopenia, leukocytosis, ● To identify anaemia ● Puff adder venom causes thrombocytopenia and leukocytosis ● Boomslang venom can cause thrombocytosis
INR	● Moderately elevated INR can be consistent with Puff adder bite ● INR > 10 usually indicates a bite from a Boomslang
Ultrasound	● Used to compare muscle compartments and exclude compartment syndrome.
Striker needle	● Muscle compartments (refer to page 31)
ECG	● Look for arrythmias ● This is to diagnose systemic envenomation
U&E	● To establish a baseline and monitor for acute renal failure ● Puff adder bites can cause acute renal failure

6. Management of Snakebite

6.1. Removal of tourniquet

6.1.1. Neurotoxic symptoms

Some neurotoxic symptoms can be observed despite the application of a tourniquet.

- Before the removal of the tourniquet, healthcare workers should be ready and prepared to intubate and ventilate the patient.
- To prevent a venom rush and a sudden deterioration of the patient, **apply a manual blood pressure cuff high up on the limb** (above the tourniquet) and **inflate** the manual blood pressure cuff
- Remove tourniquet with the blood pressure cuff still inflated.
- Administer antivenom (see pages 18-23) and wait 15 minutes.
    - Keep blood pressure cuff inflated.
- After 15 minutes, **slowly** deflate the blood pressure cuff by 5 mmHg / minute whilst **closely monitoring** the patient for ongoing and / or new symptoms of neurotoxicity and deterioration (see page 9).

6.1.2. Cytotoxic symptoms or asymptomatic

If there are no neurotoxic or systemic symptoms the tourniquet must be removed immediately whilst the patient is **monitored closely** for ongoing and / or new symptoms of neurotoxicity and deterioration.

6.1.3. Bleeding symptoms

A tourniquet will not mask any symptoms of bleeding syndrome. If there are no neurotoxic or systemic symptoms the tourniquet must be removed immediately whilst the patient is monitored closely for ongoing and / or new symptoms of neurotoxicity and deterioration.

6.2. IV fluids

All snakebite patients should receive maintenance of IV fluids through crystalloids (e.g., Ringer's lactate, saline or any other isotonic IV fluids).

6.3. Treatment of snakebite with antivenom

- Not all snakebites need to be treated using antivenom.
- Where a patient presents with the one of the five syndromes of snakebite (see Table 5) then it is vital to administer antivenom.
- Quality antivenom developed using the species of venomous snake suspected or confirmed to have bitten the patient is the most effective and cost-efficient method of treating snakebite.
- The longer a severely envenomated patient is left without antivenom the greater the risk to poor treatment outcomes.

6.3.1. Indications for antivenom

Antivenom is indicated in all cases of systemic and severe local envenoming.

Antivenom is **not** indicated for patients bitten by another organism (i.e., not a snake), bitten by non-venomous snake, or patients bitten by a snake species that is not included in the development of the polyvalent or monovalent antivenom.

Table 6: Indications for antivenom treatment after bites by African snakes:

Systemic envenoming	Local envenoming by species causing local necrosis
● Neurotoxicity ● Spontaneous systemic bleeding ● Incoagulable blood (20MWBCT) ● Cardiovascular abnormality: ○ Hypotension ○ Shock ○ Arrhythmia ○ Abnormal electrocardiogram	● Bites on fingers or toes (with swelling) ● Bites on small limbs of babies and small children (with swelling) ● Extensive swelling (more than half the bitten limb) ● Rapidly progressive swelling ○ Swelling extends more than 5 cm per hour. ○ Swelling of the whole hand or foot in 1 hour after envenomation. ○ Swelling extends to elbow or knee in 3-4 hours after envenomation. ○ Swelling of whole limb in 8 hours after envenomation. ● Discolouration, bruising or blistering of the skin

6.3.2. Antivenom dosage

Antivenom needs to be given in a large enough dose to neutralise **ALL** the injected venom. Under-dosing with antivenom leads to poor patient outcomes, undermines confidence in antivenom effectiveness, and may lead to prolonged hospitalisation which ultimately exceeds the cost of an initial treatment with a therapeutically effective volume of antivenom.

Guidelines for initial dosage based on clinical studies for bites by snakes found in Eswatini (Table 7). The initial dose of antivenom, however large, may not completely neutralize the depot of venom at the site of injection or prevent redistribution of venom from the tissues.

Patients should be observed for at least 48 hours after receiving antivenom, even if they show a good clinical response to the initial dose of antivenom, and to assess need for further antivenom treatment.

Continued absorption of venom from the bite-site depot and redistribution of venom from the tissues may cause recurrent neurotoxic, cytotoxic, or haemostatic problems after therapeutic antivenom has been eliminated. This process may be enhanced by resuscitation: correction of hypovolaemia and restoration of blood pressure may improve tissue perfusion at the bite site, resulting in further absorption of venom from the site of injection.

6.3.3. Minimum initial antivenom dosage

Table 7: Guide to initial dosage of antivenom for Eswatini snakes. *Do NOT compromise; give enough antivenom to neutralize the venom!*

Syndrome	Venom	Species responsible	Initial dosage of antivenom for paediatrics & adults	If symptoms persist after	Additional Antivenom	Comments
PPS	Cytotoxic	Mozambique spitting cobra; Puff adder*; Rinkhals**	50 ml Polyvalent	1 Hour	20 ml	Repeat with 20 ml every hour until symptoms stops.
PW	Neurotoxic	Black mamba, Snouted cobra	40-80 ml Polyvalent	1 Hour	20 ml	

Mixed PPS & B	Cytotoxic & Haemotoxic	Puff adder*	50 ml Polyvalent	1 Hour	20 ml	Repeat with 20 ml every hour until symptoms stops.
Mixed PPS & PW	Cytotoxic & Neurotoxic	Rinkhals**, Snouted cobra***	50 ml Polyvalent	1 Hour	20 ml	
B	Haemotoxic	Boomslang	10 ml Monovalent	6 hours	10 ml	Repeat with 10 ml every 6 hours until symptoms stop

*Bites from a Puff adder can present as PPS or Mixed PPS & B.
**Bites from a Rinkhals can present as PPS or Mixed PPS & PW
*** Bites from Snouted cobras present with PW or Mixed PPS & PW

NOTE: The doses for antivenom for adults and children is the same. The purpose for antivenom administration is to neutralize the venom received from the snake.

6.3.4. Timing of antivenom treatment

A doctor should be able to recognize the signs and symptoms of snakebite envenomation and **make an early decision to start antivenom therapy to limit the extent of tissue damage, blood changes or paralysis.**

Antivenom should be given as soon as possible once signs of systemic or severe local envenoming are evident. It is almost never too late to try antivenom treatment for persistent systemic envenoming; it has proved effective in reversing coagulopathy 10 days or more after Boomslang bites.

6.3.5. Preparing to administer antivenom

Due to the significant risk of anaphylaxis with antivenom, health care workers should be fully prepared prior to administering antivenom. To prepare:

A	**Airway management** ● Oxygen ● Endotracheal tube ● Laryngoscope ● Oropharyngeal airway ● Suction	C	**Circulation** ● IV fluids ● Adrenaline
B	**Breathing** ● Ambu bag ● Ventilator	D	**Drugs** ● Promethazine (IV) ● Hydrocortisone (IV) ● Salbutamol and ipratropium (nebules and nebulizer) ● Midazolam or ketamine (IV) ● Other drugs

6.3.6. Pre-treatment for possible anaphylaxis caused by antivenom

To prevent or diminish possible anaphylaxis, **pre-treat with subcutaneous adrenaline**. Patients in whom adrenaline is **relatively** contraindicated include those with a history of ischaemic heart disease or stroke, uncontrolled hypertension and tachyarrhythmias.

Table 8: Adrenaline doses of paediatrics and adults

Age	Dose (SC)
<6 years	0.15 mg
6-12 years	0.20 mg
>12 years	0.25 - 0.5 mg

Premedication with antihistamines may dampen minor allergic reactions but will not prevent serious allergic/anaphylactoid reactions.

Hydrocortisone takes several hours to act and is ineffective as a prophylactic agent against acute reactions.

6.3.7. Antivenom administration

The earlier antivenom is administered, when indicated, the greater the clinical benefit to the patient will be both in terms of the potential to save life and limb. Antivenom is most effective when given as a **slow intravenous push at a rate of about 10 ml per minute**

Slow intravenous push injection requires less expensive equipment, is quicker to set up and ensures the doctor remains at the patient's side during the crucial first 10-15 minutes after the start of treatment, when early adverse reactions are most likely to occur.

The patient should be kept talking if s/he is able to do so. Uncover the neck, chest or back to check for the development of a rash. Listen carefully to hear if there is a change to the pitch of the voice or if they start to clear their throat or cough.

6.3.7.1. Monitoring of patient during and immediately after antivenom administration

During antivenom administration, monitor:

Continuously:	● O_2 saturation and pulse rate ● GCS ● Work of breathing (look for signs of bronchospasm or respiratory distress)
Every 3 minutes:	● BP

After antivenom administering is complete:

- Continue continuous O_2 saturation monitoring and:
- BP monitoring every 5 minutes for the next 30 minutes

- If patient remains stable, then continue continuous O2 saturation monitoring and:
- Every 10 minutes for the next 30 minutes
    - BP
    - Vital signs
- If the patient continues to be stable for 1 hour after antivenom administration, then monitor the patient as per Section 6.3.14.1

- If patient exhibits **any adverse reaction to antivenom**, refer to Sections 6.3.13 and 6.3.14, and continue close monitoring.

(a) (b) (c)

Figure 6: All figures taken in Eswatini; (a, b) The advantage of administering antivenom IV push is that the doctor is close at hand; (c) Minimal equipment is required to administer antivenom

6.3.8. Response to antivenom treatment

- **Early administration of antivenom leads to the best clinical outcomes.**
- Use of antivenom in patients with well-established cytotoxicity or advanced neurotoxicity may appear not to be particularly effective, due to the inability of antivenom to rapidly reverse the local effects of cytotoxins or the profound respiratory depression of paralysed patients.
- **A common reason for apparent ineffectiveness is inadequate dosage.**

Clinicians should be realistic in their expectations of what antivenom can and cannot do. It is important to remember that the role of antivenom is to **neutralise injected venom.** Antivenom does not repair destroyed tissues or nerve cells. Neutralising the injected venom may prevent further progression of cell injury but will not undo the damage that has already been done.

A favourable response can be expected within 15 minutes to 6 hours, when adequate quantity of antivenom has been administered (otherwise a second antivenom dose might be indicated).

