

Conclusion

A better safety culture is on the rise in all sectors of our economy, following the institutionalization of proactive accident prevention strategies. Training and information programmes on safety and health are no longer the duty of government officials alone but of everyone. There is an increase in safety and health training programmes organized by companies, private consultancies and non-governmental organizations addressing safety and health issues. The safety and health policy, rules and regulations are being revised through the work of committees where every sector of the economy is represented. The participation of industry has been increased.

In Kenya, there is now increased concern over the provision of good working conditions as part of good business practice. Proactive accident prevention strategies will be expanded to cover the whole country once the proposed National Disaster Centre is established.

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Prevention of snake bites and management of envenomations in Africa

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Snake bites constitute a serious public health problem and a medico-surgical emergency in Africa. Annually, the number of accidents involving snakes reaches one million, resulting in 600,000 envenomations and more than 20,000 deaths (1). The incidence ranges from 300 to 400 bites per 100,000 inhabitants per year in rural areas. Of these bites, half causes envenoming, and without treatment the mortality may reach 5 to 30% depending on the region. Especially in the rainy season it is frequent to see rural hospitals invaded by victims of envenomations or of one of the complications of envenomation.

Three factors contribute to the severity of snake bites in Africa (2):

- a) The diversity of species, some of which have a particular toxic venom.
- b) The density of snakes and the human activities, above all in rural areas, that result in numerous accidents
- c) The scarcity of health facilities and their poor equipment.

Diversity of ophidian species – Characteristics and populations

Two ophidian families are responsible for most accidents in Africa (3). The *Elapidae* (cobras and mambas) are proteroglyphic snakes, with fixed poison fangs in the fore part of the maxillary. Their venom is essentially composed of toxins and phospholipases. The envenomation results in neuromuscular symptomatology, respiratory paralysis and – in the absence of correct treatment – death by asphyxia. The *Viperidae* (true vipers) have a more sophisticated venomous apparatus: their long and powerful poison fangs are mobile and re-erect at the moment of the bite. The venoms of the *Viperidae* are particularly rich in enzymes that have, most notably, an effect on blood coagulation. They induce severe local symptoms; pain, inflammation, oedema and necrosis, followed by an often lethal haemorrhagic syndrome (purpura, epistaxis, haematemesis, haematuria, meningeal haemorrhage).

The other families of snakes do not constitute such a risk for humans. Except for a few rare exceptions, no *Colubridae* have a venomous apparatus capable of injecting venom. The *Atractaspidae* are crepuscular or nocturnal little burrowing snakes. Only the genus *Atractaspis* includes venomous species. Their venomous apparatus is the same as for the vipers. The venom causes necrosis and is cardiotoxic. Apart from some regions where the incidence of bites by *Atractaspis* seems to be higher, envenomations by snakes belonging to this family are rare.

The encounter of snake and humans is not accidental. It results from behav-



Photo by D. Heuvelin

Naja melanolenca (cobra= Elapidae)

The DOHSS provided the experts as resource personnel, assisted by consultants who have received safety and health training. Most of the training events were held at the enterprises themselves.

Active promotion of safety and health for enhanced economic development and industrial growth

Apart from fostering stakeholders' active participation in the establishment of safety and health policies and in the provision of training and information, the government has used economic losses arising as a result of accidents, the subsequent increased medical costs and low productivity as indicators for safety and health at all levels. Citizens have been enticed to be creative to improve their working life by minimizing accidents and diseases at workplaces.

The government is converting the present workmen's compensation systems into a work injury benefit scheme where every worker will be compensated in case of an occupational accident. Workers, trade unions, employers and their associations will be members of the board running the new scheme, and the government's role will be to develop policies to manage and control the activities of the scheme. It is further envisaged that the accident prevention programmes will be financed from scheme resources set apart from the rehabilitation centres that will be established under the scheme. Workers, employers and their unions are being given the autonomy to play their rightful roles in preventing accidents at their level so as to minimize the premiums of the insurance scheme while at the same time playing a role in deciding their own destiny.

