Introduction to EHV-1, ‘neurological herpes’ or EHM, and vaccination

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Introduction – neurological herpes or EHM

neurologic herpes or EHM (*EHV-1 Myeloencephalopathy*) is associated with EHV-1 respiratory tract infection

Vaccination against EHV-1 will help to reduce EHM numbers during an outbreak.

Reduce, but not completely prevent...
EHV-1 – primarily a respiratory tract infection

Infection & replication in respiratory epithelium

Inhalation

cell-associated viremia

Lymph-node

viremia

©Dr. Gabi Landolt, Colorado State University
spinal cord - endothelial cell infection during viremia
Pathology – EHM

Clinical signs:
neurologic gait abnormalities: ataxia – dysmetria – paresis – paralysis
A time line following EHV-1 infection (day 0):

- Fever curve after infection
- Viral genome copies - unitless

Days following intranasal infection

Viraemia
Few facts on neurological herpes or EHM:

Everything in Biology is ‘50 shades of grey’
... nothing is ‘one’ or ‘zero’

EHM: Warmblood breeds (and ‘tall horses’) are most susceptible after infection.

‘Female’ and ‘increasing age’ are significant risk factors.

EHM outbreaks are more common in Winter and Spring
‘season starts in November until end of April’
EHM outbreaks are extremely rare in the southern hemisphere.
Infection follows a 3-tier ‘cascade-like’ system

- respiratory tract disease with shedding
- colonization of lymphatics (lymph follicles and lymph nodes)
- viremia – 50 shades ... *duration and magnitude.*
- neurological form or abortion.

All steps are connected, interdependent, and uni-directional! No viremia, no EHM!
In summary:

No viremia – no EHM!

and: ... if there is LESS viral replication in the respiratory tract...

i) Less shedding into environment and towards others in vicinity
ii) Less ‘push’ towards colonization of lymphatics and viremia.
Infection comes in 50 shades of grey

Respiratory Tract Infection = Dose - Immunity

Infectious dose:
quantity: infectious dose – infectious dose over time
quality: droplet size \(\ldots\) aerosol

Immunity build-up after vaccination (or previous infection)
i) Quality and quantity: cellular immunity vs humoral immunity
ii) time factor: natural decrease in immunity over time
Immunity comes in 50 shades of grey
Infectious dose vs Immunity
Thus, major goal in infection prevention is:

- keeping transmissible dose as LOW as possible
- keeping distance between horses as large as possible
- keeping the immunity level as HIGH as possible
There are several vaccines available (world-wide) with label claim: ‘to aid in prevention of EHV-1 abortions’
several vaccines have shown that there is reduced shedding, reduced or absent viremia.
... and yes,
there is no vaccine with label claim ‘in the prevention of EHM’.

WHY?

only recently, researchers have been able to consistently reproduce EHM under experimental infection conditions!

- 10 out of 10 EHV-1 infected horses were viremic
- 8 out of 10 horses developed severe EHM
# EHV-1 vaccine efficacy:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Vaccinated (inactivated)</th>
<th>vs. placebo</th>
<th>Odds ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>1.05</td>
<td>Odds ratio</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>P= 0.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical Score</td>
<td>7.3</td>
<td>Odds ratio</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>P&lt;0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nasal shedding (log copies)</td>
<td>-1.16</td>
<td>Parameter estimate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P&lt;0.0001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viremia</td>
<td>0.23</td>
<td>Odds ratio</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>P= 0.02</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nº of viremic animals</td>
<td>2/ 8</td>
<td>6/ 8</td>
<td></td>
</tr>
</tbody>
</table>

**critique and comments:**
- Yearling ponies
- High dose intranasal challenge with EHV-1 (OH03)
- 2 weeks after last vaccination
- Vaccine coverage of 67%

Included appetite, maintenance of weight, conjunctivitis, nasal discharge

- Reduction by one Log (e.g. 100000 -> 10000)
- Less viremia (magnitude & Nº days)

!! undetectable viremia !!

