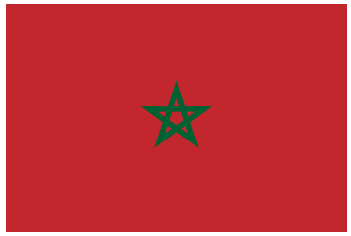

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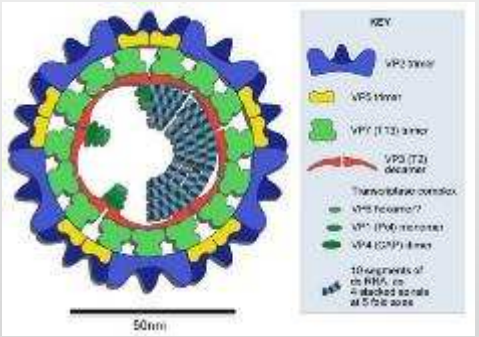
Lessons to be Learned from AHS Previous Outbreaks in Morocco

African Horse Sickness (AHS)

- Viral disease of Equidae, listed disease Obligatory notification and recognized status
- Seasonal: epizootics during the warm season associated with the vector. Prevalence linked to Moist mild conditions, intense vegetation and warm temperatures.
- Wind has been implicated in dispersal of infected Culicoides in some epidemics
- Usually subclinical in donkeys and zebra, but often fatal in horses.



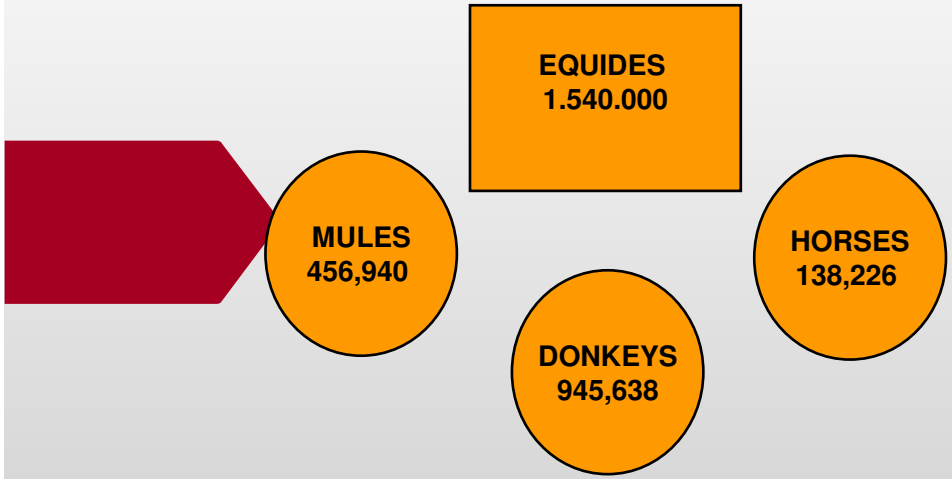
Morocco: AHS High Risk Country

Morocco present favorable conditions for AHS spread:

- **The green belt NW, between Atlantic ocean and Atlas Mountains**
- **Temperate climate**
- **Vegetation cover and frequent swampy areas**
- **Intensive presence of Culicoides, AHS vector**
- **Huge equine population**

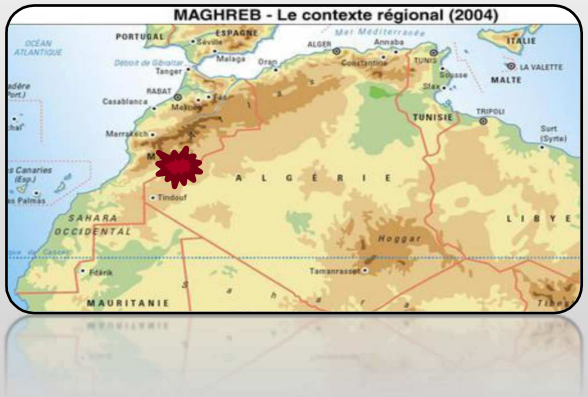
Morocco Equids Population

Long and secular equestrian tradition. Fundamental socio-economic and cultural appeal for animal traction, to transport goods and people. Over 1000 *Tbourida* troops employing some 15000 horses. These troops participate in horse competitions on the local or international events and competitions