It is therefore the intention of the government to move services closer to the people and to involve them in achieving better results. The hope is that the consequent improvements will stimulate investments, culminating in increased socioeconomic development that will promote industrialization.

Strengthening of national, regional and international co-operation

Because it would be very costly and unmanageable for an individual enterprise to implement preventive strategies, in every sector of the economy, working groups comprising a number of enterprises, with technical assistance from government officials, have been formed to prevent accidents at plant level and to put into place good management plans and control strategies. This new approach is activating many enterprises to strive to be included in the programmes.

The Nairobi Disaster Prevention Committee is one of the best examples of a working committee. This committee, made up of government officials

assure citizens of their safety. In the same vein, international know-how is being tapped in order to improve approaches and enrich the existing knowledge. There remains much to be done internationally in order to acquire the best methods and to minimize duplications. We need closer co-operation with international agencies and organizations to be able to obtain support for enhancing local capacities.

Areas of concern

Good planning and organization are the cornerstones of proactive strategies in accident prevention. Accident prevention strategies, however, are expensive and outside the reach of many developing countries; this is an area in need of

attention. There is also concern with regard to linking good business practices with the provision of a safe and healthy work environment, especially as international trade will require a safe and healthy work environment. Hence a good working life is an area of great concern to developing economies.

There is an abundant supply of trained safety and health experts in industrialized countries. This expert knowledge should be shared with the few experts available in

developing economies in order to develop training programmes, thereby assisting the local experts in popularizing and institutionalizing safety and health.

Systems for reporting accident statistics are well documented in industrialized countries, while very poor systems, if any, exist in developing economies. This has resulted in repeated occurrences of accidents and disasters affecting many people around the globe. Expertise should be transferred and enhanced so as to address the issues of safety before disasters and accidents occur, not after. The transfer of cleaner, healthier and safer technology should be a global concern, and mechanisms should be introduced to monitor that this is carried out. Otherwise accidents and disasters will continue to cause devastation despite the adoption of the best proactive accident prevention strategies.



Photo by David G. Kipara

Poor working postures lead to unnecessary fatigue and work accidents.

and private sector representatives, was formed to draw up plans to control and manage fires in Nairobi and its immediate environment. The various communities in Nairobi were encouraged to participate in the process. Thanks to the committee's good work and expertise, their terms of reference have been expanded to cover all aspects of disaster management, including safety and health. The work of this committee is being replicated in other cities and towns of Kenya. The government is now widening the committee's authority to form a National Disaster Centre (NDC) with the mandate of co-ordinating prevention programmes at the national level.

Kenya cannot be safe unless her neighbours, too, are safe. Thus, through East African co-operation, safety and health issues have been itemized and a regional committee is in the making to

our characteristic of both protagonists and may be studied with a view to prevention.

Snake behaviour

The snake is territorial. Its living area per individual is generally limited to some ten acres, even less for small species. Irrigation or agricultural installations are an essential factor determining the distribution of the ophidian population: the attraction or the repulsion of some species results, on the one hand, in a modification of the density of the snake populations and, on the other, in the selection of certain species (Figure 1). The incidence of snake bites doubles in most plantations and, in some of them, it may even increase by tenfold (4). It has been shown that in banana plantations in the Ivory Coast, the number of snakes may be increased by fivefold or tenfold that in the surrounding bush area; the annual incidence of snake bites there can reach 3 to 4 bites per 100 workers.

