



## EQUINE HERPESVIRUS (EHV-1 & EHV-4)

<a href="#">Summary</a>	<a href="#">to Sample for</a>	<a href="#">Following</a>	<a href="#">Vaccination</a>
<a href="#">Clinical Signs</a>	<a href="#">Diagnostic Testing</a>	<a href="#">Resolution of</a>	<a href="#">Release of animals</a>
<a href="#">Incubation Period</a>	<a href="#">Diagnostic</a>	<a href="#">Clinical Signs</a>	<a href="#">from isolation</a>
<a href="#">Risk Factors for</a>	<a href="#">Sampling, Testing</a>	<a href="#">Environmental</a>	<a href="#">Biosecurity Issues</a>
<a href="#">development of</a>	<a href="#">and Handling</a>	<a href="#">Persistence</a>	<a href="#">for Receiving</a>
<a href="#">EHV-1 infection</a>	<a href="#">Post-mortem</a>	<a href="#">Specific Control</a>	<a href="#">Animals</a>
<a href="#">Transmission</a>	<a href="#">Findings</a>	<a href="#">Measures</a>	<a href="#">Zoonotic Potential</a>
<a href="#">Selection of Horses</a>	<a href="#">Shedding of Virus</a>	<a href="#">Biosecurity</a>	

### Summary

Equine herpesviruses are very common DNA viruses in horse populations worldwide. The two most significant are EHV-1, which causes respiratory disease, abortion, and neurologic disease; and EHV-4, which primarily causes respiratory disease and only occasionally causes abortion or neurologic disease. Fatal neonatal disease infrequently occurs as a result of in utero infection. Asymptomatic infection is common and facilitates transmission within groups of horses.

Equine herpes viral respiratory disease (rhinopneumonitis) can be caused by EHV-1 or 4 and is most commonly seen in weaned foals and yearlings, often in autumn and winter. Older horses are more likely to transmit the virus without showing signs of infection. Although EHV-1 is the principal cause of outbreaks of viral abortion, some strains of EHV-4 have been associated with sporadic cases of the disease.

EHV-1 myeloencephalopathy (EHM) occurs when cell-associated viremia leads to vasculitis, thrombosis, and focal infarction within CNS vasculature, ultimately resulting in focal spinal cord malacia and neurologic disease. Herpesvirus myeloencephalopathy cases can occur singly or as outbreaks affecting 20-50% of the at-risk population. Occurrences may or may not be preceded by a febrile episode or signs of respiratory disease. Retrospective analysis of multiple EHM outbreaks have clearly demonstrated that both the 'neuropathic' (G2254/D752) and 'non-neuropathic' (A2254/N752) EHV-1 strains are capable of creating outbreaks of EHM.

Additional detailed information regarding EHV-1 is available open-access in the [ACVIM Equine Herpesvirus-1 Consensus Statement](#).

### Clinical Signs

#### Fever

Fever is often biphasic and can be transient. The initial febrile phase (peaking at day 1–2) precedes infection of the upper respiratory tract. The second febrile phase (6–7 days) often precedes a systemic viremia. Fever may go undetected and may be the only clinical sign noted in an infected horse. Temperature monitoring twice daily is recommended.



### Respiratory disease

- Fever (body temperature is >101.5 F (38.6 C))
- Coughing
- Nasal discharge (most common sign in older foals)
- Variable enlargement of the mandibular and/or retropharyngeal lymph nodes
- Lethargy, anorexia
- Conjunctivitis
- Ocular disease including uveitis and keratitis
- Lower limb swelling

### Abortion

Most often, there are no warning signs of impending abortion in the mare. This typically occurs in late pregnancy (7+ months); very occasionally as early as 4 months. EHV-1 abortion can occur from two weeks to several months following exposure to the virus without mares showing abnormal clinical signs.

