Steve Peios:

Hello, everyone. And welcome to our 10th webinar in the Australian Biosecurity Series. Today's webinar topic, taking the reins on equine health - three emerging biosecurity risks for Australian horses, hosted by the Department of Agriculture, Water and the Environment or DAWE.

Steve Peios:

My name is Steve Peios and I will be facilitating today's forum. A big thank you to each and every one of you for joining us today and taking time out of your busy schedules.

Steve Peios:

I would like to begin by acknowledging the traditional custodians of the land on which we meet and pay my respects to their elders, past and present. Those are the Ngunnawal people here from where I'm presenting in Canberra. I extend that respect to Aboriginal and Torres Strait Islander peoples attending today. We have an extraordinary mix of listeners with us today including folks joining us from Bunbury, Katherine and Coopers Plains. We also have listeners tuning in from around the world including New Zealand and India.

Steve Peios:

Our topic today examines three emerging equine diseases and some of the work being done to ensure Australia is in a solid position to combat any biosecurity risks. I think everyone would agree that the horse looms large in the Australian psyche from pony clubs, adult riding groups, agricultural show competitions, through to our breeding and racing industries.

Steve Peios:

There are about one million domestic horses in Australia owned by 400,000 people. Now, that represents 2% of the population. On top of that is the harness and thoroughbred racing and export industries worth about $1.6 billion to the Australian economy. Now, protecting the health and welfare of their animals from biosecurity risk and disease is imperative for these invested groups as incursions are costly emotionally as well as economically.

Steve Peios:

Australia was witness to this in 2007 during the equine influenza virus outbreak or EI. The outbreak infected 69,000 horses across 9,600 properties and cost $571 million to eradicate. Today, we're going to shine a spotlight on three equine biosecurity risks including Japanese encephalitis virus or JEV, the Hendra virus variant and African horse sickness virus or AHSV. We'll hear from three speakers, all of whom are at the forefront of the response plans, policies and tools being developed to help combat and prepare for these equine diseases.

Steve Peios:

To start today's session, we're going to show a short video showing how equine influenza impacted horses in Australia. Now, I would like to warn everyone that it is a little bit grainy and does show infected animals in distress from the 2007 outbreak, which the thoroughbred racing industry alone claims it cost them $500,000 a day in lost income and containment costs.

Steve Peios:

The video was produced by the University of Queensland's professor Chris Pollitt from the School of Veterinary Sciences. We thank him and the Queensland Department of Agriculture and Fisheries for letting us use it here today.

Steve Peios:

We will then hear from Dr. Debbie Eagles, Deputy Director, Australian Animal Health Laboratory at the Australian Centre for Disease Preparedness at the CSIRO. Dr. Eagles will talk to us about the work being done on African horse sickness. Historically, the spread of AHSV has been limited to Africa with occasional outbreaks in Europe, although there have been recent incursions of AHSV in Malaysia and Thailand.

Steve Peios:

We will then hear from Dr. Ed Annand, a Senior Veterinary Officer, Epidemiology and One Health Section here at the department, DAWE. As a researcher with Sydney University, he was involved with program work that helped identify the Hendra virus variant which has also resulted in the development of a variant vaccine.

Steve Peios:

Then we will follow with Dr. Dan Edson, Manager of the Department's Pacific Engagement Program in the Office of the Chief Veterinary Officer. He is involved with progressing the importation of a Japanese encephalitis virus vaccine for use in Australian horses.

Steve Peios:

We then look forward to answering your questions as part of the Q&A session that I will moderate after all of our speakers. So, let's start today's session with a short equine influenza video.

Steve Peios:

Dr. Debbie Eagles, please kick us off today sharing your insights about the collaborative work being done on African horse sickness and how it contributes to Australia's preparedness given the disease is now in Southeast Asia. Thank you very much, Dr. Debbie Eagles.

Dr. Debbie Eagles:

Thanks Steve. And certainly, that video brings back many memories for I think all the Australian veterinarians on the call that were in any way involved in the equine influenza disease outbreak. But today, what I'd like to talk to you about is something that we thankfully so far haven't seen in Australia which is African horse sickness. And I bring this presentation to you today from Australian Centre for Disease Preparedness which is shown on the slide here and which is in a beautiful Wathaurong country here in Geelong, Victoria.

Dr. Debbie Eagles:

So, just a little bit of background first on African horse sickness. As many of you will know, it is an economically significant, vector-borne disease. And the primary hosts of the disease are species of equids, so particularly horses but also mules, donkeys and zebras. And in terms of disease significance and presentation of clinical disease and mortality, it tends to be in that order. So, horses with most significant disease, whereas zebras are actually considered a reservoir or maintenance host and tend not to show significant clinical signs. They're generally either asymptomatic or with very mild presentation of disease.

Dr. Debbie Eagles:

Beyond the equids, dogs can also be infected and they can have clinical signs which can be fatal, so tending to be significant respiratory distress with fatal outcomes. But these species aren't important epidemiologically. And there's a small number of other animals that can be infected, but again are not generally important from an epidemiological perspective.

Dr. Debbie Eagles:

Overall, and this will be the focus of much of my talk, African horse sickness is transmitted by infected Culicoides, also known as midges. They've got lots of different names around the world like no-see-ums or sandflies but specifically the genus Culicoides midges. The African horse sickness belongs to the same group of viruses or genus of viruses as Bluetongue virus. For those of you familiar with Bluetongue which can occur in cattle and sheep. Essentially, African horse sickness sits in the same genus of viruses. And there's nine serotypes of the virus which is important from a control and prevention perspective.