Moreover, the severity of these bites depends on the plantations. In banana plantations that are irrigated by drain pipes, the majority of snakes are largely inoffensive piscivorous grass snakes, while in banana plantations that are not drained, little vipers (*Causus maculatus*) represent half of the snakes found there. In hevea plantations or palm groves, mostly Elapidae abound. In coffee or cacao plantations, where venomous snakes seem to be rarer, the big Vi-

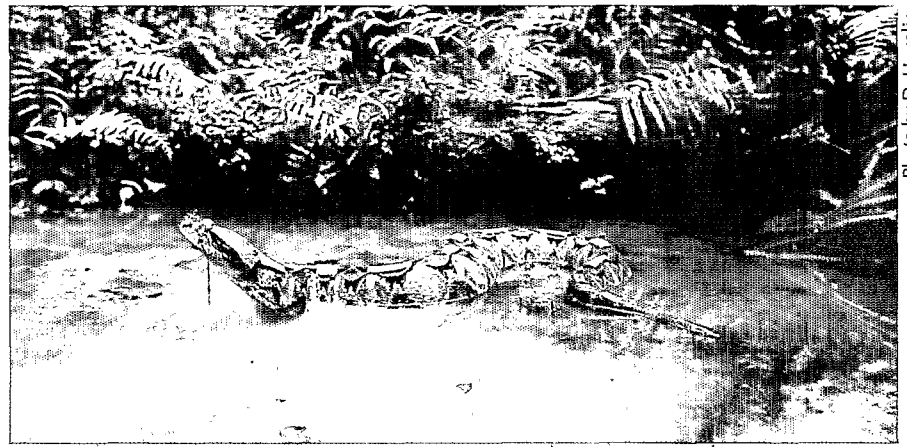


Photo by D. Heuvelin

Bitis gabonica (Viper) is one of the two ophidian families which are responsible for most accidents in Africa.

peridae (*Bitis* or gaboon viper) constitute the main risk. Thus, every type of plantation presents a particular risk which can be evaluated by organising regular "harvests" by the staff when they encounter a snake. In this way, the most frequent species can become known, and suitable preventive measures can be organized.

Snakes move around for two reasons: to hunt, which is a regular weekly activity throughout the year; and to mate, which is generally a more seasonal activity. The birth season generally occurs at the end of the dry season or at the very beginning of the rainy season. The newborn spread out from their place of birth to find their own living area. It is common to observe particularly high

densities of snakes during this period. As a matter of fact, it is interesting to note that most female snakes give birth to ten to twenty young and that the *Bitis*, for instance, give birth to some thirty little vipers that disperse immediately in the surroundings. From birth, the young venomous snakes are capable of biting and of inoculating enough venom to cause a severe or even lethal envenomation.

Human activities

Some professions involve a great risk of exposure to snakes than others do. Persons employed in agricultural labour account for 85% of those receiving snake bites. The type of activity varies during the year, which explains the seasonal distribution of bites.

A large majority of bites occur in food crop plantations, where traditional methods of cultivation still predominate. It has been observed that many bites are connected with a specific activity: unstubbing; weeding; gathering of wood or stones; or, generally speaking, any movement bringing a limb, foot or hand near a place that may be used by a snake as a hiding place. Moreover, since these movements are repetitive, watchfulness progressively decreases, which increases the risk.

Prevention of bites

Prevention aims at reducing, on the one hand, the number of snake bites, and, on the other, the severity of the envenomations and the resultant mortality. Prevention can be organized on three levels:

- Limiting the population of snakes on plantations
- Avoiding bites
- Improving treatment.