If **adequate dose of antivenom** has been given, response can be expected:

- Appropriate administration of antivenom can **stop the progression of swelling**.
- **Neurotoxic effects begin to improve within 30 minutes, but complete recovery takes much longer.** In the event of acute neurotoxic envenoming (respiratory paralysis), antivenom will NOT prevent progression of neurotoxic effects. In this case, respiratory support is the ONLY life-saving treatment. By administering adequate dose of antivenom, the time the victim requires artificial respiration, is shortened dramatically. Some patients have required up to 12 days artificial ventilation but have recovered completely.
- The blood pressure normalises within an hour
- Cardiac arrhythmias improve rapidly.

Ongoing monitoring of patient symptoms should be continued to determine if additional antivenom is required (see Table 7 for dose and frequency if further antivenom is required).

6.3.9. Additional drugs for neurotoxic envenomation

6.3.9.1. For bites confirmed to be from a Snouted cobra only

Neostigmine: inhibits the action of acetylcholinesterase and may prevent paralysis progression and in some cases reverse the symptoms. Atropine should always be administered with neostigmine to prevent serious muscarinic effects and other side effects, such as bowel discharge.

Atropine and neostigmine may be given simultaneously, but in patients with bradycardia, the pulse rate should be increased to 80 per minute with intravenous atropine before administering neostigmine.

- Atropine must be administered intravenously immediately before neostigmine. For doses of atropine and neostigmine, refer to Tables 9 and 10 below.
- Neostigmine + atropine can be administered every 2-4 hours if there has been significant improvement after the first dose.

Table 9: Dose of atropine for use in neurotoxic snakebites

Body weight	IV dose
Up to 3kg	0.1 mg
3-7 kg	0.15 mg
7-9 kg	0.2 mg
9-12 kg	0.25 mg
12-16 kg	0.3 mg
16-20 kg	0.35 mg
20-27 kg	0.4 mg
27-32 kg	0.5 mg
32kg and above	0.5 mg – 1mg

Table 10: Dose of neostigmine for use in confirmed snouted cobra bites only.

Age	Body weight	IV dose
1-3 Years	Under 11 kg	Up to 0.25 mg
4-7 Years	11-15 kg	0.35 mg
8-11 Years	16-20 kg	0.45 mg
12-17 Years	20-50 kg	0.5mg to 2.5mg
Adults	50kg and above	0.5mg to 2.5mg
Dose of intravenous neostigmine in children is 10-40 micrograms per kg bodyweight given over 1 minute after or with atropine. Neostigmine must be used with atropine.		

6.3.9.2. For bites confirmed or suspected to be from a black mamba

- Atropine: To be used for excessive salivation (black mamba bites), and to reduce some of the side effects, such as bowel discharge.
- Atropine must not be administered if BP> 150 mmHg and/or HR > 100 bpm.
- Atropine can be administered every 2-4 hours. See Table 10 above for doses.

6.3.10. Snakebite and antivenom in pregnancy

Antivenom is not contraindicated in pregnancy. Envenomed pregnant woman are at risk and early and adequate antivenom treatment is indicated, as its benefits outweigh the risks to the mother and foetus.

The dose of antivenom in pregnant patients is the same as for other adults.

During the last trimester of pregnancy avoid the supine hypotensive syndrome by resuscitating the mother while she sits up or place her in the left lateral decubitus position or raise the left hemipelvis. Envenoming by the Puff adder causes a bleeding diathesis and may cause ante-partum haemorrhage and precipitate miscarriage at any stage of pregnancy.

Pregnant women should be questioned about and examined for evidence of vaginal bleeding, and, in the third trimester, foetal heart rate and uterine contractions should be monitored. Foetal bradycardia may indicate foetal envenoming. **Late deceleration of foetal heart rate** in relation to uterine contractions indicates foetal distress. Envenomed pregnant women are at risk of ante- and post-partum haemorrhage, premature labour, foetal distress, and stillbirth. **Early adequate antivenom treatment is indicated,** its benefits outweighing the risks to the mother and foetus e.g., of anaphylactic antivenom reaction

Pregnant patients may develop **uterine vasoconstriction** during compensated hypovolaemic shock even though maternal vital signs may appear normal. As a result, the **foetus may become hypoxic while the mother has normal tissue oxygenation.** Adequate fluid resuscitation and oxygenation of the mother are therefore essential. Uterine and foetal heart rate monitoring are recommended to detect asymptomatic premature labour and foetal distress. If there is coagulopathy, retroplacental haemorrhage may occur, causing high maternal and foetal mortality. **Early, adequate doses of antivenom are therefore essential** if there is any suggestion of haemostatic disorders. Labour (for example, induced by the snakebite) in a woman with snake venom-induced haemostatic abnormalities may be complicated by massive post-partum haemorrhage.

6.3.11. Snakebite and antivenom in paediatrics

The dose of antivenom administered is the same as for adults because antivenom is designed to neutralize a fixed venom dose, which the snake injects indiscriminately into humans large or small, including neonates.

Children may be more prone to morbidity and mortality due to the higher dose of venom they receive relative to their body weight compared to adults.

The indications for antivenom arise sooner in children, which tends to mitigate this.

Venous access may be a problem. The intraosseous route may be required. Due to high venom: mass ratio both morbidity and mortality are higher than in adults. Swelling travels further and faster up their bodies, coagulopathies occur sooner as does weakness and respiratory failure due to a faster evolution of envenomation. Frequent reassessment of snake bitten children is necessary.

6.3.12. Snakebite and antivenom in the elderly

The elderly is no different than younger patients when it comes to snakebite. However, they may be more prone to hypotension, therapeutic fluid overload and adverse effects of adrenaline (epinephrine) and are more likely to be suffering from intercurrent and unrelated chronic illnesses such as hypertension and other cardiovascular diseases, chronic obstructive bronchitis, and diabetes mellitus. These possibilities should be considered during treatment.

6.3.13. Adverse reactions to antivenom treatment

Early reactions

Antivenoms can cause a range of adverse reactions,

- **Mild**: Urticaria, generalised itchiness, discomfort, fever, nausea
- **Moderate**: mild bronchospasm, angioedema,
- **Severe**: Hypotension, severe bronchospasm, anaphylactic shock

The risk of a potentially severe reaction to antivenom should be balanced against the imperative need to neutralise circulating venom

Clinicians should prepare to treat adverse anaphylaxis before administration of antivenom. Adequate supplies of adrenaline should be drawn up and ready for use, and resuscitation equipment, drugs and volume expanders kept close at hand. Premedication with adrenaline is helpful as it is effective in reducing incidence of antivenom reactions caused by antivenom.

6.3.14. Management of adverse reactions

- The patient should be kept talking if s/he is able to do so.
- Uncover the neck, chest or back to check for the development of a rash.
- Listen carefully to hear if there is a change to the pitch of the voice or if they start to clear their throat or cough.

Urticaria only, administer:

- promethazine 25mg IV/ IM (for paediatric patients, under 2 years = do not give, 2-6 years = 6.25mg, 6-12 years = 12.5mg, >12 years use adult dose)

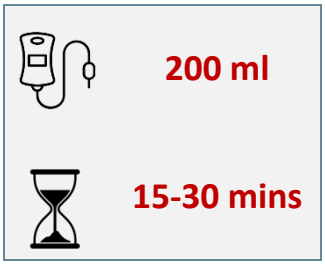
Mild bronchospasm only:

- nebulise salbutamol (5mg adults, 2.5mg paediatrics) together with ipratropium (0.5mg adults, 0.25mg paediatrics) should be given every 15-20 minutes.

6.3.14.1. Treatment of anaphylaxis.

The following steps should be immediately taken to manage a patient going into anaphylaxis:

1	**STOP ANTIVENOM**
2	**Adrenaline:** ● Give 0.01 mg / kg dose (maximum 0.5 ml of 1:1000) IM into anterolateral aspect of the thigh if the patient develops progressive systemic features. Repeat every 5-15 minutes if there is no improvement.
3	**Oxygen**: ● Give high flow volume mask ~8-10 L / min via mask
4	**Maintain an open airway**: ● Position in semi-Fowler's to assist breathing. Monitoring respiratory parameters and vital signs continuously.
5	Always be **ready for intubation** should condition progress to obstruction.
6	**IV fluids:** ● Give 1-2 litres (20 ml / kg for paediatric patients) of crystalloid if hypotensive. Keep Systolic Blood pressure >90 mmHg
7	**IV adrenaline:** ● **Try and avoid IV adrenaline because of its hazardous potential unless you have all equipment for monitoring.**
8	**Antihistamine:** ● Promethazine 25 mg IV / IM

	○ for paediatric patients, under 2 years = do not give, ○ 2-6 years = 6.25 mg, ○ 6-12 years = 12.5 mg, ○ >12 years use adult dose is sufficient.
9	**Corticosteroids**: ● Give hydrocortisone 200 mg IV ○ for paediatrics patients, <1 years = 25 mg, ○ 1-6 years = 50 mg, ○ 6-12 years = 100 mg, ○ >12 years use adult dose slowly.
10	**Bronchodilators**: ● Nebulise salbutamol (5 mg adults, 2.5 mg paediatrics) together with ipratropium (0.5mg adults, 0.25 mg paediatrics) should be given every 15-20 minutes if bronchospasm is a major feature. ○ If there is life threatening bronchospasm, patient should be intubated. ○ Sedative drugs (such as midazolam or ketamine) can be administered to assist with intubation may be administered.
11	**Propofol:** ● Should not be used in an anaphylaxis situation, as it exacerbates hypotension
12	**Glucagon:** ● 0.02 mg / kg (= 20 mcg / kg) IV / IM is given if patient is not responding to adrenaline.
13	● **Admit for observation** overnight in case of recurrence.
14	● Antivenom treatment should be continued using **<u>infusion</u>** if the patient has been stabilize unless there was full blown anaphylactic shock. ● Administer antivenom in <u>200 ml crystalloid fluid</u> and infuse over <u>15-30 minutes</u> ○ Closely monitor patient for further reactions ○ Restabilize patient if necessary ○ Call EAF: 7602 5088 for advice. ● Never administer antivenom into a 1-litre bag and infuse for several hours. 
15	● Snakebite is a medical emergency. ● If your facility does not have 200 ml infusion bags, call EAF: 7602 5088 for advice.

6.3.14.2. Pyrogenic reactions

Pyrogenic reactions result from pyrogen contamination of the antivenom during manufacture. They begin within 1-2 hours after treatment.

- There is an initial chill with cutaneous vasoconstriction, gooseflesh, and shivering.
- Body temperature rises sharply during the rigors and there is intense vasodilatation, widening of the pulse pressure and eventual fall in mean arterial pressure.
- In children, febrile convulsions may occur at the peak of the fever.
    - Their temperature should be reduced by fanning, tepid sponging, and antipyretic medicines such as paracetamol (15 mg / kg) given by mouth, suppository or via nasogastric tube.

