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Why can't we vaccinate against African swine fever?

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African swine fever virus (ASFV) is a large and complicated DNA virus. Many of its genes encode proteins that stimulate an immune response in the host, and some suppress the immune response of the host to allow the virus to invade the cells more easily. Variations of these proteins are present in the 24 known genotypes of ASFV in existence.

All 24 genotypes are present in Africa, where the disease is endemic in many countries and has been since the virus was first recognised in the early 1900s. Because ASF occurred only in Africa, other countries protected themselves from the disease using import regulations and, when outbreaks occurred, a policy of immediate culling to eradicate all potentially infected animals. These countries did so in order to be officially recognised as free of the disease, and using vaccination would interfere with that goal. There was therefore little interest or financial investment in developing a vaccine. However, after 2007, genotype II of ASF broke out in the country of Georgia and from there spread to much of Eastern Europe and Asia. Attempts to control the disease using the traditional method of culling were unsuccessful and in some countries the disease became established in wild populations of wild boar. The development of a vaccine therefore received renewed interest and work in this field has started in earnest.

The immune response to infection with ASFV relies on both the humoral (antibody producing) and cellular immune systems. Experimental inactivated virus vaccines have all been unsuccessful, as these vaccines induce antibody production only, and not the production of the T-cells needed to destroy cells that are infected with the virus.

Most current development efforts are therefore focused on the development of strains of live attenuated virus. This can be done by using gene-editing tools to remove virulence factors from field strains, though the resulting strains must then be tested to make sure they still induce a protective response. Due to the complex nature of the ASFV genome, gene deletion techniques that work to develop a vaccine from one strain of the virus may not work for another.

Using an isolate of the ASFV that caused the outbreak in Georgia in 2007 (ASFV-G), researchers at Plum Island Animal Disease Centre, USA, discovered that when they deleted a gene known as I177L, the resulting strain produced sterilising immunity against the original virus strain in inoculated pigs. Vietnamese researchers are now working on a vaccine based on these findings that they hope to produce and sell commercially later in 2021.

Researchers at the Harbin Veterinary Research Institute in China have also developed a live vaccine based on gene-deletion techniques. In the first stage of clinical trials on 3000 pigs, all pigs remained clinically healthy and the efficacy of the vaccine was above 80% in all groups given different doses. There were no adverse effects observed in vaccinated pregnant sows. Clinical trials are now being expanded to test the vaccine on 10 000 pigs.

While the use of a live attenuated virus vaccine seems like a promising option in the future, there are some challenges. It is not currently known whether live attenuated viruses may have the potential to persistently infect pigs or susceptible wildlife. It would not be possible to distinguish between animals infected with vaccine virus or with field strains of the virus, making local eradication of the disease more difficult. There is also only a limited degree of cross-protection between strains of ASFV, so a pig with immunity to ASFV-G may still be susceptible to disease caused by any other strain of ASF.

The development and use of a subunit vaccine would solve some of the problems of a live attenuated vaccine, but to do so is much more challenging. Because ASF has a large and complicated genome with many genes encoding proteins that contribute towards the immune response to the virus, the right combination of genes would have to be chosen for a subunit

Domestic pigs are susceptible to African swine fever (Photo: R Niewenhuis)

vaccine.

There is some progress on this front, as Pirbright Institute in the UK has developed a vectored vaccine using another virus that carries several ASFV genes to stimulate an immune response to ASFV. All pigs in the trial were protected from severe disease, but some developed clinical signs.

While the research being done is promising, we are far from having an easy solution in the African context. Any vaccine commercially available in the near future is likely to be protective only against the ASFV-G strain currently plaguing Europe and Asia, and may provide little to no protection against the genotypes circulating in Southern Africa. It also may be produced in limited quantities and for a price that is not feasible for many pig owners in Africa.

At this point in time, despite the potential for a vaccine in the future, our best and most reliable weapon against ASF remains the promotion of biosecurity measures on pig farms, for which pig keepers must take responsibility.