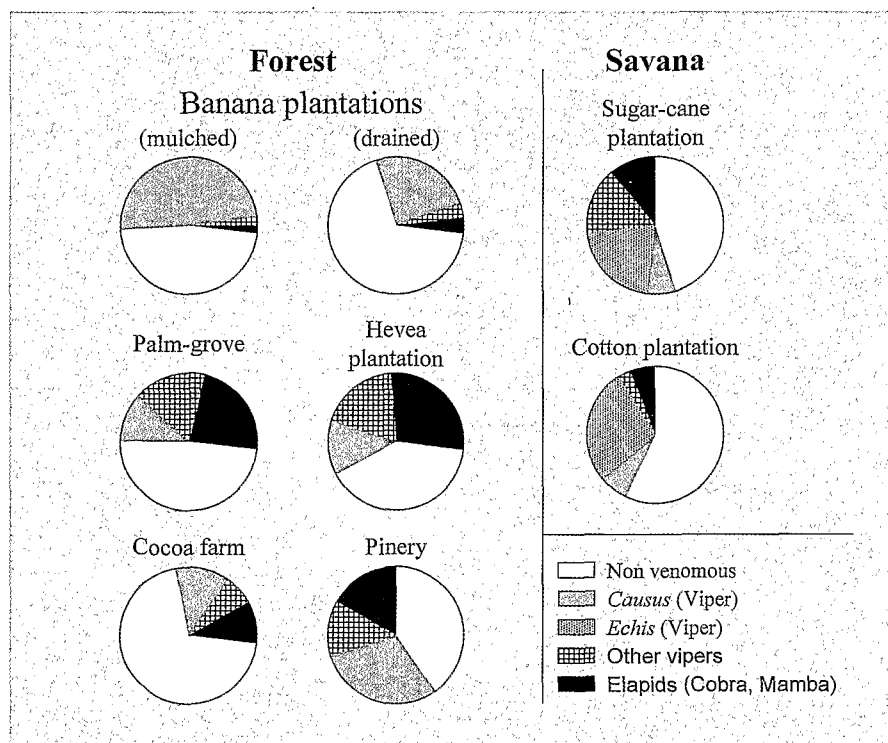


Figure 1. Variation in snake populations according to type of plantation

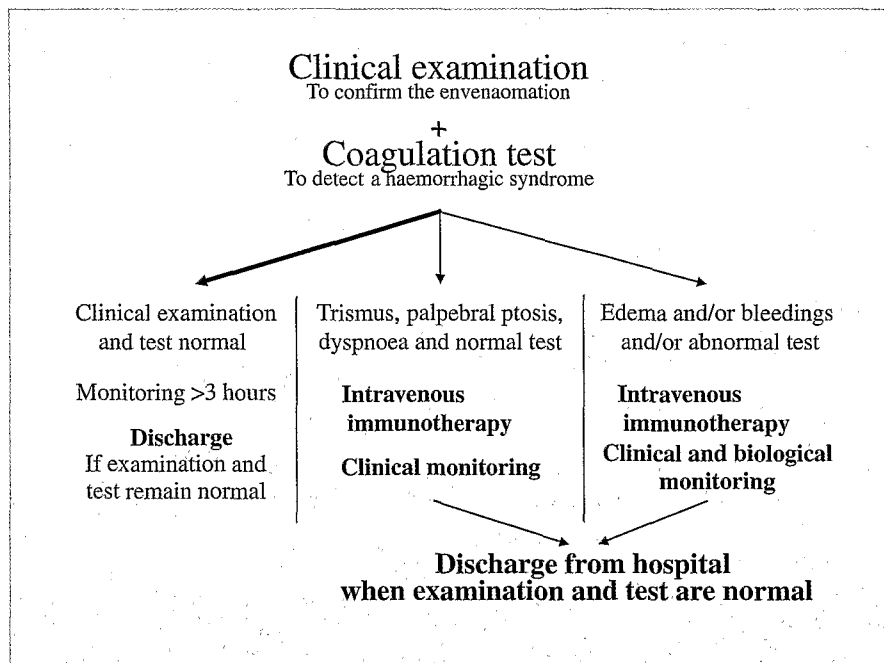


Figure 2. Guidelines for snakebite management

Snake control

This strategy has long been proposed but with only little success. The use of repellents or toxic substances is not only ineffective, but also costly and dangerous for the environment. In Japan, protective devices have been tested (traps, ditches or fences around the plantation) (5). An electric fence around cultivated land has been shown to be very effective. This device repels the reptiles without hurting them and considerably limits their penetration to the interior of the plantation. However, the cost remains high. Snake catching, encouraged by a bonus system, is often the source of fraudulent practices such as bringing in snakes that have been caught outside the plantation.

It must be remembered, however, that snakes contribute to the environmental balance, and their control may result in a rapid multiplication of their usual prey, especially of rodents which are also harmful (6).

