African Horse Sickness Vaccines

Webinar 28 April 2020

AHS Thailand

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DG SANTE

European Commission

Requirements for vaccines

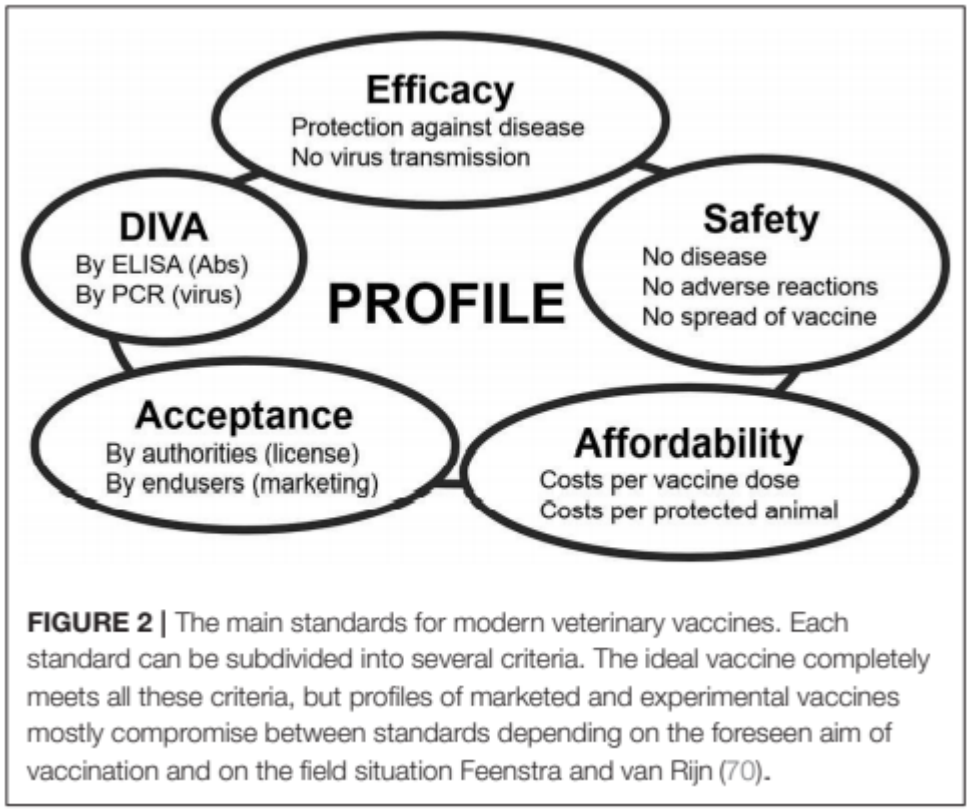


FIGURE 2 | The main standards for modern veterinary vaccines. Each standard can be subdivided into several criteria. The ideal vaccine completely meets all these criteria, but profiles of marketed and experimental vaccines mostly compromise between standards depending on the foreseen aim of vaccination and on the field situation Feenstra and van Rijn (70).

Prospects of Next-Generation Vaccines for Bluetongue
Piet A. van Rijn
Frontiers in Veterinary Science, November 2019, Volume 6, Article 407
www.frontiersin.org

AHS vaccines - OIE

SECTION 3.5.

