African horse sickness surveillance systems and regionalisation/zoning: the case of South Africa *

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Summary: Central and Southern Africa are generally regarded as being endemic areas for African horse sickness (AHS). With the advent of the concepts of risk analysis and regionalisation/zoning, however, the possibility has now arisen of establishing 'zones' within South Africa for AHS surveillance purposes.

In 1993, a protocol was submitted to the European Community (now European Union: EU), proposing the establishment of an AHS-free zone in the Cape peninsula. The proposal is based on historical evidence that AHS virus overwinters (in zebra) only in the Kruger National Park, from where it spreads westwards and southwards every year. The infection only extends to the Western Cape Province once every fifteen years.

A ban on vaccination in the proposed AHS-free zone has been suggested, together with strict control of the movement of horses into and through this zone. The entire equine population of this zone (some 8,000 animals) would serve as sentinels. All equine mortalities would be notifiable, with mandatory post-mortem examinations.

The establishment of an insect-free quarantine station in this zone would enable the movement of certified AHS virus-free horses from South Africa to the EU and the rest of the world.


INTRODUCTION

African horse sickness (AHS) has been known in Africa for many centuries. In South Africa, where no indigenous horses existed, the disease was first noticed soon after the introduction of horses from Europe and the Far East more than 300 years ago (4).

The virus responsible for the disease is transmitted by Culicoides midges, which are normally active from dusk until just after dawn. Transmission of the virus by insects means that incidence of AHS is strictly seasonal in most temperate regions, such as South Africa. In general, the disease first appears in mid-summer (December/January),

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peaks during early autumn (March/April) and disappears abruptly within two weeks after the onset of the first heavy frost in early May. AHS is also more prevalent in warm, moist, low-lying regions and during seasons of above average precipitation.

Available information indicates that AHS is endemic only in the lowveld of Northern and Eastern Transvaal Provinces (2). The disease invariably first appears in the northernmost areas of the country during or after spring, spreading southwards for variable distances depending on the time of the first appearance of the disease, the number of susceptible equids and the favourability of climatic conditions for breeding of Culicoides spp. This spread can obviously be facilitated by the movement of actively infected horses. Cases of AHS in racehorses and other competition horses are rare, and although racehorses are frequently transported between various racing and breeding centres, their movement plays a limited role in the spread of the disease. Horses other than racehorses are infrequently moved over long distances.

Zebra (Equus zebra) are susceptible to AHS virus; they may develop subclinical infection and can serve as a source of infection. Most of the zebra in South Africa (31,000 or 75% of the total population) are found in the Kruger National Park, where seroconversion of young zebra has been shown to take place during most months of the year, maintaining the endemic state of the disease in that part of the country (Fig. 1).

The southward spread of infection is terminated abruptly by the first heavy frost in May. It is of particular significance that an outbreak does not continue from where it stopped the previous season, as would be expected if carrier animals were present.

![Possible routes of African horse sickness infection within South Africa](image-url)
Instead, the infection retreats to the endemic area, from where it emerges again the following season (5). Available information indicates that outbreaks in successive years are usually due to different virus serotypes. Over the last thirty years, the disease has occurred every summer in the Northern and Eastern Transvaal and KwaZulu/Natal Provinces, approximately once every five to ten years in the Free State, and very rarely in the Western Cape Province (1). During the last outbreak of the disease in the Western Cape Province, in 1990, there was strong circumstantial evidence that the infection was introduced from the northern provinces by the transportation of horses which were incubating the disease.

Between 1979 and 1985, *Culicoides* midges were collected at twenty-five different sites throughout South Africa, and 918 virus isolates were made from 4,506 pools of midges. AHS virus was isolated in 66 cases, of which 94% were from midges collected in the Northern and Eastern Transvaal and KwaZulu/Natal Provinces. No virus isolates were obtained from the midges collected in the Western Cape Province (6).

**VETERINARY CONTROL OF AFRICAN HORSE SICKNESS IN SOUTH AFRICA**

The incidence of animal diseases in South Africa is monitored by the National Directorate of Animal Health through a national disease surveillance programme (Fig. 2). State Veterinary Offices are strategically placed in the nine provinces, and each province has a Provincial Director of Veterinary Services who is responsible for reporting disease occurrences to the National Directorate of Animal Health. State Veterinarians in each province are primarily responsible for disease surveillance in their respective areas. They are assisted by trained animal health technicians (Fig. 3).

Further support for surveillance is provided by sixteen diagnostic laboratories distributed throughout the nine provinces.