Prevention of bites

One of the simplest and least costly means of preventing bites is the use of protective clothing. Wearing high boots and gloves significantly reduces the risk of bites. Wide-brimmed hats protect against tree-dwelling snakes that may fall upon the victim or bite at head height. Some dangerous movements have to be stopped or precautions taken before performing them. For example, hollows should be examined by using a stick or a tool, thus protecting the hand. Finally, mechanization of agriculture is

also a factor that will reduce risk considerably, since it limits direct contact between humans and snake.

Medical treatment

Rapid intervention and the prompt start of correct treatment are essential (Figure 2). Panic must be avoided, since it often leads to dangerous movements. The first-aid methods must be simple (see Box 1). Some 'first-aid measures', however, are unwise. Destruction of the venom by chemicals (acid, caustic soda, pure potassium permanganate) or by

Box 1: First-aid

Remember that less is often best

1. Reassure the patient
2. Wash and disinfect the wound
3. Apply a gently tight elastic bandage to the bitten limb
4. Immobilize the bitten limb
5. If drug administration will not delay admission to hospital, give the bitten person an analgesic (not salicylate), an antihistamine, a sedative (not hypnotic), or cardiotonic treatment
6. If the symptoms are severe, administer corticosteroids, and antivenom if available
7. Transfer the patient to the nearest hospital.

physical means (cauterization by fire), or slowing down the venom's diffusion by aggressive methods (e.g. tourniquet, incisions) have complications but do not stop the envenomation. It is, however, possible to administer drugs to calm the victim and to ease the pain, without risking aggravation of the patient's status. Paracetamol, antihistamines and tonics may be used without problems; corticoids should be used prudently, while salicylics are contra-indicated because of the haemorrhagic risk.

In the case of envenomation, immunotherapy is a unique specific treatment. The new, highly purified preparations of antivenom (fragments of highly purified gammaglobulins) are very well tolerated and very effective if they are correctly administered (7). They must be injected intravenously (by perfusion in glucose serum or by slow direct intravenous injection, depending on severity).

For bites by Viperidae, patient monitoring is essentially clinical and haematological. The entire blood-clotting test is easy to perform at the patient's bedside without any need for special equipment (8). Blood that is put in a dry glass tube normally clots after 10 to 15 minutes; beyond a clotting time of 30 minutes, a haemorrhagic syndrome is probable (9).

Immunotherapy is started with 20 ml of antivenom (Figure 3). A first evaluation is made two hours after the beginning of treatment. In the case of respiratory problems (Elapidae) or persistent bleedings (Viperidae), the treatment should be repeated under the same conditions. A second evaluation is made six hours after the previous administration. The treatment is repeated if the state of the patient has not improved (respiratory problems or haemorrhagic syndrome).

In areas where health facilities are present, it may be judicious to keep ampoules of antivenom at these facilities in order to allow treatment to begin immediately, before any evacuation to a better-equipped health centre.

Conclusion

The scarcity of health facilities and the circumstances surrounding snake bites are the main reasons for the excessively high number of snake bites and especially the high mortality of envenomations in Africa (10). Agricultural workers should be better informed as to the risk of accidents and how they should react if an accident occurs. They can protect themselves by wearing appropriate clothing. Dangerous first-aid meth-