History of AHS in Morocco: the 1965 epizootic

- First outbreak reported in the SE of Morocco borders, The virus succeed to cross the Sahara barrier
- AHSV serotype 9 spread North to Europe and East to Algeria and Tunisia.
- Huge socio-economic consequences on the horse sector: the loss of around 30% of the horses country population, prohibition of animal export, disruption of social life through the prohibition of horse events, impact on agriculture work and transportation.
- Last cases reported in Autumn 1967. TATA



The 1989 AHS epizootic

1987 Episod

1987; AHS notified in Spain (serotype 4) introduced through zebra import

1988 reappeared in SW spain vaccination, vaccine bank in Morocco

1989 Episod

Oct. 1989 First outbreak reported in Tetouan of Iberian origin

AHS spread SW (100 Km), Vaccination in all infected areas, surveillance zone

1990 Episod

August 1990: Resurgence of AHS, vaccination and extension of surveillance zone
Dec.1990: last outbreak reported in NE

The 1991 AHS epizootic

AHSV spread 400 Km SW to Marrakech region and southern

Intensive vaccination allow control of AHS

Oct. 1991 : The last outbreak notified

Spring 1994 : last vaccination

AHS eradicated

Year	Cases	Death
1989	512	71
1990	555	47
1991	177	88

Lessons learned from AHS outbreaks

1. Disease reintroduction
2. Epidemiological surveillance
3. Vector surveillance
4. Hosts susceptibility
5. Early diagnosis
6. Sanitary prophylaxis
7. Vaccination strategy
8. Post vaccination monitoring

Lessons learned from AHS outbreaks

1. Disease re-introduction

- The previous AHS introduction in N Africa or Spain was through animal's import from Austral Africa. Wind transportation of infected culicoides allows spread of the Disease to neighbouring countries: No introduction by animal movement, trade or social event.
- The Grand Sahara desert seems an efficient natural barrier for contagious diseases. It's not the case for vector borne diseases such AHS, BT, EHD and WNV. Those viruses can easily cross this barrier any time.
- Information on the epidemiological situation in endemic countries is essential to establish a regional strategy.

Lessons learned from AHS outbreaks

2. Epidemiological surveillance

- In 1987, despite information transmitted by Spain VS, Morocco did not succeed to stop the disease introduction in the country two years later in 1989,
- It was also the case with BT1 outbreak, notified in Algeria (2006) months before its introduction in Morocco
- However, surveillance at borders may help in early warning system and implementation of prophylactic measures.
- Sentinel herds maintained on boarder areas regulatory tested by PCR and serology may also help in early warning mechanism

Camels, Dogs: sentinel animals?

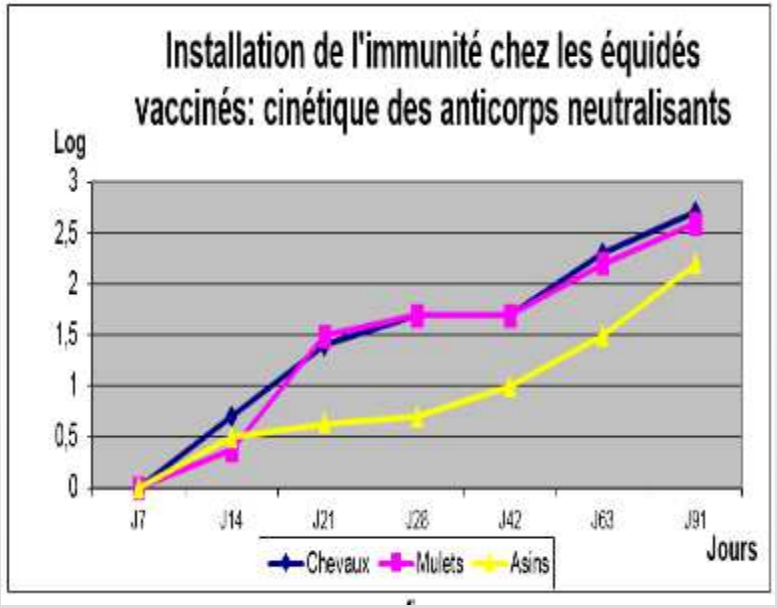
- Several studies conducted in the past confirmed that dromedary camels or dogs can replicate BTV and AHSV with no clinical signs
- Animals seroconverted with neutralizing antibodies with similar kinetic as horses for AHS or ruminants for BTV
- Camels or Pets could be the sentinel of choice because of:
  - A representative population presence
  - Camels the only animal moving in the desert margin
  - Longevity (>30 yrs)
  - Contacts with horses
  - No vaccination is conducted