6.3.14.3. Serum Sickness

Late (serum sickness type) reactions occur 5-24 days (average 7 days) after treatment. There is itching, urticaria, fever, arthralgia, peri-articular swellings, proteinuria, and sometimes neurological symptoms. Antihistamines are used for milder attacks, but in severe cases, including those with neurological symptoms, a short course of prednisolone should be given.

6.4. Treatment of snakebite when there is no antivenom available

This section has been developed because, at the time of protocol development, there was a crisis in southern Africa with a critical shortage of snake antivenom. Treatment of snakebite without antivenom is very long and expensive process to the health system and the patient. Therefore, once supplies resume, it is vital snake that antivenom is stocked at all facilities with the capacity to administer antivenom.

6.4.1. Neurotoxic bites

6.4.1.1. Treatment at clinics and other health facilities without the capacity to ventilate for extended periods

Aim: urgently stabilise and safely transfer patient to a facility that can provide extended ventilation

✔ **Vital signs**
- BP, GCS, pulse rate, respiratory rate, O_2 saturation,
- RBS

✔ **Stabilise the patient**
- Airways
  - if a patient is in respiratory arrest, then Ambu bag and/or oxygen
- Position of the patient
  - recovery position
- Insert IV line and start crystalloid fluids
- Give atropine if the patient has excessive secretions (see Table 10, page 23 for doses)

✔ **Transport the patient**
- A healthcare worker should travel with the patient and an Ambu bag and oxygen
- Maintain recovery position of the patient during transport
- Monitor the patient's work of breathing

6.4.1.2. Treatment at Health Facility with Extended Ventilation Capacity

Aim: to ventilate the patient until the body has broken down the venom and normal neurotransmission has resumed.

✔ **Take and monitor vital signs**
- GCS
- O_2 saturation
- Respiratory rate
- BP

✔ **Airways**
- Indications for intubation (where patient has not already been intubated):
  - GCS < 8/15
  - O2 < 94%
  - Respiratory rate < 12 / minute
  - Shallow breaths and / or use of accessory muscles to assist with breathing
  - Refractory hypotension
  - Excessive secretions (even if atropine has been administered)

✔ **Breathing**
- Ventilate patient (this will be prolonged!)
- Baseline settings for ventilation (follow facility ventilation protocols)
  - Modes – SIMV (Paediatrics PCV; Adults VCV)
  - Tidal volume 7 ml / kg
  - PIP 12-14 cm H_2O (Paediatrics PCV)
  - PEEP 5
  - I: E 1:2

- Rate

Age (years)	Breaths per minute
<1	25 – 30
1-5	20 – 25
5-12	15 – 20
>12	12 – 15

✔ **Circulation**
- IV fluids with crystalloids (Ringer's lactate or normal saline)
- Inotropic support (e.g., adrenaline infusion) if hypotension develops

✔ **Prolonged ventilation can be required (days to weeks)**
- Typically, patients need around 2 weeks of ventilation, however, a few patients may require several weeks of ventilation.
- It has been observed that neurotoxic snakebite patients can mimic brain death.
  - The nerves are paralysed and therefore brain reflexes will not work – but the patient is alive
  - The patient has 'locked in' syndrome; s/he can hear you but cannot respond
  - **DO NOT STOP VENTILATING THE PATIENT IF THEY APPEAR BRAIN DEAD**
  - The recovery period varies greatly from patient to patient.

✔ **Ancillary therapy**
- Neostigmine and atropine (for confirmed snouted cobra bites only) – see page 23.
- Atropine only (for confirmed or suspected black mamba bites) – see page 23.

6.4.2. Cytotoxic bites

6.4.2.1. Treatment at clinics or other health facilities without surgical capacity

Aim: urgently stabilise and safely transfer patient to a facility that can provide surgical wound care

✔ Vital signs
- BP, GCS, pulse rate, Respiratory rate, O_2 saturation
- RBS

✔ Call 977 for assistance (also see page 2 for more telephone numbers)

✔ If no neurotoxic signs observed (see page 9) remove tourniquet (see page 18) and constricting clothing or jewellery

✔ Elevate limb to heart level or just above heart level using a pillow

✔ Analgesia (see page 33). **Do not give NSAIDS!**

✔ Insert IV line into the non-bitten limb and start crystalloids (Ringer's lactate or saline)

✔ Mark the bite site and the swelling progress (see page 11)

✔ Transfer patient to a health centre or hospital with surgical capacity

6.4.2.2. Treatment at health centres and hospitals, with surgical capacity

□ Initiate / continue management of snakebite patient (see Section 6.4.2.1)

□ Perform investigations (see page 17)
- 20MWBT
- Other tests

□ If there are signs of painful progressive swelling
- Measure compartment pressures (see page 31).
- Snakebites often present with pseudo compartment syndrome which mimics compartment syndrome.

□ If there are blisters
- Deroof the blister, and apply dressings impregnated with silver or use paraffin gauze (see page 30)
- Correct snakebite bleeding disorders (often caused by puff adder bites) prior to surgery

□ If there is abscess formation, the abscess should be drained promptly
□ Preventing Contractures
- Splint wounds across joints
- Physiotherapist and/or occupational therapists for splinting and mobilising
- Early skin grafting

□ Psychotherapy
- counsel the patient for the possibility of long term / permanent consequences of the bite
- debriefing session with the patient

When treating a patient presenting with both **cytotoxic** and **neurotoxic symptoms**, refer to both sections 6.4.1 and 6.4.2

6.5. Medical management of bleeding syndrome

If bleeding syndrome has been diagnosed (page 13), contact EAF on +268 7602 5088, immediately for monovalent antivenom.

SAVP Monovalent Antivenom is manufactured for Boomslang envenomation. **Monovalent antivenom has the greatest benefit should a patient have a severe coagulopathy with active bleeding.** There is no place for heparin, fibrin stabilising drugs, fibrinolytics or thrombolytics. Venom-induced 'thrombin' is far less susceptible to heparin than physiological thrombin. **The use of fresh frozen plasma (FFP) or whole blood or vitamin K is not effective prior to antivenom administration but may only be considered after monovalent antivenom has been administered.**

The Monovalent antivenom is very effective, even when given many hours or days after the bite and the positive effect of the treatment is rapid, even in a very sick patient. **The initial dose of 10ml (one ampoule) should be injected as a slow IV push**, with the patient recumbent (lying down) during the injection, and for at least one hour afterwards.

The antivenom dose depends on the amount of venom injected by the snake, not on the size or mass of the victim, and should not be reduced in the case of children. **If bleeding continues for more than six hours after the first dose, a further injection of one or two ampoules may be given.** During this six-hour period, use of FFP or whole blood or platelets may be considered to reduce ongoing bleeding.

NB: Heparin and antifibrinolytic agents should never be used in snake bitten patients.

6.5.1. Response to monovalent antivenom treatment

Early administration of antivenom leads to the best clinical outcomes.
A common reason for apparent ineffectiveness is inadequate dosage. Clinicians should be realistic in their expectations of what antivenom can and cannot do. It is important to remember that the role of antivenom is to neutralise injected venom.

A favourable response can be expected within 15 minutes to 6 hours, when adequate quantity of antivenom has been administered (otherwise a second antivenom dose might be indicated).
- Spontaneous systemic bleeding usually stops within 15-30 minutes and blood coagulability is restored within approximately six hours.
- **The 20MWBCT test should be used** to monitor the dose of antivenom in patients with coagulopathy (see page 17).
- If the blood remains incoagulable 6 hours after the first antivenom dose, **the dose should be repeated, every 6 hours,** until blood coagulability is restored.

- During the 6 hours **after antivenom administration**, FFP or whole blood or platelets may be transfused to achieve haemostasis. The administration of these products should only be considered after monovalent antivenom has been administered.
- The antivenom neutralises the circulating venom. It takes 6 hours for the body to produce clotting factors to get too normal in a patient with normal liver function.
- **No unnecessary procedures and IM injections should be performed to prevent further bleeding and haematoma formation.**

6.6. Ancillary Treatment

6.6.1. Treatment of local envenoming

6.6.1.1. Wound infection

Although most local effects of snakebite are attributable directly to cytolytic and other activities of the venom itself, the bite may introduce bacteria, and the risk of local infections greatly increases if the wound has been incised with an unsterile instrument, tampered with in some other way or if it contains necrotic tissue. The pattern of bacterial flora may vary in different countries.

Antibiotic treatment should be delayed until there are definite signs of infection, such as a hot reddened fluctuant local swelling resembling an abscess or if the wound is necrotic. Appropriate blind antibiotic treatment is with ciprofloxacin or amoxicillin with clavulanic acid. Prophylactic antibiotics are not appropriate unless the wound has been grossly interfered with or is frankly necrotic.
Fluctuant areas, suggestive of an underlying **abscess, should be aspirated and opened for drainage, immediately** (no need to wait 5-7 days).

6.6.1.2. Wound care of the bitten limb

General wound care principles apply to create an optimum environment for healing e.g., keeping the wound moist. For snakebite wounds:

- ✔ The wound should be initially cleaned with an antiseptic solution (e.g., chlorhexidine, betadine, iodine).
- ✔ Blisters and bullae should be deroofed and dressed.
- ✔ **Commercial dressings impregnated with silver or paraffin gauze** (Vaseline gauze).
    - Vacuum dressings are a good option for chronic snakebite wounds.
- ✔ **Daily betadine dressings should not be practiced for non-septic wounds.**
- ✔ Snake-bitten limbs should be nursed in the most comfortable position but should be **elevated to the level of the heart or just above the level of the heart using a pillow**.
- ✔ The wound should be examined frequently for evidence of necrosis: blistering, blackening or depigmentation of the skin, loss of sensation and a characteristic smell of putrefaction.
- ✔ Septic wounds often need surgical re-debridement. These wounds need to be dressed daily using commercially available silver-impregnated or charcoal-impregnated dressings. If nothing else available, the last option would be daily betadine dressings.

Wounds that have not healed after 3 months should be biopsied for malignancy.

(a) (b)

(c) (d)

Figure 7: Wounds from cytotoxic venomous bites (a, b) with secondary infection on the wound requiring surgical debridement and antibiotics; (c,d) wounds that are healing and with granulation tissue.

6.6.1.3. Surgical debridement of necrotic tissue

- Necrotic tissue should be debrided by a surgeon under general or local anaesthesia **after 5-7 days.**
- Skin appearances may be deceptive because necrosis can undermine apparently normal skin.
- Large areas may be denuded of skin; recovery can be accelerated by applying split skin grafts immediately after debridement provided that the wound is not infected.
- Debrided tissue, serosanguinous discharge and pus should be cultured, and the patient treated with appropriate antimicrobials.