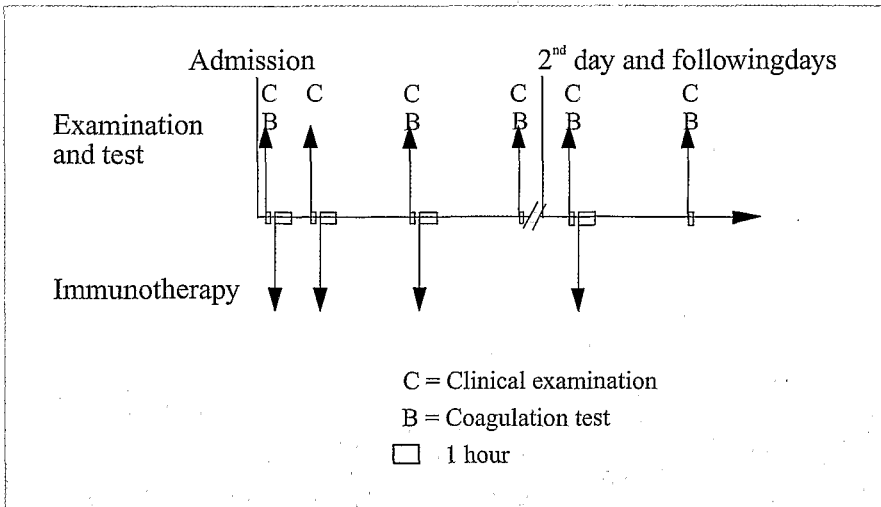


Figure 3. Immunotherapy protocol

ods, such as applying a tight tourniquet, using chemical products or cauterising the wound, should be discouraged.

Health care personnel must be prepared and trained in the surveillance and treatment of snake bites. Simple therapeutic protocols are now available, enabling the correct administration of immunotherapy, the unique specific and reliable treatment for envenomations.

Under these conditions, it should be possible to reduce the incidence of snake bites significantly and to decrease snake bite mortality by a factor of ten.

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Echis ocellatus bite – oedema and haemorrhage

Effect of training in prevention of accidents

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Introduction

An accident is an unexpected, unplanned and unwanted event that disrupts work and results in human injury, disease or death, damage to property, loss of production, time and money (1, 2). Every accident causes suffering to the victim and to the victim's family and in case of death or permanent disability, the accident may have a catastrophic effect on the family's life. Therefore, proper training and motivation of workers are of primary importance in accident prevention so that workers can identify hazards. Hazards can be removed (elimination); the probability of an accident can be reduced (containment); or the severity of accident consequences can be reduced (mitigation) (3).

State of problem

Lack of experienced trainers

The basic problem in Namibia is a shortage of training officers having the required educational qualifications, teaching abilities and level of industrial experience in advanced countries. In 1997, the Southern African meeting on the education and training of occupational health and safety professionals (4) concluded that the major feature of professional occupational health and safety education and training in the region is currently its absence in many countries (for more detailed information see 4).

Some countries have limited or adhoc training programmes. Alongside this shortage of education and training, there is a shortfall of occupational health and safety professionals working in the field and the primary care practitioners providing the bulk of occupational health and safety services have weak occupational health and safety competences (4).

The safety organization

The foundation of safety management is built on the ten axioms of industrial safety, presented by Heinrich as early as in 1931. The ninth axiom assumed that "the supervisor or foreman is the key man in industrial accident prevention" (5). In a company, accidents occur due to unsafe conditions, unsafe acts or a combination of the two. According to ten basic principles of safety (6, 7) an unsafe act, an unsafe condition, and an accident all indicate that something is wrong within the management system (7).

The ultimate responsibility for successful implementation of the safety training programme lies with the top management. However, duties have to be delegated. Most studies on safety management have indicated that full involvement of the top management in safety is a very important factor (8, 9). Delegation which forms the link between the policy and the organization, and ensures implementation of the policy. The organization for safety imple-

mentation should be clearly designed, showing the responsibility of all concerned (10). The following are points to consider in formulating a safety organization:

- Unbroken and local delegation of duties through line management to the supervisors at sites where the hazard may arise.
- Identification of key personnel who are accountable to top management for ensuring that detailed arrangements enabling safe work are designed, implemented and maintained.
- Definition of the roles of line and functional management; job descriptions should identify specific roles and should avoid expensive and potentially dangerous overlapping.
- A concern for safety and health should be envisaged as an essential part of good management.

The job description should state the limits of the particular role associated with the job type. There should be arrangements for adequate support from the relevant operational management, not only from the safety officers. Per-



Photo by M. Amweelo

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