Existing legislation, the Animal Diseases Act (Act 35 of 1984), distinguishes between 'controlled' and 'notifiable' animal diseases. With controlled diseases (e.g. foot and mouth disease [FMD]), State intervention and the instigation of zoo-sanitary control measures are compulsory in the event of an outbreak; while the actions taken following an outbreak of a notifiable disease are in line with the definition of monitoring (3), i.e. data are gathered from the field but no official action is necessarily implied.

AHS vaccination is not compulsory in South Africa. Due to the higher prevalence of AHS in the northern regions of South Africa, however, most horses (probably more than 70%) in KwaZulu/Natal and the northern provinces are voluntarily vaccinated, while a lesser proportion are vaccinated in the Free State, and in the Eastern, Northern and Western Cape Provinces. This large-scale vaccination creates an effective immune barrier against the southward spread of infection.

**ZONING FOR AFRICAN HORSE SICKNESS IN SOUTH AFRICA**

The epidemiology of African horse sickness in South Africa seems to preclude any possibility of obtaining freedom from disease for the whole country, while supporting the contention that disease-free status is obtainable for a demarcated zone in the
Western Cape Province. Should South Africa wish to declare freedom from disease – and eventually perhaps even freedom from infection – in the proposed zone in the Cape peninsula, the first step will be to obtain provisional freedom from disease status, along the lines accepted by the OIE for FMD (3).

In order to declare the proposed zone provisionally free from disease, the following conditions must be fulfilled:

a) The proposed zone must have well-defined boundaries.

b) No clinical disease should have been detected for at least three years.

c) There should be an effective Veterinary Service which is able to monitor the animal health situation in the country and especially within the zone.

d) The Veterinary Service should investigate all clinical evidence suggestive of African horse sickness.

e) There should be an effective reporting system from the field to the central veterinary authority and thence to the OIE.

f) There should be a reliable system for preventing the introduction of infection, involving movement control, quarantine, etc.

g) All vaccination against African horse sickness in the proposed zone should cease by the date of declaration.
"Surveillance", as defined by the OIE (3), requires the following actions:

- obligatory reporting of any signs of disease or infection which come to the notice of livestock owners or officials of the Directorate of Animal Health;

- an active programme of examination of statistically-selected samples from host populations in order to detect clinical signs or other indications of disease occurrence or transmission of infection;

- official action (instigation of zoo-sanitary control measures) in the event of evidence of disease or infection being discovered in the proposed zone.

A protocol submitted to the European Community (EC: now European Union) in 1993 by the Directorate of Animal Health – in line with EC Council Directive 90/426 and the recommendations of the OIE – proposed the establishment of an AHS-free zone in a demarcated area in the Western Cape Province (Fig. 4). In this protocol, the following control measures were suggested:

- African horse sickness will be notifiable under the terms of the Animal Diseases Act 1984. However, the above requirements will necessitate the designation of African horse sickness as a controlled animal disease in the zone identified for declaration of provisional freedom from disease.
Proposed control zone for African horse sickness within the Western Cape Province, South Africa

- No vaccination against AHS will be allowed within the zone, except for horses which are due to be moved out of the zone and into the infected area. Such horses will be held on the premises of vaccination under veterinary surveillance and control until being moved out of the control zone.

- All horses in the zone will be individually identified, and those moving into or out of the zone will have an official passport containing details of all vaccinations, particularly against AHS.

- A complete census of all equids will be performed. The information obtained will be recorded in registers to be kept and updated by the owner and available for inspection by officials of the Directorate of Animal Health.

- Horses may enter the zone only if accompanied by a veterinary health certificate, issued by an authorised veterinarian at the premises of origin, which certifies that the horse has been examined on the day of movement and shows no clinical signs of disease, and that no contact had taken place with equids known to be suffering from infection in the fifteen days prior to movement.

- Other equids (e.g. donkeys, mules and zebra) will be allowed entry into the control area only during the ‘vector-safe’ period (July-September) and provided that they are isolated and tested twice for AHS virus antibodies (interval of twenty-one days), yielding negative results.

- No equids will be moved into the AHS control area for slaughter purposes.
Continuous monitoring of *Culicoides* spp. will be maintained at key locations within the control area, and these will be tested for the presence of AHS virus and other orbiviruses affecting equines. Two different host testing systems will be used for the isolation of virus, namely three blind passages on cell culture, Vero or BHK (baby hamster kidney) 21 cells, and intra-cerebral inoculation of two-day-old mice or intra-vascular inoculation of ten- to twelve-day-old embryonated eggs. Monitoring will include zoos and nature parks where equids are kept.

To establish the status quo and to demonstrate that there has been no incursion of AHS virus into the zone, a serological survey will be performed on a minimum of 500 randomly-selected blood samples from horses with a known AHS vaccination history (both vaccinated and non-vaccinated animals). These samples will be subjected to both the agar gel immunodiffusion test and a serogroup-specific enzyme-linked immunosorbent assay (4) to prove absence or presence of AHS antibodies.