Goehring et al. Vaccine 2010: Control of EHV-1 viremia and nasal shedding by commercial vaccines
- Results of 14 EHM outbreaks in Germany (11), Denmark (1) and Sweden (2)
- Total of 600 horses/ponies of various breeds

- 196 CLUSTER 1 – tall horses: Warmblood, Thoroughbred, Standardbred, Am Paint/QH with reliable information on vaccination (EHV-1) status:

  - green- vaccinated
  - orange- unvaccinated

- assuming all were infected ('under same roof' - theory)
- 111 horses w/o EHM (left column)
- 85 horses with EHM (right column)
- ... proportion of EHM horses in the unvaccinated group is significantly higher.

Results indicate: modest reduction of EHM cases in the EHV-1 vaccinated population.

Klouth et al., unpublished (Apr 2022)
Equine Herpesvirus - Neurologic

California, United States

Outbreak Identifier: 5174

Alert ID: 2549

April 14, 2022

Information Only

Source: California Department of Food and Agriculture

Notes: Orange county #1 (original EDCC notification #2438): 23 confirmed (2 EHM, 21 fever) – PREMISES RELEASED 3/24

Orange county #2 (not posted individually): 16 confirmed (2 EHM, 14 fever/mild signs) – PREMISES RELEASED 3/30

Orange county #3 (original EDCC notification #2455): 27 confirmed (3 EHM, 24 fevers) – One horse remains in isolation, all others released from quarantine

Riverside county (original EDCC notification #2416): 35 confirmed (3 EHM, 32 fevers) – PREMISES RELEASED 3/23

San Mateo county #1 (original EDCC notification #2405): 40 confirmed (4 EHM, 36 fevers) – PREMISES RELEASED 3/31

San Mateo county #2 (original EDCC notification #2479): 3 confirmed (1 EHM, 2 fever) – PREMISES RELEASED 3/26

Santa Clara county (original EDCC notification #2482): 2 confirmed (2 EHM) – PREMISES RELEASED 3/31

Sonoma County (original EDCC notification #2510): 1 confirmed (1 EHM) – PREMISES RELEASED 4/1

San Diego County (original EDCC notification #2520): 1 confirmed (1 EHM) – PREMISES RELEASED 4/14;
Direct transmission – air-borne horse-2-horse

IN-Direct transmission – via fomites (animate/inanimate)

- animate...
  - Humans: hands ... and habits!

- inanimate: ‘objects’ anything in contact with nostrils or head of the horse:
  - ... halter, bridle, twitch, ‘horse hankie’
In summary:
how to prevent incursion and spread of EHV-1 during an event?

It takes a whole village...
Vaccination alone will not do the trick!

High(est possible) vaccine coverage (>80 – 85%)
Explore options or modernize and validate our vaccines

Furthermore:
compliance and pro-active thinking by all stakeholders at an event:
think distance, barriers, bottle necks and air space..
group ‘bubble’ for those traveling together
adjusted constructions that favor the ‘individual horse’
rapid detection of a shedding horse followed by isolation (compliance and equipment)
isolation facilities available (compliance and construction)
... an S.O.P. in place for ‘case X’
Questions?
Comments?
FEI Sports Forum 2022
BIOSECURITY – WAY FORWARD

1. Background, rules & measures
2. Mandatory vaccination against EHV-1?
3. Proposed rules and recommendations
FEI rules and measures on biosecurity – Aims

1. Preventing sick horses from entering FEI venues
2. Fast detection and isolation of suspected cases
3. Prevention of further spread of virus from infected horses
4. Ensuring veterinary care of sick horses

• 2022 FEI Veterinary Regulations were updated with rules based on experience from the 2021 outbreak and EHV-1 By-Laws. There is a need for additions and amendments to rules to further improve biosecurity and safety.

• Recommendations will also be given.
EHV-1 vaccination

Would vaccination against EHV-1 be efficient in protecting horses at FEI Events against outbreaks of neurological EHV-1 (EHM)?

Protection is mainly achieved by the combined elements of:
A. Strong preventive biosecurity measures
B. Early detection and isolation of horses that are at risk of shedding virus
C. Vaccination may add limited protection by reducing virus shedding

Is there scientific and expert support for vaccination against EHV-1?
- Lack of published scientific evidence that vaccination protects against EHM
- Experts from different science and expert fields are divided on whether vaccination would reduce enough virus shedding to be effective against EHM
- Vaccination intervals lack scientific support
- There are NO substantial arguments against vaccination of individual horses
EHV-1 Vaccination

Are the currently available EHV-1 vaccines efficient in reducing virus shedding?