### Neurologic disease

- Neurologic signs are often (but not always) preceded by fever and/or respiratory signs
- Incoordination of the hind (and occasionally fore) limbs
- Leaning against a wall or other secure surface
- Ataxia or wobbly gait
- Urine retention/dribbling
- Bladder atony
- Recumbency with inability to rise
- Rarely, cranially nerve deficits, seizures, and/or brainstem signs are observed

**Neonatal disease:** foals infected in utero are usually sick at birth and exhibit any combination or all of the following:

- Fever
- Lethargy
- Weakness
- Jaundice
- Respiratory distress/stridor/pneumonia
- Severe leukopenia
- CNS signs (occasionally)
- Death usually occurs within 3 days

### Incubation Period

After exposure by any route, incubation period may be as short as 24 hours but is typically 4–6 days, or longer.



**Risk Factors  
for  
development  
of EHV-1  
infection**

- Evidence of transmission of EHV-1 virus within a group of horses
- Strain of EHV-1 virus
- Number of horses potentially exposed (areas of high commingling of horses such as racetracks, hospitals, show grounds, etc.)
- Immune status of exposed horses, i.e., hospitalized or geriatric, horse rescue (stress or immunosuppression: transport, hospitalization, training, showing, weaning, high doses of steroids)
- Positive test results among exposed and clinically affected horses
- Movement of horses during confirmed or potential outbreak situations, especially prior to placement or release of quarantine restrictions.
- Commingling with mules and donkeys, which can serve as silent shedders of EHV-1
- A case control study of the 2011 multistate EHM outbreak found the following risk factors for EHM compared to EHV-1 cases that did not develop neurologic disease:
  - Exposure to a greater number of biosecurity risks at the event
  - Female sex
  - Increasing number of classes competed in
  - EHV-1 vaccination in the 5 weeks before the event

**Transmission**

Respiratory transmission (most common route of exposure)

- Inhalation of droplets from coughing and snorting. (Note: EHV is not believed to be spread by this route as efficiently as equine influenza virus.)
- Direct contact with virus containing respiratory tract secretions, especially mucus
- Mares which have aborted, or whose foals have died, can transmit infection via the respiratory route
- Shedding by the respiratory route typically lasts for 7–10 days but can be much longer. Therefore, based on a thorough risk analysis of the particular outbreak or case, a period of 14 to 28 days after resolution of clinical signs in all exposed horses may be necessary before release of horses from movement restrictions/isolation. EHV-1 testing of horses considered exposed or infected provides increased confidence in the release of restrictions/isolation period prior to 28 days

Direct transmission

- Aborted fetuses, fetal membranes and/or fluids are significant sources of the virus. This material should be put in double plastic bag immediately to avoid contamination of other areas on the farm
- Any horses in the paddock or pasture where an abortion occurs should be removed from the area but kept isolated from as yet unexposed horses
- Infected foals are highly contagious and can transmit infection to other horses via the respiratory route through shedding virus into the environment



### Indirect transmission

- Virus can be viable for several weeks in the environment once it has been shed by the horse
- Virus contaminated fomites (such as clothing and footwear of personnel, sharing of grooming equipment or tack between horses) also water and feed sources and surfaces such as stalls, tie rails, wash racks can become contaminated with virus shed in nasal secretion and thus pose a possible means of EHV spread

### **Selection of Horses to Sample for Diagnostic Testing**

Horses showing clinical signs consistent with EHV infection particularly during the times when they are febrile or at onset of neurologic signs. During outbreak situations when multiple horses are febrile, if initial testing for EHV is negative and other likely causes of the clinical signs are not identified, then resampling of febrile horses initially having a negative test for EHV is recommended. Horses with known exposure to EHV may need to be sampled in order to comply with quarantine release protocols depending on the venue and requirements by State Animal Health Officials.

Surveillance screening via testing of asymptomatic horses is not recommended.