Dr. Debbie Eagles:

In terms of geographical distribution of African horse sickness, it's actually endemic in sub-Saharan Africa. And predominantly there, we see serotype 9 although there has been an increased distribution within Africa pet, particularly West and East Africa of serotypes 2 and 7 since 2007. But there've also been occasional outbreaks in the Middle East, the Mediterranean and North Africa of African horse sickness over really the last 50 to 70 years.

Dr. Debbie Eagles:

And most importantly from an Australian perspective, African horse sickness was detected in Thailand in March of 2020. There was also a small detection in Malaysia in September 2020, but only a small number of animals and likely vaccine related. The detection in Thailand was associated with the import of zebras. And it appears that there seems to be a subsidence of that outbreak over time. So, there's been vaccination used for control and not significant further outbreaks since 2020. But still this remains a risk for Australia and certainly has reminded us of the importance of being prepared for this threat.

Dr. Debbie Eagles:

Just describing the clinical disease, there's actually four forms of African horse sickness. So maybe if we start at the bottom with a pulmonary or peracute form, this actually results in sudden death and this can be over a period of hours after onset of clinical signs. Or in some cases, there can be really significant respiratory distress. And the photo to the right shows the really significant frothy discharge that is commonly seen from the nostrils as a result of this pulmonary form.

Dr. Debbie Eagles:

There's also a mixed form which has slightly lower mortality. And that's a mix of what we see with the cardiac and pulmonary forms. And the cardiac form is a subacute form, so really significant. Fever is seen with this. And tend to see characteristic subcutaneous edoema, so particularly around the supraorbital fossa. Congested conjunctiva are really common as well and occasionally colic.

Dr. Debbie Eagles:

And then there's a much milder form which is typically seen in African donkeys, sometimes in zebras as well if they show clinical signs at all and sometimes impartially immune horses also. Well, there's also oedema in this instance. They tend to show mild to moderate fever, tend to recover and overall, the clinical signs are very mild.

Dr. Debbie Eagles:

So, let's move on just to talking about the vectors of African horse sickness. So, as I mentioned previously, these are almost solely Culicoides biting midges. As I mentioned down the bottom of this slide, very occasionally mosquitoes and ticks have been implicated as potential transmitters but this is of exceptionally low importance overall from an epidemiological perspective.

Dr. Debbie Eagles:

In Africa particularly, Culicoides imicola is the most important vector. There's other species that have been implicated, but generally this is the most important species for transmission of African horse sickness. And importantly, there are some correlations seen between the vectors of Bluetongue virus and African horse sickness.

Dr. Debbie Eagles:

For those who don't know Culicoides well, as mentioned, they're very small. They're generally species that are active around dusk and dawn and the females are blood feeders. And obviously due to their size, they tend to travel very short distances on their own, but they can be blown hundreds of kilometers by wind as well.

Dr. Debbie Eagles:

So, how could African horse sickness be introduced into Australia? Well, of course, African horse sickness to be introduced to any area requires vertebrae hosts, so equids, needs adult insect vectors to be present both at source and the arrival site, temperatures for those vectors to survive and an introduction event.

Dr. Debbie Eagles:

So, the most likely mode of introduction into Australia would be by the long distance wind-borne spread if infected vectors were to make it to particularly Timor-Leste, to Eastern Indonesia, or potentially to Papua New Guinea. And we do know that Bluetongue viruses, novel Bluetongue viruses do get blown into Australia by infected Culicoides on a reasonably regular basis by this means.

Dr. Debbie Eagles:

So, what do we know about Culicoides in Australia and their ability to transmit African horse sickness? Well, we have really accurate descriptions around the Culicoides species in Australia. We know that there's at least 141 species and these are well characterised. We also know that we have a species called Culicoides brevitarsis. It's exceptionally widespread and feeds readily on horses. And it is closely related to primary vector species, Culicoides imicola.

Dr. Debbie Eagles:

We don't have imicola in Australia. But the fact that the brevitarsis species is related to imicola, and as mentioned previously that Bluetongue and African horse sickness vectors are often the same, is a potential concern from Australian perspective. What we don't have a good handle on are what species across Australia feed preferentially on horses and overall, which ones of these are what we call competent vectors of African horse sickness or can transmit African horse sickness.

Dr. Debbie Eagles:

So, there's a couple of projects that have either been conducted or are underway to fill these gaps. So, the Northern Territory Berrimah Veterinary Laboratory has conducted some work in conjunction with the Department of Agriculture around identifying Culicoides that are attracted to horses, and certainly found some really information, useful information, particularly highlighting the importance of Culicoides actoni that's a strong horse feeder in Northern Australia.

Dr. Debbie Eagles:

This same work has been mirrored from a Southern perspective looking at Victorian species through work here at ACDP. And then following that, we're looking at doing some competency work, so understanding all of those species that preferentially feed of horses, which ones can be potentially infected with African horse sickness.

Dr. Debbie Eagles:

And this particular piece of work will be conducted in the PC3, so high containment laboratory, insectary here at ACDP. We don't actually keep colonies of Culicoides. We have colonies of a number of different sorts of mosquitoes and ticks. But unfortunately, most species of Australian Culicoides are not well colonised so would need to be brought into the facility.