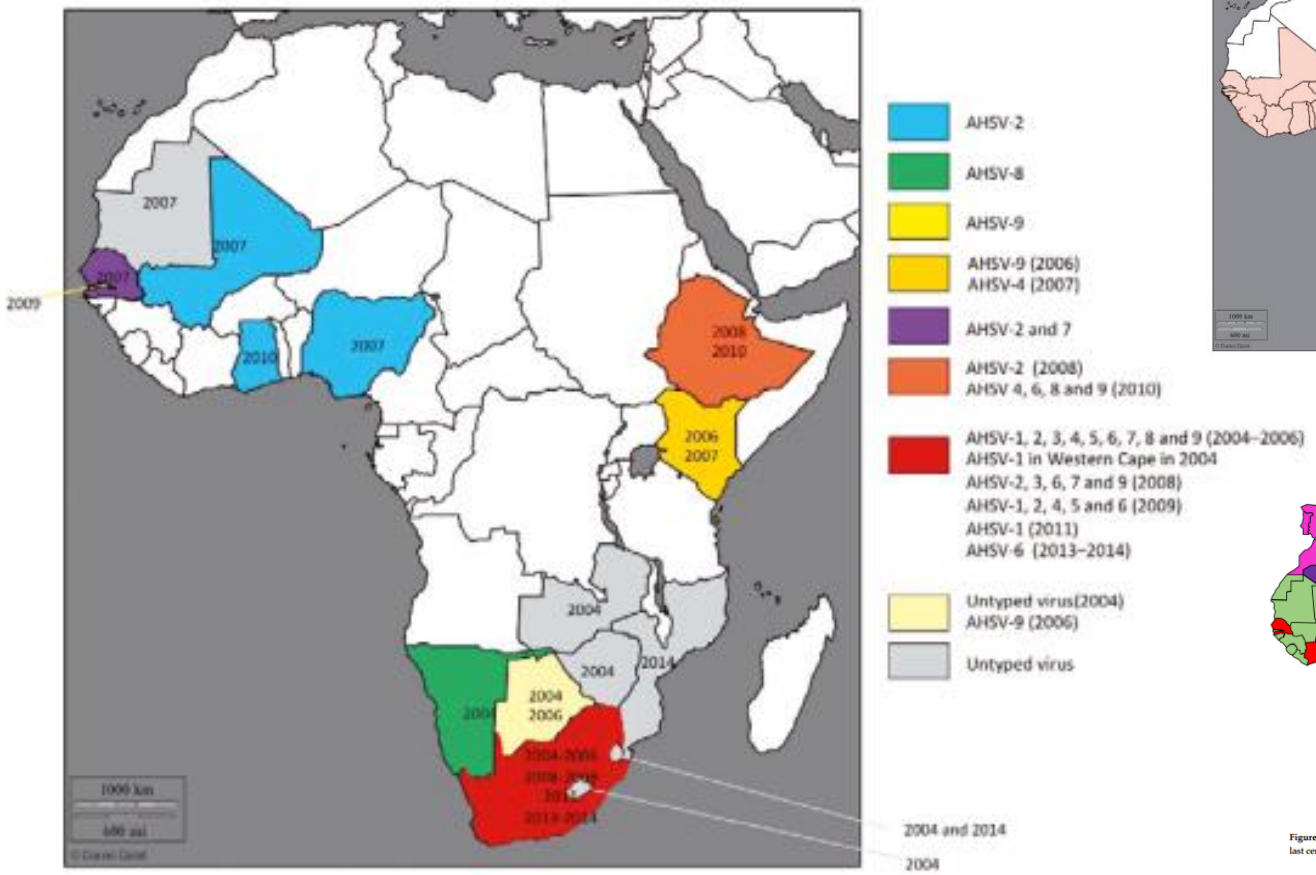
EQUIDAE

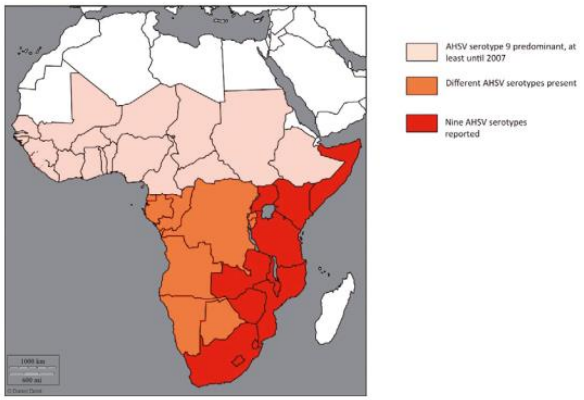
CHAPTER 3.5.1.