Inexperienced surgeons may mistake bruised for necrotic muscle. In some cases, muscle fibres damaged by snake venom mycotoxins may regenerate if the muscle sheath is left intact and so debridement should be

6.6.2. Physiotherapists and occupational therapists

These therapists should be involved with the management of the snakebite patient early to mobilise joints and limbs and assist with splinting to prevent contractures.

6.6.3. Mental health

The short- and long-term impact of snakebite victims is still being studied. It is important to provide:

□ counselling to the patient for the possibility of long term / permanent consequences of the bite

□ debriefing session with the patient

6.6.4. Compartment syndrome

- Compartment syndromes are uncommon and over-diagnosed but require urgent attention.
- Snakebites often present with pseudo compartment syndrome which mimics compartment syndrome.

- Symptoms can include severe pain, tense tender swelling, cold cyanosed anaesthetic skin, pain on passive stretching of the muscles and apparently absent pulses.
- However, these appearances are usually misleading and when the intercompartmental (tissue) pressure is measured directly (for example with a **Stryker monitor**) pressures are found to be below the threshold of danger for ischaemic necrosis of the intercompartmental muscles.
- Compartment syndromes of hands and feet tend to self-decompress via the bite site. If a compartment syndrome in a limb is suspected, the pressure should be measured directly as this is the only reliable way of confirming raised intercompartmental pressure and justifying fasciotomy.
- **The normal intercompartmental pressure is 0-10 mmHg.** This intercompartmental pressure can be measured using a Stryker monitor**.**
- **An intercompartmental pressure of more than 45 mmHg is usually associated with compartment syndrome,** but there may be a risk of intercompartmental ischaemia at lower pressures if mean arterial pressure (perfusion pressure; **mean arterial pressure = diastolic pressure + 1/3 [systolic – diastolic pressure]**) is reduced, for example, in an elevated limb.

If a Stryker monitor is not available, an ultrasound can be carried out to look at the muscle compartments and compare with another limb to determine intercompartment swelling.

If the pressure is raised but mean arterial pressure is more than 30 mmHg higher than intercompartmental pressure, the patient may be treated conservatively for one hour with the appropriate antivenom and **intravenous mannitol** 100 g (500 ml of 20% solution in adults, less for children). Reassess compartment pressures after 1 hour of mannitol administration.

Should conservative treatment fail, open full-length fasciotomy should be performed **providing there is no coagulopathy or gross thrombocytopenia.** However, animal studies have shown that fasciotomy is ineffective in saving envenomed muscles**. Provided that adequate antivenom treatment is given as soon as possible after the bite, fasciotomy is rarely if ever needed** (Warrell and Rollinson, 2000). However, bites involving the finger pulps are frequently complicated by necrosis. Expert surgical advice should be sought, especially if the thumb or index finger is involved.

6.6.5. Haematomas

Haematomas (e.g., iliacus haemorrhage causing unilateral weakness of hip flexion as in patients with haemophilia) are treated conservatively after correction of the haemostatic disorder with antivenom and, in some cases, clotting factors.

6.6.6. Amputation

Amputation of afflicted digits and limbs is the **last resort**, but the decision must be made and agreed upon by the patient and family before life-threatening septicaemia, or gas gangrene.

6.6.7. Late complications

Late complications of local envenoming can include:

- incapacitating and deforming hypertrophic and keloid scars,
- muscle, and tendon contractures,
- equines deformity,
- destroyed or arthrodesis joints,
- osteomyelitis,
- chronic ulceration with or without malignant change, and
- consequences of intercompartmental syndromes such as Volkmann's ischaemic contracture.

These should be treated according to local standard guidelines.

6.7. Hypotension and shock

Antivenom can reverse the direct myocardial and vasodilating effects of some venoms, but in patients who have leaked large amounts of blood and plasma into the bitten limb and elsewhere, a plasma expander is needed to correct hypovolaemia. As an emergency, the foot of the bed can be raised to improve cardiac filling while an intravenous infusion is set up. Other causes of hypotension, such as a massive, concealed haemorrhage or effects of venom toxins on the physiological mechanisms controlling blood pressure (e.g., ACE-inhibiting and bradykinin potentiating peptides should be considered).
Inotropic support maybe required for severely envenomated patients (e.g., adrenaline).

6.8. Analgesia

Analgesia is indicated for all cytotoxic envenomation's (mild to severe).

- □ Paracetamol (PO / IV) should be first line.
- □ Opioids (e.g., tramadol, codeine) can be added.
    - Note, opioid administration can cause confusing presentation of a neurotoxic bite.
- □ NSAIDS (e.g., diclofenac, ibuprofen, indomethacin) SHOULD NOT be used.

6.9. Ventilation

For neurotoxic envenomation and severe anaphylactic reactions to antivenom, ventilation may be required. Management of neurotoxic envenomation (with or without antivenom) may require prolonged ventilation (days to weeks). **Typically, patients need around 2 weeks of ventilation, however, a few patients may require several weeks of ventilation.**

□ The following are baseline settings for ventilation (follow facility ventilation protocols)

- Modes – SIMV (Paediatrics PCV; Adults VCV)
- Tidal volume 7ml / kg
- PIP 12-14 cm H2O (Paediatrics PCV)
- PEEP 5
- I: E 1:2
- Rate

Age (years)	Breaths per minute
<1	25 – 30
1-5	20 – 25
5-12	15 – 20
>12	12 – 15

□ It has been observed that neurotoxic snakebite patients can mimic brain death.

- The nerves are paralysed and therefore brain reflexes will not work – but the patient is alive
- The patient has 'locked in' syndrome; s/he can hear you but cannot respond
- **DO NOT STOP VENTILATING THE PATIENT IF THEY APPEAR BRAIN DEAD**
- The recovery period varies greatly from patient to patient.

6.10. Snake venom ophthalmia

Spitting cobras can cause intense conjunctivitis and bullous corneal erosions complicated by secondary infection, anterior uveitis, corneal opacities, and permanent blindness.

First aid treatment consists of:

- Irrigating the eye or other affected mucous membranes as soon as possible using large volumes of water for at least 10 minutes.
- To facilitate irrigation, a single drop of 1 in 1000 adrenaline can be administered to the eye to relieve the burning sensation instantaneously and to overcome tightly closed eyelids.

- Unless a corneal abrasion can be excluded by slit lamp examination or fluorescein staining, the patient should be treated as for a corneal injury with a topical antimicrobial eye ointment (e.g., chloramphenicol).

Topical or systemic antivenom treatment is not indicated.

7. Snakes of Eswatini

6.1. Highly venomous snakes of Eswatini

The "7 Deadly Sins" of Eswatini for which either polyvalent or monovalent antivenom should be used, are:

1. Black Mamba (*Dendroaspis polylepis*) **-** iMamba
2. Snouted or Savannah Cobra *(Naja annulifera)* - Phemphetfwane
3. Mozambique Spitting Cobra *(Naja mossambica)* - Mfeti
4. Rinkhals *(Hemachatus haemachatus)* - Phemphetfwane
5. Puff Adder *(Bitis arietans)* - Libululu
6. Boomslang *(Dispholidus typus)* – Indlondlo

The following snake is highly venomous snake and is found commonly in Eswatini. Bites are extremely rare and our antivenoms (polyvalent or monovalent) are **not** effective against:

7. Twig, Bird or Vine Snake *(Thelotornis capensis)* - Lununkhu

6.2. Venomous and dangerous: rarely seen

1. Berg Adder *(Bitis atropos)*
2. Shield Nosed Snake *(Aspidelaps intermedius)*
3. Zambezi Garter snake (*Elapsoidea boulengeri*)
4. Sundervall's Garter snake (*Elapsoidea sundevalli*)
5. De Coster's Garter snake (*Elapsoidea sundevalli decosteri*)

One or more deaths have been attributed to these snakes, not normally regarded as deadly, but in exceptional circumstances they could be. Antivenom is **not** effective.

6.3. Mildly venomous snakes of Eswatini

1. Stiletto Snake / Bibron's burrowing asp *(Atractaspis bibronii)*
2. Night Adder (*Causus rhombeatus)*
3. Snouted Night Adder (*Causus defilippii*)

Although classified as mildly venomous, the following snakes may cause severe pain and may need medical attention. Antivenom is **not** effective.

6.4. Mildly venomous (mostly asymptomatic)

Many other snakes classified as Mildly Venomous cause almost no pain, swelling or discomfort. Antivenom is **not** effective against:

1. Eastern Tiger Snake *(Telescopus semiannulata semiannulata)*
2. Herald Snake *(Crotaphopeltis hotamboeia)*
3. Marbled Tree snake/ Cat-eyed Tree snake *(Dipsadoboa aulica)*
4. Short-snouted Whip snake (*Psammophis brevirostris*)
5. Western Stripe-bellied Sand snake (*Psammophis subtaeniatus*)
6. Olive Grass Snake *(Psammophis mossambicus)*
7. Crossed Whip snake (*Psammophis crucifer*)
8. Black-headed Centipede-eater (*Aparallactus capensis*)
9. Reticulated Centipede-eater (*Aparallactus lunulatus*)
10. Spotted Skaapsteker *(Psammophylax rhombeatus)*
11. Spotted Harlequin snake (*Homoroselaps lacteus*)
12. Striped Harlequin snake (*Homoroselaps dorsalis*)
13. Natal, Purple-glossed snake (*Amblyodipsas concolor*)
14. Common, Purple-glossed snake (*Amblyodipsas polylepis*)

6.5. Non-venomous snakes of Eswatini

Eswatini's non-venomous snakes are harmless as they do not have venom glands and pose no danger to man at all.

1. Brown House snake (*Lamprophis capensis*) - umdlumi
2. Spotted Bush snake (*Philothamnus semivariegatus*)
3. Eastern Natal Green snake (*Philothamnus natalensis natalensis*)
4. Common Wolf snake (*Lycophidion capense*)
5. Common Egg-eater (*Dasypeltis scabra*)
6. Aurora House snake (*Lamprophis aurora*)
7. Olive House snake (*Lamprophis inornatus*)
8. Yellow-bellied House snake (*Lamprophis fuscus*)
9. Swazi Rock snake (*Lamprophis swazicus*)
10. Spotted Rock snake (*Lamprophis guttatus*)
11. Dusky-bellied Water snake (*Lycodonomorphus laevissimus*)
12. Common Brown Water snake (*Lycodonomorphus rufulus*)
13. Floodplain Water snake (*Lycodonomorphus obscuriventris*)
14. East African Shovel-snout (*Prosymna stuhlmannii*)
15. Sundervall's Shovel-snout (*Prosymna sundevalli*)
16. Semiornate snake (*Meizodon semiornatus*)
17. Green Water snake (*Philothamnus hoplogaster*)
18. Western Natal Green snake (*Philothamnus natalensis occidentalis*)
19. Common Slug-eater (*Duberria lutrix*)
20. Variegated Wolf snake (*Lycophidion variegatum*)
21. Southern File snake (*Mehelya capensis*) – iMamba lukhonkhotse
22. Black File snake (*Mehelya nyassae*)
23. Southern Brown Egg-eater (*Dasypeltis inornata*)
24. Schlegel's Blind snake (*Phinotyphlops schlegelii*)
25. Bibron's Blind snake (*Typhlops bibronii*)
26. Long-tailed Worm snake (*Leptotyphlops longicaudus*)
27. Peter's Worm snake (*Leptotyphlops scutifrons*)
28. Incognito Worm snake (*Leptotyphlops incognitos*)
29. Tello's Worm snake (*Leptotyphlops telloi*)
30. Cape Worm snake (*Leptotyphlops conjunctus conjunctus*) – umtfwana wenyoka lengaboni

6.6. Non-venomous and possibly dangerous

There are two exceptions about non-venomous snakes. Both these **snakes have no venom** but can inflict a nasty bite which may **need stitches**.