Dr. Debbie Eagles:

So, to do the vector competency work will require field collection of the Culicoides. We'll subsequently get them acclimatised in the laboratory. And this will also be initial test step beforehand. Then we'll feed them blood infected with African horse sickness virus, incubate those Culicoides and subsequently test for the ongoing presence of African horse sickness in those particular midges that we've infected.

Dr. Debbie Eagles:

So, a fair bit of work to do obviously not across all 141 species, but looking at primary species such as brevitarsis and also actoni which we know is a horse feeder in Northern Territory at a number of other species that we'll be looking at as well. So, this work is underway with hopefully results coming out in the next 12 months or so. And I would like to say thank you very much and hand back over to you, Steve.

Steve Peios:

Moving on now to our second presenter, we will now hear from Dr. Ed Annand and his work on the Hendra virus variant and also other emerging related diseases first discovered as a cause of a classic fatal Hendra virus disease in Australian horses in 2021. He's doing some great work and we look forward to hearing all about that. So, everybody, please a warm welcome for Dr. Ed Annand, our second presenter today.

Dr. Ed Annand:

Thank you very much, Steve. And thanks, Debbie, for a very interesting and related talk in its clinical manifestation. So, Hendra is a disease that we've known about since 1994. A very good friend of mine, Peter Reid, was the attending veterinarian in '94 in the stables in Hendra where it spilled over outside paddock, came into the stables where there may have been spilling and spread through the stable, very sadly causing the death of the trainer and illness in the strapper and spreading also to the neighbouring stable.

Dr. Ed Annand:

I say similarity to African horse sickness because these signs were originally ... Obviously then, it was an unknown disease. African horse sickness was in fact one of the differential diagnoses considered by Peter and other veterinary colleagues investigating that case. Since '94, there have been 65 individuals, spillover events recognised where this virus, a paramyxovirus related to measles and canine distemper virus has spilled over from flying foxes where it circulates to horses.

Dr. Ed Annand:

And this has been a real challenge for the veterinarians and for horse owners to manage the risks here because it is a fatal disease and it spills over consistently with very low frequency but sporadically. And what we recognised particularly off the back of my experiences in 2013, in engaging with some very sad losses of horses that turned out to be due to a relative of rabies virus, the Australian bat lyssavirus.

Dr. Ed Annand:

And we realised that many of our colleagues, as vets go out and manage concerning severe disease that's like Hendra, that looks like Hendra or another related concerning virus, comes back negative. And about a thousand horses are tested each year for Hendra and less than 1% of them are positive. So, this project really looked at seeing if we could investigate those negative cases that had high suspicion of alternative infectious cause further. This sort of surveillance as part of biosecurity is very difficult to do.

Dr. Ed Annand:

And that it's looking for unknown diseases and emerging disease threats. And that can be very hard and it requires really integrating a lot of different perspectives. We realised as we went forward that there'd been some bias to the sampling of horses to certain areas where we were expecting to see Hendra. And this was perhaps limiting the numbers of horses that we're getting tested in other areas of the country where there equally may have been a risk.

Dr. Ed Annand:

Horses interact with a lot of biting insects, as we've heard from Debbie. Also, they are very inquisitive in their grazing behaviour. And the thought is there that they will inhale a little bit of virus-laden neuron that's coming from a bat and then get the virus that way. So, it's very unpredictable where it can happen, and it really just takes one horse that's unvaccinated to come in contact with that virus.

Dr. Ed Annand:

That previous slide was just showing the many differential diagnoses that we consider, us vets. Hendra can mimic many diseases, some noninfectious like colic. Really, it tends to involve a very rapid disease course. It can be severe respiratory signs but not always going to be so obvious. A neurological science can feature there too. Changes in the mucus membranes. But, of course, at any one time point, those signs can really mimic many other diseases causing a great challenge for us as vets and owners to manage that biosecurity risk.

Dr. Ed Annand:

This project is considered the critical steps needed to go from a horse sick in the field to getting a diagnosis of Hendra or a novel disease. And there are involvement of owners, people in labs, many different people and many factors. We tried to consider all those factors and design a system that could support the routine system. Take only the critical information that would help us diagnose the cases beyond Hendra and leave the sensitive material managed by the state and the veterinarian and develop assays.

Dr. Ed Annand:

We looked very carefully at the clinical science of Hendra disease. And we searched amongst the biobank that we built for those cases that we felt would be most likely to have a Hendra-like virus. And we developed new assays that might not be so readily utilised in routine investigations because perhaps they're searching for an unknown related virus or they don't have a perfect control result to compare to, molecular assays that can bring out completely novel viruses, and many serological assays probing for even cross-reactivity.

Dr. Ed Annand:

And so, we did this in two separate pipelines in parallel. And in 2021 in January, we were very fortunate to detect a virus through these methods. That was particularly clear for everyone to understand in its significance and that it caused indistinguishable disease but was being missed by the current testing systems which have to be very reliable, very accurate for knowing Hendra because of divergent genome sequence.

Dr. Ed Annand:

So, its genome which is the PCR assay tests for was 15% different. Whereas when it built itself into a virus, it was much more similar. And the critical areas of the virus that caused the disease, we've got a video there of the attachment protein, so that's how it enters into the cell, were completely unchanged, those critical areas where it binds onto the cell, this virus.