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Beyond our borders: H5N1 HPAI in West Africa

Circulation of highly pathogenic H5N1 avian influenza has been confirmed and reported from several countries in West Africa in late 2020 and early 2021. The viruses are likely related to the new H5 variant in Eurasia, which is in the same clade (2.3.4.4) as the 2016/2017 H5 viruses.

The first reported outbreak came from Kano province in northern Nigeria in December 2020. Swollen wattles and deaths were seen in backyard poultry, including chickens, turkeys, peacocks and geese.

Later in December 2020, an outbreak occurred on a commercial layer farm in Senegal, with closed houses, 58% of birds died after showing clinical signs of cyanosis. congestion, lethargy and oedema. All 100 000 chickens on the farm were culled as a result.

In January 2021, 200km north of the affected layer farm, more than 800 wild great white pelicans died in Djouj National Bird Sanctuary in Senegal along the border with Mauritania. On the Mauritanian side of the border a similar situation was seen with about 500 pelicans reported dead from Diawling National Park. This area is a natural wetland that provides a stop-over point for birds that have crossed the Sahara desert from the north during their seasonal migration.

In Niger, outbreaks were reported from backyard chickens and a commercial layer farm in February 2021 and another commercial chicken farm in March 2021. All affected properties were in the Niamey region in the south-western part of country.

Also in March 2021, three outbreaks occurred in the area surrounding Bamako in south-western Mali. Two commercial layer farms were affected, as well as one property on which exotic chickens were kept.

There is evidence that the AI virus that caused the South African outbreaks in 2017 travelled from Eurasia via West Africa. It was most likely transported in a relay fashion within Africa, via wild waterfowl. We therefore urge the agricultural community to remain vigilant and to notify their local state veterinarian immediately should unusual mortalities in wild or domestic birds be seen.

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Great white pelicans (*Pelecanus onocrotalus*), which also occur in the Western Cape (Photo: Azurfrog)

African horse sickness vaccination permissions 2020

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Introduction

Annual vaccination against African horse sickness (AHS) is compulsory in South Africa (Animal Diseases Act, 35 of 1984) except in the AHS free and surveillance zones in the AHS controlled area in the Western Cape province. Vaccination against AHS in these zones can only be performed following written approval from the Veterinary Services of the Western Cape Department of Agriculture (WCDOA). Permission to vaccinate against AHS is only granted for vaccination to be performed between 1 June and 31 October each year. This vaccination period is based on the potential for vaccine virus re-assortment/reversion to virulence and the risk of transmission during periods of increased vector activity. The restricted vaccination period mitigates this risk.

The process for vaccination permissions is summarized and available at http://jdata.co.za/myhorse/documents/infographics/Vaccination%20Schema/1.%20Vaccinating%20against%20AHS%20in%20the%20Free%20and%20Surveillance%20Zone.pdf. This report briefly summarises the vaccination permission applications that were received and the descriptive statistics of those permissions that were issued. Permissions are given on an individual horse basis, with horses associated with specific holdings, and the information is analysed as such.

Summary of permissions issued

The total permission applications received are shown in Table 1 with their comparisons to previous seasons. Historically there are approximately 1100 applications received each year, corresponding to 7300 horses, and permissions are given for approximately 96%. It is likely that COVID-19 restrictions and impacts had an influence on the 2020 season as numbers were slightly lower than previous years. By far the majority (206 of 215 – 95.8%) of declined applications in 2020 related to invalid or non-existent passports. This is similar to previous years.

Thirty-nine veterinarians and veterinary practices were registered as the associated vet likely to perform the vaccination, with the top five practices responsible for vaccinating 78.13% of the permission granted horses (n= 6476), and the top ten practices responsible for 90.5% of all permission granted horses.

The most common (89.4%) reason for requesting permission to vaccinate was to enable horses to comply with AHS movement requirements. This is also similar to previous years.