1. Southern African Python (*Python natalensis*) - inhlatfu
2. Mole snake (*Pseudaspis cana*) - imboma

8. Characteristics of Eswatini's Venomous Snakes

7.1. Highly venomous snakes of Eswatini

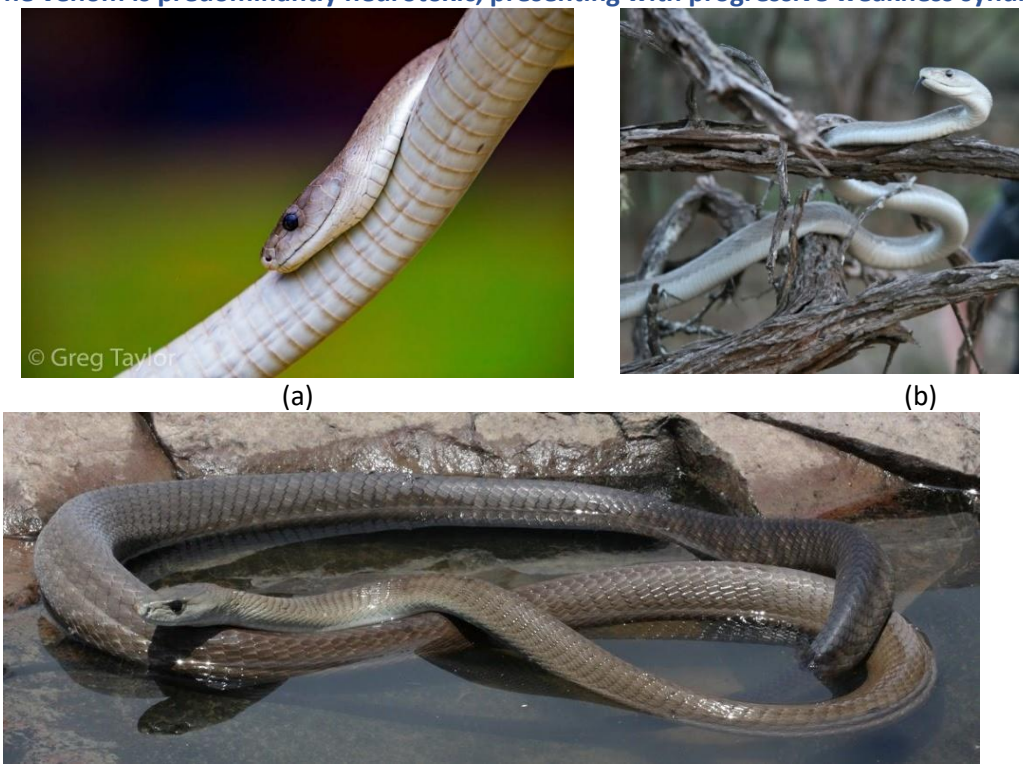
7.1.1. Black mamba (*Dendroaspis polylepis*) – "Imamba"

Found throughout Eswatini. A long slender snake that on average, reaches 2.0 - 2.8 m with larger individuals reaching 3.0m. Maximum 4.3 meters (KZN). The head has vertical sides with the distinctive coffin shape. The colour is never pitch black although it can become very dark, almost black, just before shedding. The normal colour is a light to dark grey, light black or various shades of brown or olive, with lighter banding on the rear part of the body. The underside is white in colour and can be plain or sometimes heavily spotted towards the tail. The inside of the mouth is inky black.

This snake is shy, nervous, alert and tries to avoid contact with humans. It does NOT attack unprovoked as is often reported and is NOT an aggressive snake. The belief that it will "chase or hunt" its victim is totally untrue. When approached it will lift the head well off the ground to obtain a better view, flatten the neck into a slight hood, hiss a hollow sounding hiss, and gape the mouth showing the black lining of the mouth. Any closer approach could result in the snake lunging forward to bite, sometimes striking twice in quick succession. Black Mambas rarely give a dry bite. They do not hold on and chew but deliver a quick bite and release immediately. Many locals believe that a snake that bites twice will remove all the venom with the second bite, this is not true, in fact, it will envenomate with each bite.

It is active during the day, normally emerging from about 7:00 in the morning to bask in the sun for about 1 - 2 hours, after which it will move away to forage for prey. It will return to its refuge, which can be a hole in the ground, or under a large rock outcrop, or a hollow tree, from about 15:00 to 17:00. They will live undisturbed in the same hollow log or termite mound for up to 8 years. Mambas will often enter houses or building when foraging for prey. They are often attracted to human dwellings because of the presence of rats, mice, and chickens. The estimated maximum speed of a mamba is probably 15 to 20 km/h over a short distance, not 40 km/h as is believed.

The venom is predominantly neurotoxic, presenting with progressive weakness syndrome



(a) (b)

(c)

Figure 8: Black mamba (Dendroaspis polylepis), Eswatini;

(a)

(b)

Figure 9: Black mamba (Dendroaspis polylepis), Eswatini (left) fangs, venom, and black buccal lining; (right) raised body and small hood

7.1.2. Snouted cobra *(Naja annulifera)* – "Phemphetfwane"

This non-spitting cobra is slender averaging 1.2m but can reach 2m or longer when it becomes quite thickset and robust. The head is distinct from the neck. Large specimens have bulging temporal muscles. The colour is variable but more often grey, brown, or light brown on the back with a lighter yellow underside, which is usually heavily mottled.

Easily identified by the broad, dark honey-coloured band on the throat. When threatened it will lift the head off the ground and spread an impressive hood. These snakes are very defensive, and they will strike readily and repeatedly whilst possibly making a hissing sound.

A banded phase occurs throughout the range of the species but has to date not been found in Eswatini. The banding is hardly discernible in hatchlings, but by the time a snake attains a length of 600 mm, it is black with seven to nine yellow bands on the body and one or two on the tail. The light bands are usually about half the width of the dark ones and may be divided by a narrow black transverse line. The yellow bands may encircle the body but are frequently mottled with black ventrally.

The venom is predominantly neurotoxic and mildly cytotoxic, presenting with progressive weakness syndrome or mixed progressive weakness and painful progressive swelling syndrome

(a)

(b)

(c)

Figure 10: Snouted cobra (Naja annulifera), Eswatini (left and centre) honey-coloured band on the throat, broad hood, and large temporal muscles; (right) juvenile Snouted cobra typically heavily mottled

7.1.3. Mozambique spitting cobra (*Naja mossambica)* – "Mfeti"

Found throughout Eswatini, they are common and responsible for most of the serious envenomation's in Eswatini. A medium length snake averaging 1.2m – 1.5m, very rarely growing larger 1.6 m.

The colour is light to dark grey. The skin between the scales is black, giving it a fish-net stocking appearance on the dorsal (top) side. The ventral is light orange to with from one to three irregular black bands on the throat. Although it becomes more active at night, it is also often found during the day.

It will eat almost anything and is fond of frogs, toads, rodents, birds and their eggs, nestlings as well as other snakes. Given the slightest opportunity it enters a residence, especially when doors and windows are left open.

The most common encounter with this cobra would be venom spat in the eyes, but most reported snakebites are attributed to this snake. Bites to sleeping people are also regularly reported.

The venom is predominantly cytotoxic, presenting with painful progressive swelling syndrome

(a) (b)

Figure 11: Mozambique spitting cobra (Naja mossambica), Eswatini (a) typical salmon coloured throat and black bands; (b) making a hood and spraying venom

7.1.4. Rinkhals (*Haemachatus haemachatus*) - "Phemphetfwane"

Found in the cooler regions of Eswatini. A small to medium size snake usually 90cm to 1.2m in length but it can reach 1.5m. The snake is closely related to the true cobras but differs from them in having keeled dorsal scales and it produces live young but in all other respects in acts like a cobra, being able to rear up and spread a hood.

The colour is usually a light grey when young, turning darker and becoming black when about 1m in length. The ventral part is normally dark brown or shiny black with one to three white bands on the throat. A banded phase occurs throughout the range of the species.
This snake is active during the day. It starts its day with a basking session, usually from about 8 to 9 am, after which it will start moving around in search of prey. It loves raiding chicken runs, eating eggs as well as small chicks, and is often found near homesteads in search of prey or water.

This snake will usually flee but if cornered it will face its attacker, rear the front of the body off the ground and spread a broad hood, exposing the black with white bands on the throat. From this position it will lung forward and spray its venom at an attacker, the body hitting the ground and at the same time the snake emits a loud hiss. If the threat from an attacker is kept up, the snake may drop to the ground, turn the front of the body over, open the mouth and lay there as if dead. A very effective ploy, fooling many people as well as dogs. It will later "come to life" again and move off.

The venom is predominantly cytotoxic with some neurotoxicity, typically presenting with mixed painful progressive swelling syndrome and progressive weakness syndrome

(a) (b) (c)

Figure 12: Rinkhals (Hemachatus haemachatus), Eswatini (left and centre) with typical black throat and white bands; (right) acting dead

7.1.5. Puff adder (*Bitis arietans*) – "Libululu"

Found throughout Eswatini. A short fat snake with adults averaging between 0.9m to 1.2m.

The head is triangular, broad, and very distinct from the neck

The colour can vary from light to dark brown to black with yellow or cream V shapes (chevrons) down the back. The ventral part is light-cream or yellow.

This very common snake is responsible for a large majority of snakebites in Eswatini as it tends to remain immobile as a form of defence whereas other snakes will move away. Mainly active at night but does also emerge during the day to bask in the sun. Most seen in spring and autumn.

It is often found around human habitation where it will hunt for prey.

The name puff adder comes from this snake's habit of inhaling air and expelling it forcefully through the nostrils to produce a loud hiss. This is a warning that the snake's patience is running out, and if ignored the snake will form an S shape and strike out at remarkable speed.