Dr. Ed Annand:

And that was very, very important to understand. Not only was it matching up with the fact that it's shown Hendra disease, but we would expect it to have the same risks for human disease. And very fortunately in slight contrast to what Steve said in the intro, we could develop a new vaccine. The vaccine we've got that's safe and effective is going to be reliable against this virus. And that's matched up with the fact that the vaccine actually works for a far more distant related virus, the Nipah virus which is still very similar. And also with that analysis and then further studies and further testing that's been done in the laboratory comparing the susceptibility of these viruses.

Dr. Ed Annand:

Very incredibly, we saw a prospective case detection later that year, even before the ultimate peer review publication. So, we shared all of our material with the government sector and helped update those assays and put out our new assays and further updated assays from the Australian Centre of Disease Preparedness into the state labs. And sure enough, we saw this prospective detection in Newcastle of another case.

Dr. Ed Annand:

And furthermore, it's also subsequently become clear that the virus that we've been detecting in that case and in our research matches the virus that is being detected in flying foxes across a what much broader distribution than what's previously understood and recognised, and also including species in which Hendra virus hadn't been detected in the urine reliably. So, we're seeing Hendra virus detected in the urine of the grey-headed flying fox and the black flying fox.

Dr. Ed Annand:

Whereas in the past, there'd been a failure to reliably across the wide geography detect Hendra virus. And so, explaining that there are a number of factors that have played into what's been perceived as a geographical limitation for Hendra that is no longer accurate and Hendra that should be understood that there is a risk. While it's a low likelihood, it's a high consequence of Hendra occurring wherever there are flying foxes in Australia. Thank you, Steve.

Steve Peios:

Our final presentation this morning is going to be from Dr. Dan Edson. Now, although Japanese encephalitis virus has infected pigs in Australia, we have not had an Australian horse reported as infected. Dan will explain JEV and its risks to the equine industry, as well as provide an update on the process of getting a vaccine here. Thank you so much for joining us. This is Dr. Dan Edson.

Dr. Dan Edson:

Thanks very much, Steve. And thanks very much to Debbie and Ed for their great talks. So, today, I'm going to be talking about Japanese encephalitis virus, and I guess more specifically, how does this affect your horses, what can you do to help protect your horses, the work that's been going on in relation to the JEV emergency animal disease response to date and some of the work that's underway to make a vaccine available for use in Australian horses.

Dr. Dan Edson:

So, what is Japanese encephalitis? Well, it's an acute mosquito-borne viral disease with the cause of JE virus belonging to the Flavivirus genus. Other types of Flaviviruses include yellow fever virus for which the genus was named based on flavi equaling yellow. And while Australian ... And we also have some other Australian Flavivirus examples including Kunjin virus and Murray Valley encephalitis virus that are endemic in Australia.

Dr. Dan Edson:

It can cause reproductive losses in pigs and encephalitis or inflammation of the brain in horses and also in people. And animals including people become infected through the bite of infected mosquitoes. The natural life cycle of JEV is between waterbirds and mosquitoes, but the virus is being maintained in the waterbird host. And detection of JEV in the blood and/or serological evidence of infection have been observed in over 90 wild and domestic bird species including chickens, ardeid wading birds which includes herons, egrets and bitterns are considered the primary enzootic host of JEV.

Dr. Dan Edson:

And in Australia, we have 14 species in family Ardeiidae and we have about six species that we see as occasional visitors to our shores. A wide range of animals can become infected and infection is mostly subclinical in nature, which means that we don't see any clinical signs. Only a few species including those wild wading birds and pigs have been demonstrated to have enough virus circulating in the blood that they can infect mosquitoes.

Dr. Dan Edson:

And pigs are known to be amplifying hosts characterised by high natural infection rates of prolonged viremia or period of time where virus is circulating in the blood and high birth rates that provide a regular source of susceptible pigs. Humans and horses are considered what we call dead-end host. They don't have enough virus in the blood to infect mosquitoes. And they therefore don't play an important epidemiological role in ongoing disease transmission.

Dr. Dan Edson:

So JEV is endemic in South and East Asia as you can see on the coloured yellow area in the map from the World Health Organisation. And in these countries, JEV is often seasonal with the timing normally following higher mosquito populations and subsequent amplification by pigs and waterbird hosts. Some countries or areas however including Southern Thailand exhibit low level year-round patterns of infection. So, it sort of depends on which country and exactly where you are in terms of the pattern of disease.

Dr. Dan Edson:

But in countries where the disease pattern is seasonal, we don't know exactly how the virus returns each year, but a variety of mechanisms have been proposed including persistence in enzootic foci within vertebrate hosts and mosquitoes, reintroduction of the virus through migratory birds and/or mosquitoes, and possibly other vertebrates including bats and over-wintering in mosquitoes through vertical transmission where infection is passed from the female mosquito to the eggs and subsequent larva, pupa and adult stages.

Dr. Dan Edson:

Vertical transmission is a little bit contentious. It's been demonstrated experimentally, but JEV is rarely isolated from field-collected larva or adult male mosquitoes. So, we have to interpret those experimental infection studies looking at vertical transmission with some caution. And in terms of the Australian distribution, JEV has been detected so far in piggeries across Queensland, New South Wales, Victoria and South Australia, as well as being detected in feral pigs in the Northern Territory and a single alpaca in South Australia.

Dr. Dan Edson:

Horses with clinical signs are currently being investigated, but testing for JEV in horses is a longer process and complicated due to cross-reactivity with some of those other Flaviviruses that I mentioned earlier. As I've already mentioned, horses are dead-end host for JEV and most infections are subclinical. And what that means is that there'll be no outward or visible signs that your horse has been infected with JEV.