- Vaccine producers make varied claims regarding efficacy (NONE against EHM)
- Vaccination is likely to reduce some shedding but will vary between vaccines and individual horses and their age
- Limited data on efficacy in field conditions

Are vaccines widely available?
- EHV-1 vaccines licensed in at least 45 countries
- 20 NFs reported that there was no licensed vaccine available in their country
- Interruptions in deliveries were reported by 33 out of 73 NFs

Is there ongoing research and development on more efficient vaccines against EHV-1/EHM?
- Yes, we are aware of four ongoing projects. It is unlikely that new technology vaccines are available in the upcoming five years

Is there national legislation blocking vaccination against EHV-1?
- Legislation prevents use/importation in at least two countries.
EHV-1 vaccination

Should vaccination against EHV-1 be mandated?

Possible alternatives for discussion:

1. The FEI to seek further input and keep the situation under review, deferring a rule proposal on mandatory EHV-1 vaccination to the 2023 FEI General Assembly at the earliest?

2. The FEI to propose mandatory vaccination against EHV-1 with implementation in 2025 in countries with available licensed vaccines?

3. Other proposals?

Regardless of alternative the FEI plans to:

- Make a plan to identify and fill in the missing gaps of knowledge.
- Encourage academic institutions to conduct field studies etc.
- Increase the dialogue with vaccine developers/producers and encourage them to improve the current vaccine technology.
Jurisdiction

Jurisdiction is key to manage an outbreak

Recommendation
It is strongly recommended that National Federations implement their own biosecurity rules and, most importantly, have a rule that would allow them to shut down a national event where there is a disease outbreak and block in-contact horses.
The equestrian community

Awareness, factual knowledge and skills among all stakeholders is crucial. So is also the acceptance for rules and everyone taking individual responsibility.

Recommendation
• Continued close dialogue with stakeholders
• Biosecurity campaigns
• Promotion of biosecurity education on FEI Campus
• Solidarity projects towards NFs and OCs (ongoing)
Breaches and compliance

Despite knowledge and awareness, there are stakeholders still willing to breach biosecurity measures.

Recommendation:
Sanctions will remain but are under review to better reflect the level of biosecurity risk that the various breaches have resulted in. This will be addressed in the 2022 draft Rules revision process for the FEI Veterinary Regulations.
FEI HorseApp

The FEI HorseApp is instrumental to implementation and control of biosecurity requirements and outbreak management. It is also a valuable asset for the facilitation of temporary Horse Movement to FEI Events.

Recommendation:
Further development of and support for the FEI HorseApp is strategically important, including the launch of additional offline capabilities and any new biosecurity modules as and when required.
Examination on Arrival

Identifying horses with signs of infectious disease prior to entry onto an FEI Event venue is key. Examination on Arrival is a critical tool. The taking of rectal temperatures is not without risk, particularly for grooms.

Recommendation:
Horses should be trained to tolerate temp taking. FEI is aware of alternative methods for taking body temperature and will be reviewing these for possible validation.
Risk classification of FEI Events

Currently all Tours are considered high risk. There are however major differences within that group. Increased identification of risk factors would allow for allocation of resources to where they are most needed.

Recommendations

• Increased identification of risk factors and use Critical Control Point format (CCP)
• Consider different biosecurity protocols based on the discipline specifics.
• Provisions in the FEI Veterinary Regulations to impose measures on any Organiser where there may be an increased biosecurity risk.
• One-day FEI Events without onsite stabling should have a low risk classification and some measures could be derogated.
FEI Event inspections

Inspections of FEI Event organisations before and during an Event increases compliance and provides advice to the organisation.

Recommendation

• More FEI Events should be visited pre-event and pre-season. The FEI assigned Veterinarian or FEI Staff should evaluate the organisation of the Event using the CCP system. There are potential synergies with the Event Standards Project.