The venom is predominantly cytotoxic, sometimes with haemo- toxicity. Typically presenting with painful progressive swelling syndrome, or mixed painful progressive swelling syndrome and bleeding syndrome

(a) (b) (c)

Figure 13: Puff adder (Bitis arietans), Eswatini (a) with chevron markings on the back; (b) Fangs can grow up to 5mm in length; (c) ready to strike

7.1.6. Boomslang (*Dispholidus typus*) – "Indlondlo"

Found throughout Eswatini. A long slender snake growing to 1.8m in length. It can be identified by the blunt head and very large eye. Because of the bright green colour of the males, it is often mistaken for a green mamba. However, **green mambas are NOT found in Eswatini.**

The females normally grey or brown and the males are bright green. It is often confused with the green mamba, which is not found in Eswatini, or other harmless green snakes. Their bellies are light yellow, green, or cream. Juveniles are grey with a brown head and white jaw. The most distinctive feature of the juvenile Boomslang is the large bright green eye. The juvenile Boomslang are often mistaken for the Vine/Twig/Bird snakes.
This snake is active during the day and often found in fruit trees where they hunt for birds. It is not true that snakes eat fruit or bees.

It avoids human contact and rarely bites but will demonstrate its displeasure by inflating the front part of the body when molested to almost twice its normal size. From this position it may strike out, often at a sideways angle. Although venom may not be injected in this instance, the venom is so potent that even a tiny scratch could cause serious symptoms. If the snake is allowed to hang on and "chew" the consequences are usually dire.

The fang marks presented on a victim can be very confusing as they often have two or three fangs on the one side and one or two on the other side. Their fangs are situated just below the eye (see Figure 14).

The venom is haemotoxic, and typically presents with bleeding syndrome

(a) (b) (c)

(d)

(e)

Figure 14: Boomslang (Dispholidus typus), Eswatini (a) males are green in colour; (bt) Fangs are situated below the eye. There are often two fangs on each side; (c) Natal green snake (Philothamnus natalensis) often mistaken for a green mamba which is NOT found in Eswatini; (d) Female Boomslang (Dispholidus typus), Eswatini. Females are brown in colour;(e): Juvenile Boomslang (Dispholidus typus), Eswatini. They are often mistaken for a Vine snake but can be identified by the distinctive large green eye

7.1.7. Twig bird or Vine snake *(Thelotornis capensis)* – "Lununkhu"

A very slender snake with a long, thin tail. The colour is various shades of grey resembling a twig. The head is lance-shaped and can be green, emerald, or brown with black spots. The eye has a horizontal pupil and is keyhole shaped.

This arboreal snake is active during the day when it will move around in search of its favourite prey like lizards and chameleons. It will also hunt reed frogs and will raid bird's nests for hatchlings. This snake will then be mobbed by the parents in defence of their young and are occasionally killed by these birds.

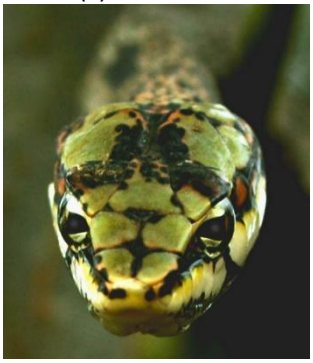
It is an inoffensive snake which has never been implicated in any legitimate snakebites. Reptile enthusiasts are most at risk. When annoyed, it will inflate the front part of the body, like the Boomslang. From this position it will strike sideways towards its attacker. This snake must bite and chew to get the fangs into play and should not be allowed this opportunity as there is no antivenom available to treat its bite.

The venom is haemotoxic, and typically presents with bleeding syndrome

(a)

(b)

(c)



(d)

Figure 15: Vine/Twig/Bird snake (Thelotomis capensis), Eswatini (left) inflating its neck as a warning; (second from left) Distinctive keyhole shaped eye; (second from right and right) colour variations

7.2. Venomous snakes of Eswatini

7.2.1. Berg adder (*Bitis atropos*)

Very seldom seen in Eswatini as it is only found in certain remote locations. Average total length 30–40 cm (maximum 60 cm). This small, stoutly built viper is greyish, reddish, olive to dark brown with two rows of triangular black dorsal markings and lateral rows of square markings. The belly is off-white with grey infusions. It does not have the raised ridges above the eyes.

It is a very rare snake, only found on the high mountains in the Bulembu and Malolotja area.

The venom is neurotoxic and cytotoxic

(a) (b)

Figure 16: Berg adder (Bitis atropos, a,b)

7.2.2. Shield nosed snake/ Shield cobra (*Aspidelaps scutatus*)

Very seldom seen in Eswatini. Short and stocky with obvious large scale covering the tip of the snout which they use to bulldoze through loose sand. Adult length is 40-45 cm but can reach 75 cm. The colour is very variable but usually salmon pink or creamish or orange, brown with indistinct blotches on the back. The head and neck are black, but the throat is usually white with possible black band around the neck. The underside is white or yellowish.

The venom might be neurotoxic

Figure 17: Shield nosed snake (Aspidelaps scutatus)

7.2.3. Zambezi garter snake (*Elapsoidea boulengeri*)

Very seldom seen in Eswatini. Above, dark chocolate brown to black with 8-17 narrow white bands on the back and up to 3 white bands on the tail. Juveniles have a white head and are black above with 12-17 white to pale yellow bands on the body and tail. The belly is usually dark grey or brown but may occasionally be white. Adult length 50-60 cm.

A cobra type venom that may cause immediate pain and stiffness of the affected limb. The symptoms are usually short lived and severe effects have not been recorded.

(a) (b)

Figure 18: Juvenile Zambezi garter snake (Elapsoidea boulengeri); (a) picture taken by M. Douglas ©; (b) adult Zambezi garter snake

7.2.4. Sundervall's garter snake (*Elapsoidea sundevalli*) / De Coster's Garter snake (*Elapsoidea sundevalli decosteri*)

Both species are very seldom seen in Eswatini.

Sundervall's garter snake (*Elapsoidea sundevalli*)

The adults are slate grey with a reddish-brown tinge and have 19-34 pale bands on the body and 2-4 pale bands on the tail. The belly scales are yellowish and may have darker mottling. In juveniles, the head and belly are pale, and the body and tail distinctly banded with chocolate brown to black and white to cream bands. The white bands fade with age.

De Coster's garter snake (*Elapsoidea sundevalli decosteri*)

Juvenile species have 19-21 white edged pale brown bands on a darker background on the body. There are also 3-4 of these bands on the tail. The belly scales on the lower flanks are white. These bands fade with age and eventually disappear completely.

The venom has not been studied very much and only a few case histories have been documented. Known symptoms include nausea, vomiting, pain, swelling, blurred vision and loss of consciousness.

(a) (b)

Figure 19: Sundervall's garter snake (Elapsoidea sundevalli), South Africa (a,b)

7.2.5. Stiletto snake / Bibron's burrowing asp *(Atractaspis bibronii)*

Found commonly throughout Eswatini. Burrowing asps are found in a wide variety of habitats. They are fossorial (burrowing), living mostly underground in deserted termite mounds, under stones or logs, or in soft soil or sand. They are coloured predominantly grey, black, or brown. Most are relatively small (30–70 cm in length). They are glossy, with a head indistinct from the neck. A very short tail ends abruptly, giving the snake a "two-headed" appearance. The head is short with tiny dark looking eyes.

These snakes are nocturnal and usually emerge on warm, wet summer evenings, especially after heavy rains. When the snake strikes, one fang is protruded out of the side of the mouth and is then hooked or jabbed into the victim with a backward jerk of the head ("side swipe"). They are extremely irritable, striking in sideways swings and sweeps (multiple bites), and showing annoyance by flattening the body. Accidental bites usually occur at night when the victim treads on the snake in a gutter or water-logged path after heavy rain or when incorrectly identified as non-venomous and handled.

These snakes are easily confused with several species of non-venomous black snakes. Even experienced snake enthusiasts find it difficult identify. There are two characteristics you can look out for:

- When threatened, they make a distinct stiletto shape by burrowing their heads into the ground.
- They show annoyance by flattening the body

It is impossible to pick this snake up by hand, you will get bitten. Use a Snake Glove or better yet, a snake tong or hook.

The venom is cytotoxic and will present with mild to moderate swelling. Antivenom is NOT effective and should NOT be administered.

(a) (b) (c)

Figure 20: Southern (Bibron's) Stiletto snake (Atractaspis bibronii), pictures are all from © David A Warrell; (a) showing unique fangs; (b) typical warning behaviour; (c) a non-descript small black snake that is often underestimated.

7.2.6. Night adder (*Causus rhombeatus*)

The night adders are small (less than 100 cm) and, despite their name, are active by day and by night. They are not adder-like and are tubby. The most obvious feature is the V mark on the top of the head. The point of the V extends up to the centre of the eyes.
The venom fangs are short compared to those of genus *Bitis* (Puff adder) but the length of their venom glands is impressive. They have round pupils (most adders have vertical slit eye pupils).

When threatened, they hiss and puff ferociously, inflating the body to a great extent. They may also raise the forepart of the body off the ground and slide forward with the neck flattened, looking quite cobra-like.

The venom is cytotoxic and will present with mild to moderate swelling. Antivenom is NOT effective and should NOT be administered.

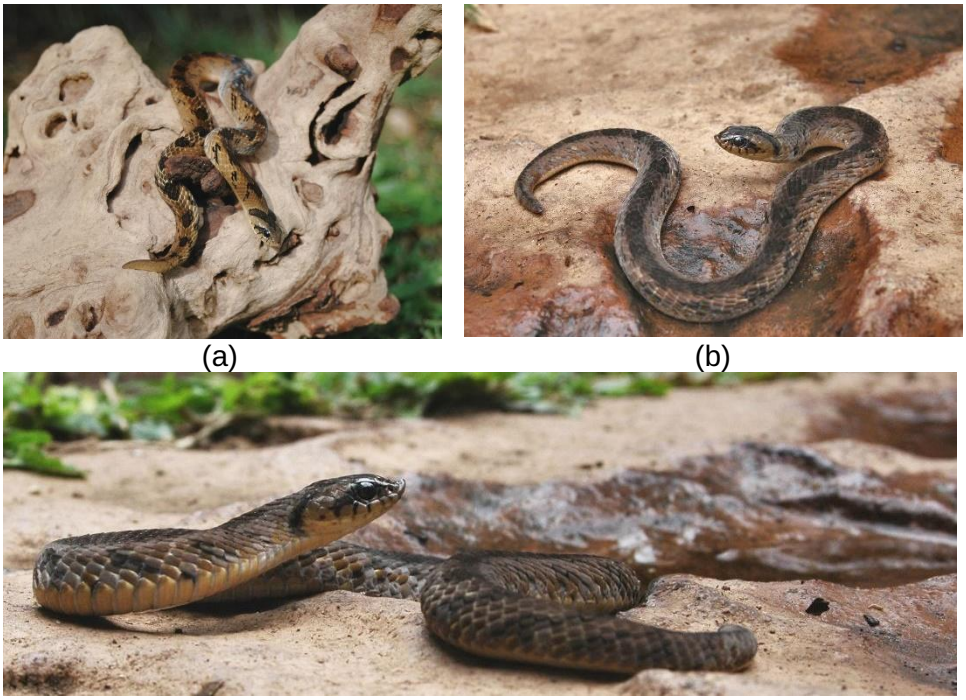
(a) (b)

Figure 21: Night adder (Causus rhombeatus), Eswatini; (a,b) distinguishing V shaped mark on the head.