We now have four years of detailed, individual horse information for the vaccination permission process in the AHS controlled area. 4457 (4556 in 2018-2019) horses that were granted permission in 2020 had also been granted permission in 2019, making up 68.8% (62.1% in 2018-2019) of the total for the year. 2211 horses were granted permission to be vaccinated in 2017, 2018, 2019 and 2020, accounting for 34.1% of permission granted horses in 2020. There are currently 16318 horses registered in the AHS surveillance and free zone.

Conclusion

Vaccination coverage within the AHS controlled area, including the AHS surveillance and free zone continues to be fairly comprehensive with approximately 40-50% of the known population being vaccinated based on permissions requested during any year. 13342 different horses have been vaccinated in the AHS surveillance and free zone in the last 4 years (i.e. since 2017). A high number of those horses are associated with repeat requests from year to year, and also, since vaccination is a prerequisite for movement into the controlled area, any new adult horses entering the controlled area will be vaccinated already.

References and Acknowledgements

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Table 1: Number of applications received for vaccination permissions with associated horses. Granted applications are shown with a percentage of the total in brackets.

Year	Applications received/ Associated holdings	Total horses applied for	Total horses granted
2017	1078/647	7183	6893 (96%)
2018	1117/606	7277	7058 (97%)
2019	1108/610	7330	7044 (96%)
2020	976/567	6691	6476 (97%)

Outbreak events

Pigs on holdings belonging to 13 owners in **Mfuleni** tested positive for **African swine fever** in March, bringing the total of affected owners in the area to 17. Seven of these holdings have been depopulated or all of the pigs have died. There are therefore ten currently active confirmed outbreaks in Mfuleni. Clinical signs seen in the area have included depression, loss of appetite, redness of the skin, dyspnoea, bloody or foamy discharge from noses and mouths, hind limb weakness and acute deaths.

A pig farmer in the town of **Wilderness** bought 30 new piglets from a seller in a nearby informal settlement in mid-February 2021. Approximately three weeks after he had brought them to his small farm, the farmer introduced the piglets to a commercial feed ration. Within eight hours, the pigs showed anorexia, respiratory distress and hind limb weakness. Only the newly arrived pigs were affected, of which 25 died over a five-day period. Five runts were the only survivors. Because none of the other pigs on the farm were affected, the cause of the deaths was suspected to be oedema disease as a result of the feed, but subsequent lab results confirmed **African swine fever**. The farm was placed under quarantine and was inspected by officials several times. The dead pigs were buried on the farm. No further clinical signs were seen for 30 days since the last death and quarantine was thus lifted after the pens had been disinfected.

A two-year-old spayed female **dog** presented to a private veterinarian in **Cape Town** with lameness of the front limb. During a diagnostic work-up, evidence of discospondylitis was seen on radiographs taken of her spine. A subsequent blood culture confirmed infection with ***Brucella canis***. The owners of the dog elected to euthanase her. The dog had been adopted from an animal welfare organisation as a puppy and did not show any clinical signs of brucellosis. The other dog in the household will be tested for *Brucella canis*.

On a small holding on the outskirts of **Langebaan**, a **bat-eared fox** approached a house and lay down in the garden. It appeared disorientated, but was not aggressive. The fox was shot and its brain submitted for **rabies** testing, with a positive result. The dogs and cats on the property were revaccinated and dogs and cats on other properties in the vicinity were also visited and vaccinated by an official.

An **ostrich** compartment in the **Mossel Bay** area tested positive for **H7 avian influenza** antibodies in February.

This month, evidence of **H6 avian influenza** infection was found on an **ostrich** compartment in the **Tulbagh** area, within 15km of another farm detected to have H6 AIV antibodies in December 2020 and belonging to the same owner. A second ostrich compartment, in the **Riversdale** area, tested AI seropositive. Follow-up testing has resulted in negative serological tests for H5, H6 and H7 AIV, and negative H5, H6 and H7 PCR tests after a suspect positive AIV PCR test. This indicates infection with a low pathogenicity, non-H6 virus.