Continuous monitoring for AHS virus infection will be conducted in non-vaccinated horses and other equids. Blood samples will be taken from a statistically-significant population (distributed evenly throughout the area) at regular monthly intervals and checked for seroconversion. This testing will be performed concurrently with the collection of *Culicoides* spp. from insect traps at key locations.

An insect-proof pre-embarkation quarantine facility will be established at the existing quarantine station at Cape Town, where the necessary zoo-sanitary control measures will be taken to prevent the introduction or spread of the disease.

**DISCUSSION**

The standards which are recommended for epidemiological surveillance before a country may apply for disease-free status with regard to FMD require a continuous review and planning of active surveillance, and the implementation of control measures for at least four years (3). It can be assumed that the measures accepted for FMD will serve as a working model for the declaration of freedom from disease with regard to other List A diseases, but adaptations for each disease will have to be made to accommodate differences in epidemiology, transmission, economic significance, means of control and diagnosis.

The OIE proposes the following requirements for provisional freedom from disease within a zone or région (3):

- well-defined boundaries
- no clinical disease for at least three years
- monitoring by effective Veterinary Services
- investigation of all clinical evidence suggestive of the disease
- effective system of reporting to veterinary authorities
- reliable system for preventing the introduction of infection (movement control, quarantine, etc.)
- no vaccinations against the disease.

Although the above proposals for AHS should meet the minimum requirements to obtain the status of provisional freedom from disease, it is debatable whether a total ban on vaccination in a declared zone would be feasible. In view of the epidemiology of
AHS (e.g. the high mortality rate), technological advances (e.g. vector identification), the development of more effective vaccines (inactivated and, possibly, recombinant vaccines) and the possibility of distinguishing serologically between naturally-infected and vaccinated animals create alternative means of disease surveillance, and the necessity of non-vaccination should therefore be reconsidered.

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Résumé : L’Afrique centrale et l’Afrique australe sont généralement considérées comme des zones d’endémie pour la peste équine. Grâce à de nouveaux concepts tels que l’analyse des risques, la régionalisation et le zonage, il est désormais possible de délimiter des « zones » de surveillance de la maladie en Afrique du Sud.

En 1993, un protocole a été soumis à la Communauté européenne (aujourd’hui l’Union européenne : UE) proposant de déclarer une zone de la péninsule du Cap indemne de peste équine. Cette demande se fonde sur la démonstration, apportée sur une longue période, que le virus ne fait qu’hiverner (chez les zèbres) au Parc National Kruger d’où il se propage ensuite, chaque année, vers l’Ouest et vers le Sud. L’infection ne gagne la province occidentale du Cap qu’un fois tous les quinze ans.

Les auteurs de la demande ont suggéré d’interdire la vaccination dans la zone proposée pour l’obtention de ce statut et de soumettre les déplacements d’équidés vers ou à travers ce périmètre à des contrôles stricts. Tous les équidés de cette zone (8 000 environ) serviraient ainsi d’animaux témoins. Toute mortalité devrait être déclarée, avec examen post-mortem obligatoire.

La création, dans cette zone, d’une station de quarantaine protégée des insectes permettrait les déplacements d’équidés reconnus indemnes de peste équine entre l’Afrique du Sud, l’Union européenne et le reste du monde.


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Resumen: África central y austral suelen ser consideradas áreas endémicas de la peste equina. Los nuevos conceptos de análisis de riesgos y de regionalización/zonación, sin embargo, ofrecen la posibilidad de establecer «zonas» dentro de Sudáfrica con fines de vigilancia sobre la peste equina.

En 1993 se presentó un protocolo a la Comunidad Europea (hoy Unión Europea: UE) en el que se propone establecer una zona libre de peste equina en la península de El Cabo. Esta propuesta se basa en la evidencia histórica de
que el virus de la peste equina sólo inverna (en cebras) en el Parque Nacional Kruger, desde donde se propaga cada año hacia el Oeste y hacia el Sur. La infección no se extiende a la provincia occidental de El Cabo más que una vez cada quince años.

Junto a un control estricto del paso de caballos al interior o a través de la zona que se propone declarar libre de peste equina, se ha sugerido prohibir la vacunación en el interior de dicha zona. El conjunto de la población equina del área (unos 8.000 animales) haría las veces de centinela. Sería obligatoria la declaración de toda mortalidad equina, así como la realización de autopsias.

La creación en esta zona de un centro de cuarentena protegido contra los insectos haría posible el desplazamiento de caballos certificados libres del virus de la peste equina desde Sudáfrica a la UE y al resto del mundo.


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REFERENCES