7.2.7. Snouted night adder (*Causus defilippii*)

Average total length 20-35 cm (maximum 42 cm). It has a relatively thick body, with pointed upturned snout. The colour is brownish, greenish, or greyish, with a dorsal series of dark rhomboidal markings, extending to dark stripes on the flanks. As with the night adder, it has a prominent dark V-shaped mark on the top of the head, the apex of which extends to between the eyes. As with the Night adder (*Causus rhombeatus)*, when threatened, they hiss and puff ferociously, inflating the body to a great extent.

The venom is mildly cytotoxic and will present with mild swelling. Antivenom is NOT effective and should NOT be administered.



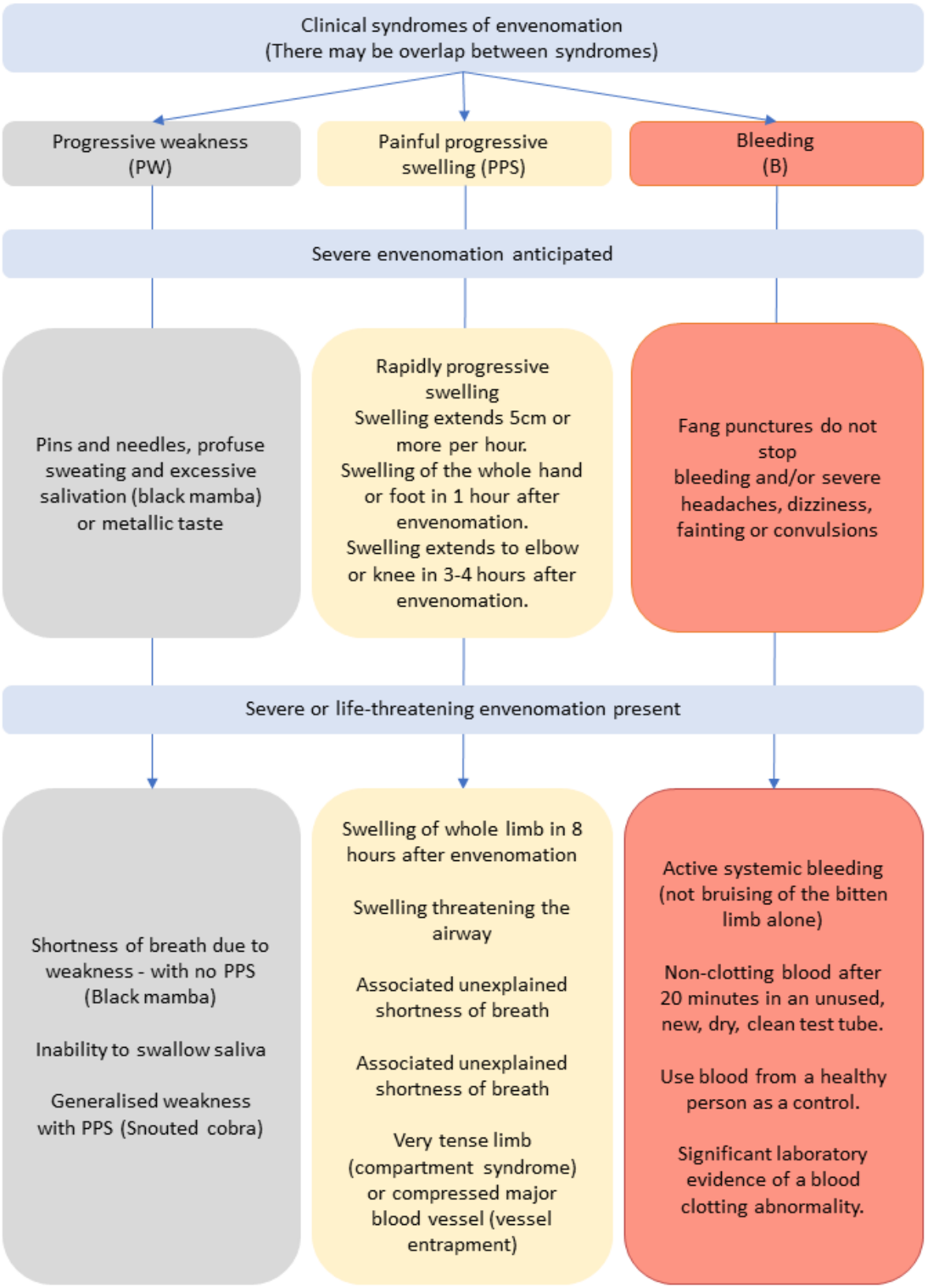
(a) (b)

(c)

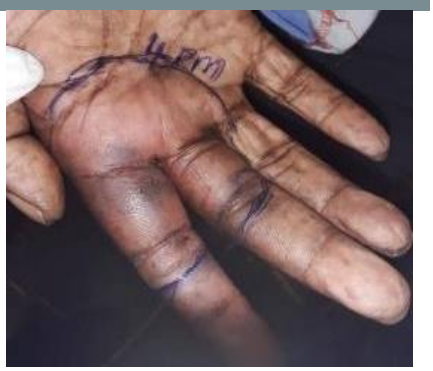
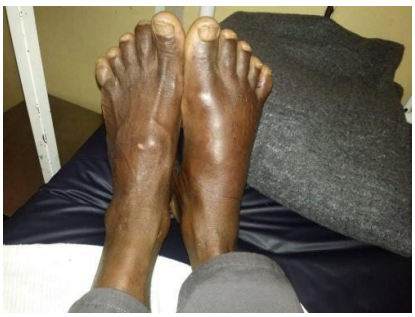
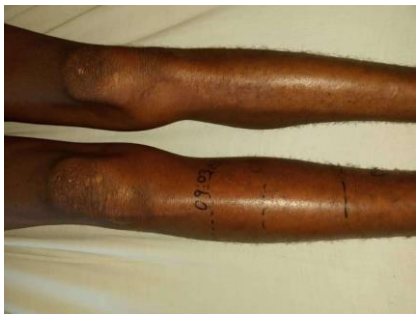
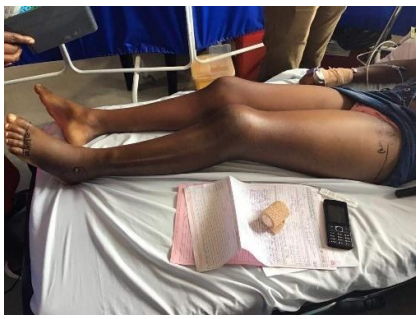
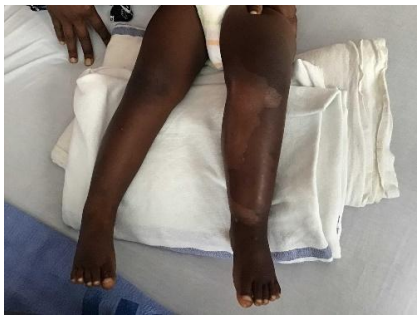
Figure 22: Snouted Night adder (Causus defilippii) Eswatini; (a,b) typical example (c) distinguishing pointed upturned snout.

Annexes

Annex 2: Indications for Antivenom



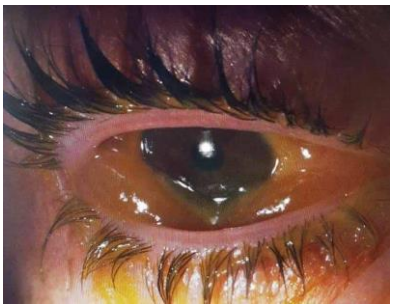
Annex 3: Differentiating Between Mild to Gross Swelling

Swelling level	Symptoms	Example pictures
Minimal Swelling	Minor swelling limited to the bite site	
Mild swelling	Swelling involving the whole hand or foot, up to the wrist or ankle, respectively. Not crossing a joint.	
Moderate Swelling	Swelling up to the proximal thigh from a foot bite or up to the shoulder from a hand bite. Not crossing two joints.	
Severe Swelling	Swelling up to the groin or ipsilateral chest wall from a foot or hand bite, respectively.	
Gross Swelling	Swelling up to the trunk from a foot bite or up to the opposite side of the chest, abdomen or neck from a hand bite	

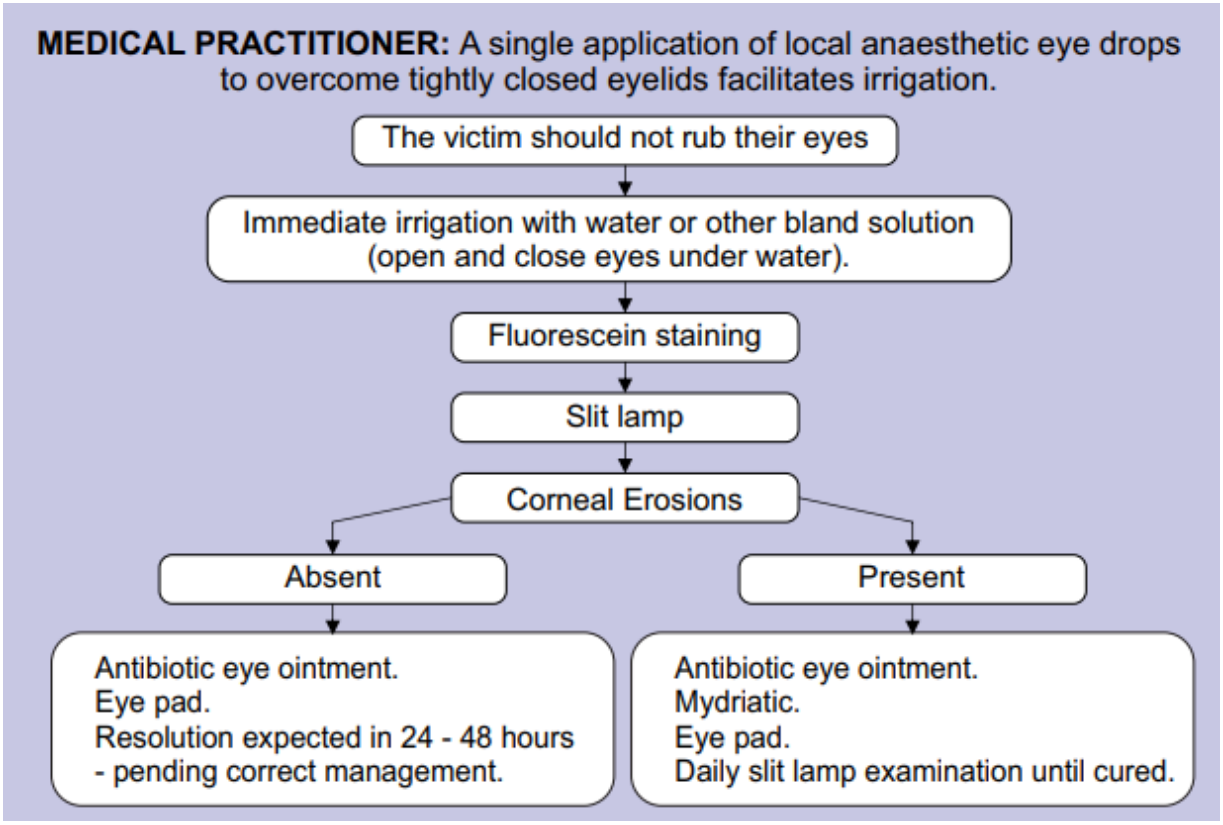
Annex 4: Flow Charts for Venom Ophthalmia