3. Hosts susceptibility

Species	Population	Mortality rate	Morbidity	Susceptibility
Horses	200 000	50-75%	70 %	Severe cases are subacute pulmonary forms. Most frequently observed: the heart form.
Mules	400 000	Rare	< 2%	Controversai data
Donkeys	1 000 000	0 %	0 %	Sub-clinical infections

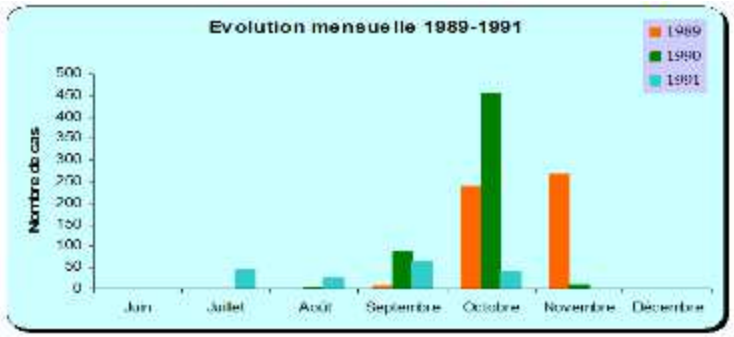
- Morbidity and mortality varies with species, immunity status, form of disease
- High percentage of equids population (87.5 %) do not show any clinical sign
  Surveillance carried out only by laboratory analysis.

Species susceptibility



Huge population
No clinical symptoms of AHS
Low response to vaccination compared to horses and mules

4. The vector surveillance



- Abundance of Cuilicoides spp population, especially **Culicoides imicola** and **Culicoides newsteadi** for two periods, April-June for both species and October-November for imicola.
- Some areas are identified **at risk,** mainly the North West of Morocco.
- **Vector competitivity** mechanism need to be investigated; A new BTV I outbreak in the same zone caused elimination of EHDV in 2006.
- Last AHS and BT epidemics improved knowledge on entomological surveillance through trapping and diagnosis.
- Surveillance should include **all Orbiviruses present** in the country because of interaction.

5. Early Diagnosis

- **Clinical signs only in horses: Supraorbital swelling is characteristic**
- **Epidemiology : Prevalence or exposure to competent vectors,**
- **Laboratory tests : confirmatory diagnosis based on qPCR**
- **Serology by virus neutralization allow serotype identification and post vaccine monitoring, Elisa test for retrospective surveys**

- **qPCR and molecular biology tools improved substantially diagnostic capability, rapidity and sensitivity.**
- **Virus isolation is suitable for further investigate pathogenicity or molecular epidemiology by sequencing strains collected in different places/dates**

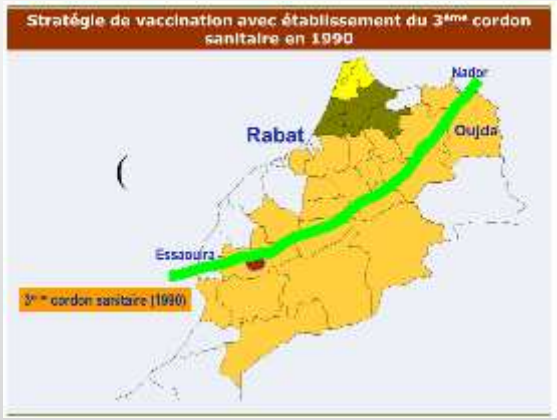
6. AHS control : sanitary prophylaxis

- World Organization for Animal Health (OIE) establishes in its Terrestrial Animal Health Code (Chapter 12.1, African Horse Sickness) what kind of measures should be carried out against African Horse Sickness (AHS).
- Restriction of animal movement was implemented as soon as the first case detected but did not improve control efficacy
- Use of insecticides was punctually applied in specific sites during the early stage of infection before spread of the virus, not recommended for environmental concerns
- Establishment of a protection and surveillance zones around farms, 100 and 50 kilometers, respectively (limited impact)

7. Vaccination Strategy

Live monovalent attenuated vaccine local production

Year	Epidemiological situation	Vaccinated equids	Area
1989	Endemic	114 000	North provinces
1990		1 600 000	North and central
1991		1 700 000	Generalized
1992	Free	1 700 000	
1993		1 700 000	
1994		1 700 000	
Total		**8 500 000**	