AFRICAN HORSE SICKNESS (INFECTION WITH AFRICAN HORSE SICKNESS VIRUS)

Requirements for vaccines: *Attenuated (monovalent and polyvalent) live vaccines for use in horses, mules and donkeys, are currently commercially available. Subunit vaccines have been evaluated experimentally.*

African horse sickness , S. Zientara , C.T. Weyer, S. Lecollinet, Rev. Sci. Tech. Off. Int. Epiz., 2015, 34 (2), 315-327
African Horse Sickness: A Review of Current Understanding and Vaccine Development , Susan J Dennis , Ann E Meyers , Inga I Hitzeroth and Edward P Rybicki , Viruses 2019, 11, 844; doi:10.3390/v11090844
www.mdpi.com/journal/viruse





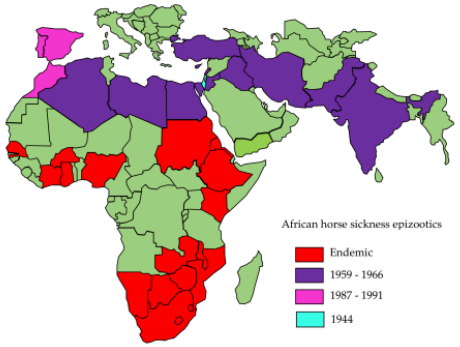


Figure 1. A map of African horse sickness outbreaks that have occurred worldwide during the last century.

b) Recent outbreaks of African horse sickness (2004–2014)

Based on data from the OIE World Animal Health Information Database, Promed alerts and a review of the literature (8, 9, 10)

Known live attenuated AHS vaccines

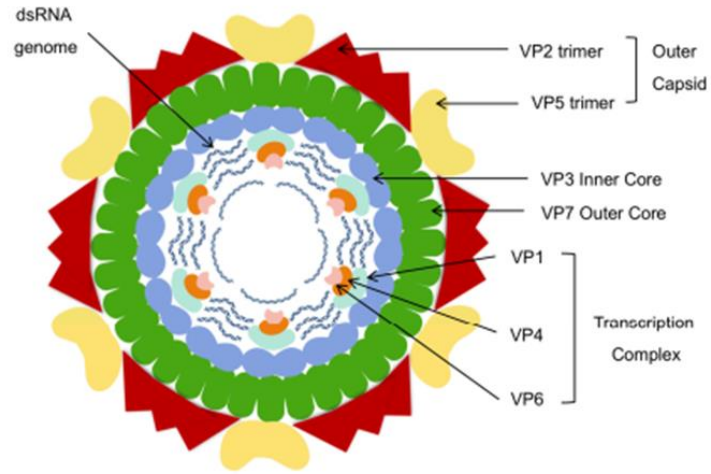
- AHSV-(1-3-4)+(2-**6**-7-***8***) (Onderstepoort Biological Products, South Africa))
  - Cross-protection AHSV-**9**/***5***
- AHSV-**9**+***2*** vaccine (National Laboratory, Senegal)
  - Cross-protective AHSV-**6**/***1***
- AHSV-**9**+4+***2*** (National Veterinary Institute Ethiopia)
  - Cross-protection AHSV-**6**/***1***