Sheep on shared grazing in the **Darling** area began losing wool (fig 1) and itching. Upon inspection by a state veterinary official, many sheep were found to be infected with **sheep scab**. The property was placed under quarantine and livestock belonging to all four owners on the farm were treated under official supervision.

Layer **chickens** on a commercial farm near **Malmesbury** tested positive for ***Salmonella gallinarum*** after the mortality rate increased and necropsies showed congestion and oedema of the lungs, white spots on spleens and enlarged livers with petechiae. The house was depopulated, disinfected and a longer resting period will be in place before restocking.

Salmonella enteritidis was detected on environmental swabs taken from breeder **chickens** near **Paarl**. The flock was slaughtered out as a result.

Over a two-week period, young **racing pigeons** in a loft in **Paarl** stopped eating, vomited, became lethargic and died. Post mortem findings included haemorrhages in the gizzard and intestines, green diarrhoea and enlarged livers. The pigeons tested positive for **pigeon paramyxovirus** (PPMV). Only birds originating from a single supplier were affected, as the rest of the flock had been vaccinated against PPMV. The flock was revaccinated in response to the outbreak.

Ten **laughing doves** (*Spilopelia senegalensis*) and a **Cape canary** (*Serinus canicollis*) that were found dead in a

Figure 1: Sheep showing wool loss caused by sheep scab (Photo: M Vrey)

suburban garden in Durbanville, **Cape Town** also tested positive for **pigeon paramyxovirus**. No poultry or other domestic birds are kept on the property.

An adult male **chacma baboon** was found in the **Franschhoek** area with difficulty breathing, weak and underweight. He was euthanased and submitted to the Stellenbosch Provincial Veterinary Laboratory, where a necropsy showed numerous abscess-like lesions, some with necrotic centres, in the lungs, kidneys, spleen, liver and lymph nodes. Histopathology of the lesions revealed granulomatous inflammation with high numbers of acid-fast, rod-shaped bacteria. The clinical signs and post-mortem findings are highly suspect for a case of **tuberculosis** caused by *Mycobacterium tuberculosis*. Mycobacterial culture is currently underway to confirm the diagnosis.

Outbreaks of **bluetongue**, affecting 14 **sheep**, were reported in four flocks in the **Beaufort West** area and one in the **Vredendal** area.

A case of sheep-associated **bovine malignant catarrhal fever** was reported from the **Beaufort West** area. One animal in a herd of 316 was affected.

A suspect case of African swine fever was investigated near **Stanford** and the cause of the outbreak found to be **greasy pig disease**. Also known as exudative epidermitis, greasy pig disease is caused by a generalised infection with *Staphylococcus* bacteria and causes depression and reddening of the skin.

Blackleg (sponssiekte) caused by infection with *Clostridium* bacteria was reported in a member of a herd of **cattle** near **Murraysburg**.

In the **Beaufort West** area, three **goats** died of **tetanus** two weeks after ear-tagging.

Fourteen **pigs** were seen to be affected by **sarcoptic mange** near **Melkbosstrand**.

An outbreak of **orf** (contagious pustular dermatitis) in **goats** near **Beaufort West** was treated with the application of zinc sulphate.

Four **lambs** born in small lambing camps in the **Beaufort West** area died of infection with ***Escherichia coli***.

Ascites (waterpens) was seen in **sheep** in the far north of the province closest to **Rietpoort** as a result of liver damage after feeding on kraalbos (*Galenia africana*)(fig 2). Three ewes were trocharised to drain excess fluid from their abdominal cavities (fig 3).

Sheep belonging to a small-scale farmer near **Riviersonderend** died after grazing near a landfill site. Upon further investigation it was discovered that a local bakery dumped bread and dough in the area, causing **rumen acidosis** in the sheep that ate it.

Figure 2: *Galenia africana* grows on disturbed land in dry areas of the province (Photo: L van Helden)

Figure 3: Draining fluid from the abdomen of a ewe using a trochar (Photo: C Lombard)

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