Dr. Dan Edson:

And that's also true for people where an estimated 99% of those infected do not show clinical signs and infection is effectively in impairment. JEV can cause neurological disease in horses and should be considered as a differential diagnosis for any horses displaying neurological signs. And additional complicating factors that the clinical signs are similar to horses infected with Hendra viruses, as Ed described, where a neurological presentation is also possible.

Dr. Dan Edson:

And this makes diagnosis difficult as Hendra virus needs to be initially ruled out to ensure that horse owners and veterinarians aren't unknowingly exposed to Hendra virus, which unlike JEV can be directly transmitted from horses to humans and for which the outcome in humans can be fatal. Different samples are also needed to diagnose Hendra virus compared to JEV in live horses. So, for Hendra virus in a live horse, you can collect EDTA blood or nasal, oral and rectal swabs or even plain and clotted whole blood.

Dr. Dan Edson:

JEV diagnosis is more complicated because we need to collect paired serum samples to demonstrate rising antibody levels over time. And you have that potential serological cross-reaction with those related Flaviviruses. So, the testing needed to try and identify which viruses involved. It can take a long time and sometimes we don't reach a definitive diagnosis.

Dr. Dan Edson:

One obvious question is what steps can I take to protect my horse from JEV? And fortunately, there are a number of measures horse owners can consider that will help reduce the chance of your horse being exposed to JEV. So, you can use a hooded rug, a fly mask and apply a safe insect repellent. While indoor spraying of surfaces with residual insecticides is an effective control option for some mosquito-borne diseases particularly malaria, this approach is largely ineffectual in reducing JEV transmission as the mosquito that transmits JEV tends to feed at night and is reluctant to enter dwellings.

Dr. Dan Edson:

So, this is behavioural trait known as exophilic resting behaviour where resting mosquitoes tend to prefer outdoor environments. But what that does mean however is that for JEV control, stabling your horses between dusk and dawn is likely to be beneficial. Eliminating mosquito breeding sites on your premises will also help.

Dr. Dan Edson:

And for more information, I'd encourage you to visit your jurisdiction or JEV website or the outbreak website as shown on the screen. And if you are concerned that your animal may have been infected with JEV, please contact the Emergency Animal Disease hotline noting that a false alarm is better than cases going undetected.

Dr. Dan Edson:

So, the Animal Health Response to date has been managed under the Consultative Committee on Emergency Animal Diseases or CCEAD. And this includes representatives from state and territory governments as well as affected industries, so namely the pigs and horse sectors. The Response is focused on management of affected piggeries, particularly vector control and appropriate herd health biosecurity practices trying to keep mosquitoes out although recognising that can be very difficult to do in practice.

Dr. Dan Edson:

Communication to raise awareness of JE and how to protect people and animals. Enhance surveillance to better understand the distribution of the virus in Australia, and that's being guided by the development of a national surveillance plan. Meeting international animal disease reporting obligations to the World Organisation for Animal Health or OIE. Managing trade impacts particularly for international horse movements, and we did quite a bit of work with New Zealand early on in the response to make sure that the trade of horses between Australian and New Zealand could continue despite the change in disease status for Australia in relation to JEV.

Dr. Dan Edson:

And also, coordinating with public health colleagues, so working closely with the Department of Health, given that it's a zoonotic disease that also infects people. And as I mentioned at the start of the talk, some work is underway to make a vaccine available to protect horses.

Dr. Dan Edson:

So, again, CCEAD requested that the Commonwealth seek an emergency use permit for a JEV horse vaccine as a useful adjunct to the broader response or a future control program to help mitigate those serious clinical disease outcomes in that small percentage of horses when they're exposed to JEV. So, work's underway with the Australian Pesticides and Veterinary Medicines Authority or APVMA to obtain an emergency use permit for a vaccine for use in horses as part of Australia's JEV response.

Dr. Dan Edson:

The Australian Chief Veterinary Officer Dr. Mark Schipp will be the proponent of the emergency use permit application. Emergency use provisions would apply to the use of the vaccine in these circumstances. We've managed to identify two candidate inactivated JEV vaccines for use in horses, both of which are manufactured in Japan.

Dr. Dan Edson:

The detailed documentation supporting the application will need to be provided by those vaccine manufacturers to allow the APVMA to assess our emergency use permit application. And we're continuing to work with the Japanese vaccine manufacturers through our agricultural post contacts in Tokyo. We're also working with our Japanese colleagues to progress applications for import permits to facilitate the import of JEV vaccines to Australia in accordance with the Biosecurity Act of 2015.

Dr. Dan Edson:

And to introduce the vaccine for more widespread and ongoing use in the Australian horse industry would require further biosecurity risk assessment and also further assessment by the APVMA. And such an application would likely require industry sponsorship.

Dr. Dan Edson:

So, just briefly, what is the longer term outlook for JEV in Australia? Well, JEV is not considered eradicable. The vector-borne transmission really complicates control measures. Environmental reservoirs create potential viral refuge. And control of virus spread is unlikely to be achieved by attempting to control wild animal populations.

Dr. Dan Edson:

The spatial distribution in Australia is also problematic because the virus has already been detected across a large geographical area. So, horse owners will need to take steps to protect their horses. And equine vets may want to consider JEV in their differential diagnosis list for horses displaying neurological clinical signs. Surveillance in horses is complicated by the need to rule out Hendra virus, as I mentioned, and the diagnostics are challenging.