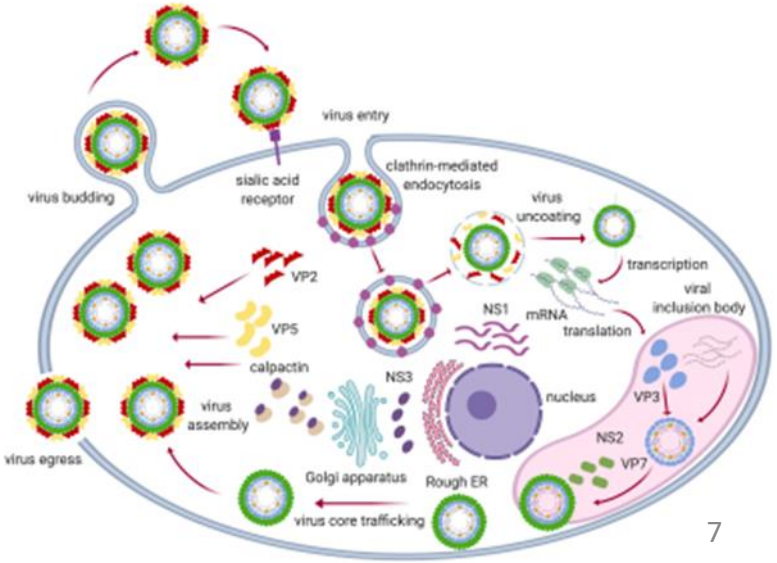
African Horse Sickness: A Review of Current Understanding and Vaccine Development
Susan J Dennis , Ann E Meyers , Inga I Hitzeroth and Edward P Rybicki,
Viruses 2019, 11(9), 844; https://doi.org/10.3390/v11090844

TYPE OF VACCINE	STRATEGY	ADVANTAGES	DISADVANTAGES
LIVE ATTENUATED VACCINES	Attenuation of live virus by serial passage in a heterologous host or cell culture. Low-level replication in the vaccinated animal permits the stimulation of virus-specific immunity.	- Mimics sub-clinical infection - Stimulates both humoral and cellular immune responses - long-lived immunity - can contribute to herd immunity - cost-effective	- reversion to virulence - gene segment re-assortment - non-DIVA compliant - variable serotype-specific immune response - requirement for high level bio-safety facilities - not licensed for use outside Africa
INACTIVATED VACCINES	Large quantities of virus are produced and inactivated by chemical or physical procedures. Infectivity is eliminated without destroying the antigenicity of the virus.	- safe - stable - no genetic re-assortment	- transient immunity - non-DIVA compliant - expensive - possible reaction to adjuvant - requirement for high level bio-safety facilities

AHS Virus

- AHSV is a non-enveloped double-stranded RNA virus
- genome consists of 10 segments (S1 to S10)
- RNA encodes
  - 7 structural proteins (VP1–VP7)
  - 4 nonstructural proteins (NS1, NS2, NS3, NS3a)
- 9 serotypes (AHSV1 to AHSV9)





RECOMBINANT VACCINES			
DNA Vaccines	DNA encoding viral proteins is injected as the vaccine. DNA is transcribed and translated to produce viral protein which elicits an immune response in the vaccinated host.	- safe - stable - cost-effective once gene is cloned - DIVA compliant	- low humoral response - possible incorporation into the host genome
Subunit vaccines	A specific viral protein is purified or produced via recombinant DNA technology and presented to the host's immune system	- safe - DIVA compliant	- weak immunogens - expensive - possible protein aggregation - boost inoculations required - need potent adjuvant
Poxvirus-vectored vaccines	The gene encoding an antigen target for neutralizing antibodies is cloned into a poxviral vector. Animals vaccinated with the recombinant virus mount an immune response to the antigen of interest.	- Induces both humoral and cellular immunity - more than one gene per vector possible - DIVA compliant	- costly - complicated design strategy - requirement for high level bio-safety facilities - can't be used in immune-compromised animals
Reverse genetics vaccines	Recombinant virus strains are genetically engineered to lack a functional gene, allowing either only a single replication cycle or preventing viral egress and inhibiting viraemia. Purified recombinant viruses are used as the vaccine.	- does not cause disease - low risk of genetic reassortment - DIVA compliant	- complicated design strategy - expensive
VLP vaccines	AHSV structural proteins are expressed from recombinant bacterial strains in mammalian, insect or plant expression systems. These assemble into empty viral-like particles which are administered with adjuvant as the vaccine.	- Safe - No risk of reversion to virulence - No risk of genetic re-assortment - Cost-effective in plants - Ease of scale up in plants - DIVA compliant	- Costly if produced in insect or mammalian cells - Possible reaction to adjuvant

Thank you