Symptoms: Photophobia, burning, watering, redness, extreme pain and blurred vision	Do NOT use polyvalent antivenom in the eyes- Use for bites only
The correct management of snake venom ophthalmia leads to fast recovery	

- Venom ophthalmia is a form of envenoming which presents as intensely painful blurred vision associated with blepharospasm, conjunctival congestion, corneal epithelial defects and chemosis.



- A drop of adrenaline or local anaesthetic eye drops will assist with the irrigation of the eyes if there is considerable pain.
- Immediately flush the eyes with clean water or saline for 10 to 15 minutes.
- A delay in washing the venom from the eyes increases the exposure to the venom which can cause scarring of the cornea and loss of vision.
- Antivenom (dilute) topically or systemic is NOT indicated
- Steroids (topical or systemic) are contraindicated
- Encourage patients not to rub herbal, home or traditional remedies in their eye.
- Venom elsewhere:
  - In the mouth: wash out with water or other bland solution
  - On the skin: wipe or wash off.



Annex 5: Reference Ranges and Doses

Adrenaline: to be administered subcutaneously 10 minutes **prior** to starting antivenom.

Age	ADRENALINE SC DOSE	**VOL (ml)** of the 1mg/ml (1:1000) solution
<6 years	0.15 mg	0.15 ml
6-12 years	0.25 mg	0.25 ml
>12 years	0.25 -0.5 mg	0.25 – 0.5 ml

[Note – if the patient goes into anaphylaxis, the same doses above can be administered intramuscularly]

Neostigmine: for use with snouted cobra only.

- To be used intravenously immediately after atropine.
- Adult dose 2.5mg. Paediatric dose is 2.5 mg. Neostigmine diluted to a volume of 5 ml.
- Neostigmine / atropine can be administered every 2-4 hours if there has been significant improvement after the first dose.

Age	Body weight	NEOSTIGMINE IV dose
1-3 Years	Under 11 kg	Up to 0.25 mg
4-7 Years	11-15 kg	0.35 mg
8-11 Years	16-20 kg	0.45 mg
12-17 Years	20-50 kg	0.5 mg to 2.5 mg
Adults	50 kg and above	0.5 mg to 2.5 mg

Atropine: to be administered intravenously.

- Adult dose 12 years > 0.6 mg.
- Paediatric dose (1 ml / 0.6 mg) diluted to 3 ml.
- The below dose can be administered for excessive oral secretions.
- Do NOT administer if BP> 150 mmHg and/or HR > 100 bpm.
- Atropine can be administered every 2-4 hours.

BODY WEIGHT	ATROPINE IV DOSE
Up to 3 kg	0.1 mg
3-7 kg	0.15 mg
7-9 kg	0.2 mg
9-12 kg	0.25 mg
12-16 kg	0.3 mg
16-20 kg	0.35 mg
20-27 kg	0.4 mg
27-32 kg	0.5 mg
32 kg and above	0.5 mg – 1 mg

Antivenom

- Polyvalent: to be administered slow IV push, one vial a minute
- Monovalent: to be administered slow IV push, one vial per minute

Minimal Initial antivenom dosage

Syndrome	Venom	Species Responsible	Initial dosage AV	If symptoms persist after	Additional dose AV	Comments
PPS	Cytotoxic	Mozambique spitting cobra; Puff adder*; Rinkhals**	50ml Polyvalent	1 Hour	20ml	Repeat with 20ml every hour until symptoms stop.
PW	Neurotoxic	Black mamba; Snouted cobra	40-80ml Polyvalent	1 Hour	20ml	Repeat with 20ml every hour until symptoms stop.
Mixed PPS & B	Cytotoxic & Haemotoxic	Puff adder*	50ml Polyvalent	1 Hour	20ml	Repeat with 20ml every hour until symptoms stop.
Mixed PPS & PW	Cytotoxic & Neurotoxic	Rinkhals**	50ml Polyvalent	1 Hour	20ml	Repeat with 20ml every hour until symptoms stop.
Bleeding Syndrome	Haemotoxic	Boomslang	10ml Monovalent	6 hours	10ml	Repeat with 10ml every 6 hours until symptoms stop
Bleeding Syndrome	Haemotoxic	Vine snake	No antivenom available			

*Bite from a puff adder can present as PPS or Mixed PPS & B
**Bites from a rinkhals can present as PPS or Mixed PPS & PW

Metoclopramide:

Paediatric and adult dosage:

Age	IV Dose	Frequency
<6 years	0.1 mg / kg	TID
6-14 years	2.5 – 5 mg / kg	TID
>14 years	10 mg	TID

AIRWAY MANAGEMENT (Adult or Child)

In case of neurotoxic bites

- Apnoeic patient
- Ensure open airway
- Apply cricoid pressure
- Ensure initial oxygenation
- Secure airway (depends on skill and availability of equipment)
- Tracheal intubation or laryngeal mask airway
- Ventilate

Vitamin K:

- For all patients who present with an ongoing coagulopathy **six hours post the administration of antivenom**.
- Adult and Paediatric: Vitamin K (1 ml / 1 mg) slow IV bolus.
- Do not give IM vitamin K to a snakebite patient, as haematoma is a risk.

Vital signs			
Age	Hear rate (beats per minute)	BP mmHg	Respiratory rate breaths per minute
Premature	120-170	55-75/35-45	40-70
0-3 month	100-150	65-85/45-55	35-55
3-6 month	90-120	70-90/50-65	30-45
6-12 month	80-120	80-100/55-65	25-40
1-3 years	70-110	90-105/55-70	20-30
3-6 years	65-110	95-110/60-75	20-25
6-12 years	60-95	100-120/60-75	14-22
12> years	55-85	110-135/65-85	12-18

Paediatric Fluid Maintenance Calculation		
Weight/ kg	Method A: Daily IV requirements (ml/24 hrs)	Method B: Hourly IV requirements (ml/24 hrs)
3-10 kg	100 ml / kg	4 ml / kg
10-20 kg	1000 ml + (50 ml / kg for each kg over 10 kg)	40 ml + (2 ml / kg/hr for each kg over 10 kg)
>20 kg	1500 ml + (20 ml / kg for each kg over 20 kg)	60 ml + (1 ml / kg/hr for each kg over 20 kg)

Paediatric Fluid Maintenance Calculation			
Weight/ kg	Total Fluid Intake ml/hr	Weight kg	Total Fluid Intake ml/hr
3	12	20	60
4	16	25	65
6	24	30	70
8	32	35	75
10	40	40	80
12	44	45	85
14	48	50	90
16	52	55	95

Endotracheal Tube Size Guide			
Size	Recommended age	Size	Recommended patient
2.5	Pre-term neonates	5.5	8 to < 10 years
3.0	≥3 kg to < 8 months	6.0	Large child
3.5	8 months to 2 years	7.0	Adult female
4.0	2 to < 4 years	8.0	Adult female/male
4.5	4 to < 6 years	9.0	Adult male
5.0	6 to < 8 years		

Annex 6: First Aid for Snakebite by Venom Type

First aid is site and situation specific.

Species	Venom	First-Aid	Antivenom
Mozambique Spitting Cobra (*Naja mossambica*)	Cytotoxic	Elevation. Do not use a pressure bandage or tourniquet	Effective
Puff Adder (*Bitis arietans arietans*)	Cytotoxic and to a less extent, Haemotoxic	Elevation. Do not use a pressure bandage or tourniquet	Effective
Rinkhals (*Hemachatus haemachatus*)	Cytotoxic and to a lesser extent, Neurotoxic	Keep limb lower than heart. Do not use a pressure bandage or tourniquet	Effective
Stiletto Snake (*Atractaspis bibronii*)	Cytotoxic	Elevation. Do not use a pressure bandage or tourniquet	**NOT effective**.
Night Adder (*Causus rhombeatus*)	Cytotoxic and to a less extent, Haemotoxic	Elevation. Do not use a pressure bandage or tourniquet	**NOT effective**.
Berg Adder (*Bitis Atropos*)	Cytotoxic and Neurotoxic	Pressure Bandage	**NOT effective**.
Black Mamba (*Dendroaspis polylepis*)	Neurotoxic	Broad Tourniquet.	Effective
Snouted Cobra (*Naja annulifera*)	Neurotoxic and to a lesser extent, cytotoxic	Pressure Bandage	Effective
Intermediate Shield Cobra (*Aspidelaps scutatus intermedius*)	Neurotoxic	Pressure Bandage	**NOT effective**.
Boomslang (*Dispholidus typus*)	Haemotoxic	Pressure Bandage	Effective
Vine Snake (*Thelotornis capensis capensis*)	Haemotoxic	Pressure Bandage	**NOT effective**

Additional Resources

For more information on snakebite treatment, snakebite prevention and the antivenom foundation, visit any of the following sites:

Eswatini Antivenom Foundation
https://eswatiniantivenom.org/

Snakebite prevention and first aid video
https://www.youtube.com/watch?v=U8hy2QhnI0g&t=7s

WHO Snakebite envenoming
https://www.who.int/health-topics/snakebite

Minutes to Die Snakebite documentary
https://www.youtube.com/watch?v=jKOSo_9kvtA

World Health Organization
Eswatini

eswatini
antivenom
foundation