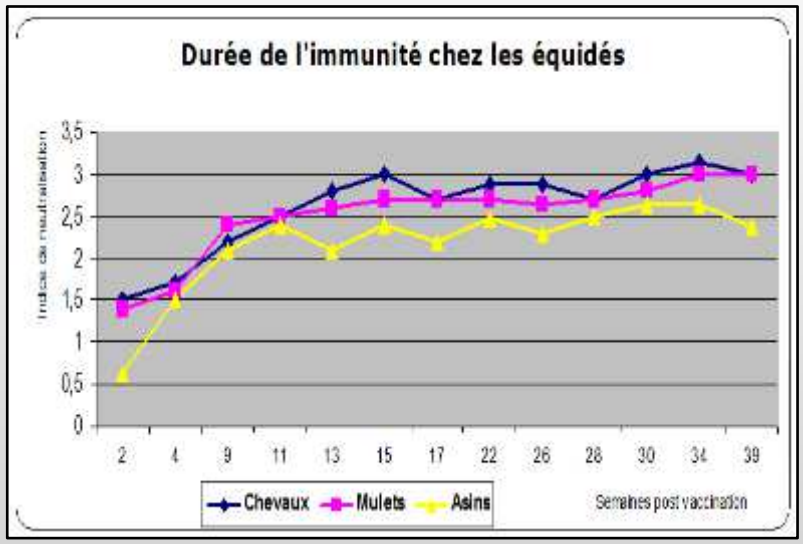
Unique example of an eradication strategy based on 4 successive vaccination campaigns

7. Vaccination Strategy

- Zonal Vaccination did not succeed to stop spread of the virus to free areas
- Starting vaccination from free to endemic zones
- Eradication was obtained after last outbreak by 3 successive vaccinations campaigns
- Vaccination in Morocco stop virus transmission to neighboring countries (Spain, Portugal and Algeria)
- Massive use of live vaccines results on long term circulation of the vaccine strain, with spontaneous seroconversion, not easy to eradicate.
- Use of inactivated vaccines should be considered at last eradicadication stages or in multi serotypes zones.

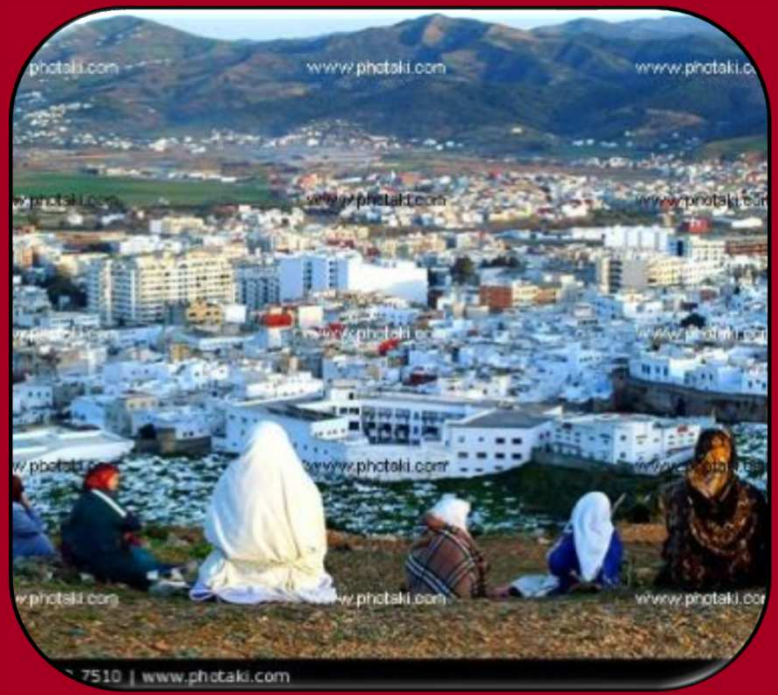
Vaccination monitoring

The live monovalent vaccine confer a high level immunity similar to post infection immunity, rapid establishment, long duration. It's also easy to produce at low cost



Could we do better in the case of AHS reintroduction?

- Previous outbreaks of AHS contribute to upgrade expertise level regarding surveillance, laboratory diagnostic, vaccine production and post vaccination monitoring. New diagnostic tools available.
- Consecutive vaccination campaigns allowed AHS eradication in Morocco, a high risk country with large equid population.
- Vector borne diseases require regional collaboration for early warning and a harmonized control strategy.
- Constraints: vaccine availability, insufficient information on endemic countries:
- Vaccine bank initiative should be encouraged (live, inactivated or new generation). Live polyvalent vaccines to be avoided because of potential reassortment.



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