• The inspections should be carried out in an advisory capacity, working together with the Organiser, although sub-optimal delivery of the biosecurity requirements would result in action being taken by the FEI.
Pre-event PCR testing

120-hour pre-event PCR testing was required in April-May 2021 at high risk events.
+ Lowered the risk of EHV-1 outbreaks during this sensitive period,
- High financial cost for Athletes and Owners.
The costs and 120-hour old test results, make this measure of limited value.

Pre-event testing should be an emergency measure during an outbreak but with 96 hours or shorter time between sampling and arrival at the event.
Sample logistics are complicated. Another option could be to use validated stable side tests (rapid antigen tests etc.) close to, or even at the arrival at the Event.

Recommendation
The International Horse Sport Confederation (ISHC) should suggest a validation system of stable side tests via the OIE Reference Laboratories for EHV-1. Such validation should be promoted to the biochemical industry.
The systematic use of validated stable side tests by Organisers should be encouraged and also result in a lower risk classification by the FEI.
On-venue temperature monitoring

Athletes and/or Grooms are required to check their horses’ rectal temperature morning and evening while they are stabled at FEI Events. This provides an early warning system in a suspected case. There is, however, information that not all temperature taking is being properly conducted.

Recommendation

As part of the daily routine FEI Officials will carry out spot checks of the horse’s body temperature to verify that controlled body temperature is taken correctly. This should also apply during the Onsite Preparation Period prior to the start of the Event.
Management of suspected cases

The protocols for management of suspected cases and the resourcing of Isolation Stables have been greatly improved.

Difficulty of finding laboratories with PCR equipment that will operate on weekends etc.

Recommendation
When validated stable side tests are available, the FEI should establish protocols for their use. (Please see recommendation under Pre-Event PCR testing.)

Photo: Sciencedirect.com
Emergency Response Unit

The investigation into the 2021 outbreak identified the necessity to set up an Emergency Response Unit.

The Unit will be funded in full by the FEI.
- Include veterinary medicine experts and,
- an expert dedicated to collecting data. ie. Epidemiologist

It is proposed that the Unit could also be made available to National Federations in the event of an outbreak at a national competition.

The establishment of the Unit is still in the proposal stage.

Recommendation
As a priority, a project should be set up for the establishment of an EHV-1 Emergency Support Unit.
Measures to minimise spread of infectious agents

Construction, layout and planning of the on-site logistics for humans and horses has impact on the spread of infectious agents.

Recommendation
FEI will provide material to organisers and producers of permanent and temporary stables on details that can minimise spread of infectious agents in stable construction, layout and planning
E.g. Height of partition walls, required volume of shared airspaces and ventilation etc.

Photo by Rasmus Westergren
Article 1003.3 EI Vaccination Booster interval

The GBR NF has proposed a change to the Equine Influenza vaccination First Booster interval. The proposal would harmonise the vaccination requirements with other horse sports.

<table>
<thead>
<tr>
<th>Vaccination</th>
<th>Current time interval</th>
<th>Proposal</th>
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</thead>
<tbody>
<tr>
<td>V1 (1st of Primary course)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>V2 (2nd of Primary course)</td>
<td>21-92 days</td>
<td>21-60 days</td>
</tr>
<tr>
<td>V3 (1st Booster)</td>
<td>7 calendar months</td>
<td>6 calendar months</td>
</tr>
<tr>
<td>Subsequent boosters</td>
<td>12 months</td>
<td>12 months (no change)</td>
</tr>
</tbody>
</table>

Supported by the FEI Veterinary Committee and FEI Veterinary Department. Implementation is suggested to 1 January 2024 and only apply to horses starting/restarting the vaccination course.
Article 1050 – Final Limb Sensitivity Exam.

In the current Veterinary Regulations the Final Examination is performed by the Foreign Veterinary Delegate/Veterinary Delegate. This has caused issues with obviously hypersensitive horses not being stopped from competing. At some major events there are often three Examining Veterinarians present.

Proposal:
Where possible, replace the Veterinary Delegate with a third Examining Veterinarian at the Final Limb Sensitivity Examination

Proposal supported by the FEI Veterinary Committee and FEI Veterinary Department.
THANK YOU