Dr. Dan Edson:

While more specific serological tests would be welcome, development of such tests remains a future challenge. And while the longer term pattern of JEV infection in Australia probably remains to be seen, we're likely to see seasonal evidence of infection associated with favourable environmental conditions for the mosquito vectors. Given the uncertainty of it, it's important for horse owners to remain vigilant year-round and particularly at those times when mosquito numbers are high such as seasonal flooding events.

Dr. Dan Edson:

And if you do suspect JEV infection in your horse, make sure you record it using the Emergency Animal Disease watch hotline as mentioned earlier. Thanks for the opportunity to speak to you today. And I look forward to hearing some of your questions in the next 20 or so minutes as we move to the Q&A session. Thanks very much, Steve.

Steve Peios:

Magnificent. Thank you very much for that, Dan. Another great presentation in our webinar today. Thank you very much to Debbie, Ed and Dan, all great presentations. Plenty of questions here and they're spread out between all of our speakers.

Steve Peios:

So, I'd like to start with you, Debbie, please, if that's okay. Debbie, a question that's coming for yourself. And the question is, "Can the African horse sickness virus be passed onto humans?"

Dr. Debbie Eagles:

Thanks, Steve. That's a really easy one. Humans aren't susceptible to African horse sickness. So, the answer to that is no.

Steve Peios:

Excellent. Nice simple one there for you, Debbie, to get underway. Thank you. Ed, thanks again for your presentation. Plenty of questions that have come in for yourself. I'll begin with this one, please, "Any consideration of self-disseminating vaccines in wild populations against Hendra? Now, for example, live viral vaccines, such approaches are being raised in the academic literature as a way to manage zoonosis."

Dr. Ed Annand:

Yes, very interesting question there, Steve. I thought a little bit about that when I saw it come in. I presume it's probably referring to the possibility of vaccinating the reservoir species. So, that's the flying fox. And of course, this has been considered. There are a few challenges obviously.

Dr. Ed Annand:

But I think really, what the research that I've been involved with through that research I've presented there and also research collaborating with the flying fox scientists is showing that we're really only looking at the tip of the iceberg. There are so many viruses and related viruses in these flying foxes. And another question is, "Did they cause disease?" Well, they don't seem to cause severe disease like they do in the mammals when they spill over.

Dr. Ed Annand:

These flying foxes have coevolved. They're most likely ancient viruses. So, I think that any sort of attempt to vaccinate the reservoir could really disrupt things. And we're better to focus on disruptive than the balance within them. We could even cause, I think, bigger problems. So I think it's probably not a good idea. And we should focus on vaccinating the susceptible to disease, the spillover species, the horses end yes, in time, the humans. And the vaccine, the same vaccine is going through its trials now in the US for use in humans.

Steve Peios:

Fantastic, Ed, thank you so much for that comprehensive response, much appreciated. Dan, question for you, Dan, that's come in here, "With the current outbreak of JE in Australia, would the biosecurity information and alerts to horse owners so perhaps provided to horse owners that are located close to affected piggeries and waterbird locations be better able to target and provide with more useful and accurate information to those who need it quickly?" And then, there's a question here, perhaps if we had a national horse traceability system.

Dr. Dan Edson:

Yeah, that's an interesting question. I mean, the need for very specific information in relation to those locations is I guess it is sense of information in a way that you don't want to create unnecessary panic about being located necessarily to an infected piggery. And so, that's always a consideration when we are looking at what type of information can we release in relation to infected properties during an emergency animal disease response.

Dr. Dan Edson:

I think the simple message should really be that if you live in an area where there's mosquitoes and waterways and birds and pigs, you just have to assume that JEV is a differential diagnosis for any horse with neurological signs. It's a little bit ... It's not dissimilar to what Ed was describing earlier where we used to have a fairly narrow view about where you had to be in Australia in order for your horses to be potentially exposed to Hendra virus.

Dr. Dan Edson:

And whilst the evidence in flying foxes suggested that you were more likely to detect Hendra virus in black flying foxes, I don't think anybody, certainly not the people who were involved in the research, they never made any claims that you should rule out the possibility of Hendra virus in those Southern states. It might have just been something that was less likely to occur based on our current knowledge.

Dr. Dan Edson:

And I think for JEV, the keeping the message simple is probably preferable. If you see that you have a horse-

Steve Peios:

And just quick one on that, Dan. Is that sort of where you're talking about there is just having that awareness of your area and what's around you and just being across what's physically and having awareness of what's about?

Dr. Dan Edson:

Yeah. Look, I guess in Australia, I mean, like I said, I'm really simplifying the message down to if you've got mosquitoes and you've got horses, then you've got a possibility of JEV infection. And that will be dependent on the exact species of mosquito in a particular area. And there might be places in Australia where it's highly unlikely.

Dr. Dan Edson:

In terms of that messaging, it's much easier just to assume that your horse is at risk and do what you can to protect them. And that's not dissimilar to the messaging around Hendra virus. If you're in an area of Australia where there's bats and horses, you need to be aware of Hendra virus regardless of the spaces of flying fox.

Steve Peios:

Fantastic, Ed. Can I get a really-

Dr. Dan Edson:

But the horse traceability system would be useful for many reasons. Particularly I guess with other diseases where horses are perhaps the primary host and where movement of horses becomes critical to control, then a horse traceability system does become very important and we would benefit from having a national system in place.

Steve Peios:

Fantastic. Could I please get a quick comment from both yourself, Ed and Debbie, on that when it comes to a national horse traceability system and any benefits that would have potentially. Can I start with you please, Ed?

Dr. Ed Annand:

Yeah. Well, look, I mean, we talked about EI. When EI came, I was actually a new graduate, 2007. And I remember running around vaccinating and microchipping completely unhandled horses, basically the first time they're getting [inaudible 00:44:44]. And it was an opportunity to try to take account of where are the horses and put microchips in them and that sort of thing.

Dr. Ed Annand:

And off the back of that, we thought we would evolve to what we see in UK, US, where horses have passports and we've got some idea where they are. It's very important as well because a lot of these horses aren't on primary production properties. They may not even have the property identification codes. They might be peri-urban properties. And so, it's got larger relevance for biosecurity even beyond horses. But yes, I think it would really be very, very useful for horse health and for our biosecurity. I think it would really help a lot of these things.

Dr. Ed Annand:

And I just quickly make the comment that people were wondering, "How can we" ... Dan did a great job simplifying that message down. I think it's important to remember that ultimately, there are a lot of viruses circulating, many horses might get exposed to some of these viruses and actually not become all that sick, particularly perhaps if they're exposed to low doses or when they're very young, for example getting bitten by mosquitoes when they're young horses.

Dr. Ed Annand:

The important thing is not to have fear, but manage those risks in close collaboration and discussion with your veterinarian and consultation. So that relationship with the veterinarian is very important I think. And that's probably ... If there was a key message here around these, don't have fear and consult with your veterinarian to manage the risks bespoke to your situation, to your horses, to what you are doing.

Steve Peios:

Perfect, Ed, thank you very much for that. That's definitely a key message you all are marking down here. Debbie, if I could get a comment from yourself on that, please, the traceability side of things and expanding on what Ed and Dan have spoken about.

Dr. Debbie Eagles:

Yeah. Thanks, Steve. I think Ed and Dan have actually really summarised it really nicely. And I like the additional message Ed's added there around that, working with your veterinarian around risks and not seeing these as threats, but yeah, absolutely opportunities to work with your vet around your situation. But specifically from traceability, I think Ed and Dan have picked up from particularly a response perspective, the usefulness of traceability systems but also from this preparedness piece to help us understand where our horses are, understand where we need resources if we need to plan for outbreak responses.

Dr. Debbie Eagles:

And even from a research perspective of understanding where horses are that can help us target particular research activities is useful as well, again, from a preparedness perspective. So, certainly, traceability systems help for all of those aspects across the board.

Steve Peios:

Fantastic, Debbie. And this next question I have here is for yourself, and there might be a bit of a relationship to that last question. It says here, "Deb, currently, there are only two states, Queensland and New South Wales that have legislation in place to create movement records for horses. How important do you think movement records are to reducing the spread of viruses? And do you think that movement records should be recorded across every state?"

Dr. Debbie Eagles:

Yeah, it probably comes to the same traceability piece as well. And I think it's particularly important from a response perspective and trying to set up those sorts of systems during an outbreak response obviously is incredibly challenging and shouldn't be the priority. Having those established in advance certainly helps from an immediacy and effectiveness of a response in face of a disease outbreak.

Steve Peios:

Fantastic, Debbie. Yeah, there are some important messages I'm hearing here which is about preparedness, primary prevention and not panicking, and just being prepared and dealing with the risks. Ed, question for you, please, sir, "Hendra vaccinations aren't something that are well governed especially across events and workplaces with horses. Do you think that events and workplaces should have a prerequisite for horses to be vaccinated before entering a location with large populations of horses?".

Dr. Ed Annand:

Yes, again, a very good question. And look, I mean, many of you may be aware that the story of Hendra vaccine and the challenges there have been rather unprecedented. We've seen a parliamentary inquiry. We've seen veterinarians prosecuted by workplace health and safety. We've seen a long evolution. There is still I think unresolved ongoing class action as well relating to this vaccine.

Dr. Ed Annand:

And to be honest, a lot of the reason for that relates to the fact that risk is appreciated very differently around this and therefore the justification of vaccine. So, the veterinarians and perhaps those with particularly valuable horses or shuttling stallions or insurance relevance or even workplace health and safety considerations will be realising that there is while a low likelihood of Hendra, there is it's sufficiently disruptive to a lot of factors that they opt to vaccinate or opt to promote vaccination for certain situations.

Dr. Ed Annand:

The problem is that many owners are not going to have that level of familiarity and maybe not also that same context. They may have horses that never go anywhere that they individually acquired unlikely to get a spillover event. They may be of moderate value, not insured, that sort of thing. And so, they may not see the benefit for them to vaccinate.

Dr. Ed Annand:

And so, that's why when it comes to these decisions, it has to be on a case-by-case basis. In certain events, the risk may be too difficult to manage without a vaccine mandate. And that may be events in certain geographical locations with high risks, lots of public, various things like that. But for a lot of other areas, it may not be so clear-cut. And again, it just comes down to looking into the risk, the legal ramifications, the insurance indemnity ramifications. Again, good close contact with the veterinarian for advice.

Dr. Ed Annand:

And the more we integrate our perspectives, the better we're going to get through this and manage the risk of Hendra in an integrated approach. So, the vaccine isn't particularly unusual in any way in the way that it is a vaccine, but it certainly has been a challenging one for the Australian horse industry to come to terms with. And there are many reasons for that.

Steve Peios:

Thank you very much, Ed. Great answer as always, we really appreciate the thoroughness. Dan, question for you, please, "Any molecular methods to mitigate viral spread by vectors e.g. like the Wolbachia control of dengue in Aedes aegypti or conventional sterile male releases like OxiTec mosquitoes or even gene drives?"

Dr. Dan Edson:

Not that I'm aware of in relation to JEV specifically. And I guess the thing with JEV is we've actually got a very effective human vaccine. So, in countries where it's endemic, over a period of decades, countries like Japan have vaccinated all their children for JEV. And as a result, they see very few cases now in humans.

Dr. Dan Edson:

So I guess in the absence of a vaccine, there might be more of an imperative from a research perspective to look at ways to control the vector. But as far as I'm aware, there's been nothing done specifically in relation to JEV. And again, the staples will be vaccinating humans, potentially vaccinating pigs given their role as amplifying hosts, vector control.

Dr. Dan Edson:

There's some interesting work that's been done in countries where it's endemic and where the mosquitoes for example inhabit rice patties and even simple bio-control measures like adding larvivorous fish to ponds can really suppress those mosquito populations. And I think there's probably some interesting work that could be done from a bio-control point of view. Bats, there are several species of microbats that specialise in preying on mosquitoes.

Dr. Dan Edson:

So, again, you can look at some of those bio-control measures as well as an adjunct I guess to those more traditional control options which is mostly, like I said, based around vaccination and preventing animals from being exposed to mosquitoes as much as practically possible.

Steve Peios:

Thank you very much for that, Dan. Question for you, please, Debbie, "Can the vector competency trials be done for LSD vectors?"

Dr. Debbie Eagles:

Yeah, that's a very good question. So, just for those that don't know what LSD is, that's lumpy skin disease. And the vectors there are generally mechanical vectors so they transmit the virus through their saliva. They're not biological vectors as we see for African horse sickness. Certainly, the same work can be done but because of that difference between the type of vector they are, it's a little bit different.

Dr. Debbie Eagles:

And for a lumpy skin disease, there's actually a broader range of potential vectors. So, certainly flies, particularly stomoxys flies are considered to be transmitters, a number of different species of mosquitoes as well, and potentially Culicoides also. So, certainly, that work can be done a little bit different in terms of methodology and obviously the complexity of a range of different insect species potentially being involved.

Steve Peios:

Thank you very much, Debbie. Magnificent. Question for you, Ed. We've got a couple of minutes left here so this might be the last one. We'll just see how we go. "Ed, what is the main ingredient for the vaccine to treat Hendra? And what is the cost for the vaccine? Also, you mentioned at the start of your presentation that a trainer had died. Would the vaccine be suitable for humans?"

Dr. Ed Annand:

Thanks very much. Yeah. So, the vaccine is a subunit vaccine so there's no full virus there, live or dead. So, it's that attachment protein. And it's coupled with an adjuvant to draw the attention of the recipient's immune system to this protein so it develops antibodies. And yes, the same model is undergoing those Phase 1 trials now for human use, and the vaccine protects against Nipah...

Dr. Ed Annand:

And Hendra ... And sorry, the question, the cost. Again, and this is one of these issues is that in Australia, horse owners are familiar with being able to go and get their vaccine from almost a feed store say for tetanus. But in many other countries, the veterinarians administer all vaccines. As it happened for Hendra, for various reasons. The veterinarians had to administer the vaccine and that certainly increases the cost and it is a slightly more expensive vaccine to start with anyway.

Dr. Ed Annand:

So, it tends to cost an owner between say $100 and $150 per dose [inaudible 00:55:39] administration. And if they do more, they can get that close to $100. Yeah. I hope that answers the question?

Steve Peios:

That's fantastic, Ed. Thank you so much. We've got just over a minute left. I'd like a final word please from you, Debbie, 20 seconds. And then I'll come to you Dan, another 20 seconds. Final message today, just regarding the complexities and everything we've talked about today.

Dr. Debbie Eagles:

Yeah. So look, I think hopefully we've raised what we know about African horse sickness, JE and Hendra virus. Obviously, really important to continue the research and awareness going. And I think Ed said it really nicely in terms of for horse owners to have really good contact with their vets and also to listen to both the state and federal veterinary advice I think is really important as well. So yeah, thanks so much for the opportunity to talk here today, Steve.

Steve Peios:

Thank you so much. Dan, 10 seconds, if you might, sorry, 10 seconds.

Dr. Dan Edson:

Yeah. Look, just one, maybe just very, very quickly in terms of having access to the horse demographic data and that traceability system, our negotiation with the Japanese vaccine manufacturers are really boiling down to what's the commercial incentive for them to import a vaccine to Australia. So, just being able to provide them with accurate information on where and how many horses we actually have in Australia would be actually quite useful in negotiating a commercial outcome when we're talking about vaccines.

Steve Peios:

Thank you so much. Thank you very much once again, Dan, Deb and Ed, magnificent presentations, magnificent Q&A. Thank you so much for your time and being so interesting today with all of your important messages. As I mentioned earlier, there's internet addresses there to check things out on the web, as well as email addresses.

Steve Peios:

Sorry, we couldn't get through all of your questions today but that just goes to show how interesting our panellists were and how many questions that there were. Thanks so much, everybody, for your time and your engagement. That was a brilliant webinar. And we look forward to bringing you the next one in our Biosecurity Education Series.

Steve Peios:

Thanks so much. I'm Steve Peios. I'll see you next time at our Biosecurity Webinar Series. Thank you very much, everyone.