### **Diagnostic Sampling, Testing and Handling**

## EHV-1 and -4

Sample	Test	Shipping	Handling
Nasal(N) or nasopharyngeal (NP) swab and EDTA or citrated blood  <b>Both blood and N/NP swab should be tested together</b>	EHV 1 or 4 qPCR;  Viral Isolation	For PCR testing send swab in plain red top tube; for viral isolation place swab in viral transport media or red top tube with a few drops of sterile saline	Chilled, ship overnight
Paired Sera	EHV 1 and 4 Serum neutralization (SN)	Leak proof container	Chilled, ship overnight
Paired Sera	ELISA* Differentiation of EHV 1 from 4	Leak proof container	Chilled, ship overnight

\* detects antibodies directed against viral glycoprotein gG (Svanovir™)



*NOTE: In acute EHV1 infection, fever can precede both nasal shedding and viremia. It is, therefore, recommended that febrile horses with suspected exposure to EHV-1 positive horses (or any horse identified with a fever during an outbreak situation) found to be negative on initial PCR testing of blood and/or nasal swab be retested via PCR on blood and nasal swab 24-72 hrs. after initial testing. Horses should remain quarantined until results of the second tests are available.*

**Virus Isolation:** Virus isolation (VI) is considered the gold standard laboratory diagnostic test. It is highly specific and unequivocally confirms the presence of infectious virus. Although virus isolation should be attempted during outbreaks, it is time-consuming and can lack sensitivity.

**PCR:** Quantitative PCR (qPCR) is more sensitive and more rapid than virus isolation and is the test of choice for rapid detection during outbreaks.

**Initial testing for EHV should be performed with PCR assays that detect and quantify the glycoprotein B (gB) gene.** Assays used to further characterize EHV-1 strains based on point mutations in the DNA polymerase gene (ORF30: A2254G, N752D) are not appropriate as screening tests, as some EHV-1 strains lack either genotype. It is important to also note that both the 'neuropathic' and 'non-neuropathic' EHV-1 strains have been associated with outbreaks of EHM.

**Serology:** Serological diagnosis using the viral neutralization test (requires paired serology with no vaccination against EHV between sampling times) (synonym: serum neutralization [SN] test) cannot distinguish between EHV-1 and EHV-4 infection. Nevertheless, in combination with specific clinical signs, a four-fold or greater rise in antibody titer between acute and convalescent samples collected 14-21 days apart is confirmatory of a recent infection.

A commercial ELISA test kit, suitable for use in practice, is available for detection and differentiation of EHV-1 and EHV-4 specific antibodies directed against viral glycoprotein gG ([Svanovir™](#)).

Contact your diagnostic laboratory for specific instructions regarding sample procurement and further information regarding sampling. Many diagnostic laboratories sell viral transport media and other products. Other sources are available from veterinary distributors.

#### [Nasal Swab/Transport Media Resource Option](#)

(Note: This is just one resource and is not specifically a recommended or endorsed supplier or product of the AAEP.)



### Nasopharyngeal or nasal swab collection procedure for EHV 1/4 and related diseases

#### Supplies Needed

- Dacron swabs with plastic sticks 5–7 inches (often supplied with bacterial transport medias)
- Plain red top tube (blood tube) or viral transport media
- Few milliliters sterile saline
- Clean exam gloves
- Disinfectant material or wipe

#### Procedure

1. The horse should be restrained. Pass the swab(s) along the left/ right ventral meatus being careful to avoid the false nostril, until you are in the horse's nasal passage. Rotate the swab to increase the collection of respiratory secretions for 5–10 seconds. Two swabs can be done at the same time if more than one sample is needed by the laboratory. Some labs request one sample for qPCR and one for virus isolation. Swabs that contain large amounts of dirt that may be present in the nasal passage of horses kept in a drylot or in those working in a dusty environment after collection should be discarded and a new swab collected, since dirt often inhibits PCR analysis. Alternatively, clean the nostril to be collected with a disposable cloth prior to swab collection.
2. Place swab(s) into a plain red top tube and, if available, add 1–2 drops of sterile saline for qPCR/viral isolation. **DO NOT PLACE qPCR/VIRAL ISOLATION SAMPLES IN BACTERIAL TRANSPORT MEDIA.**
3. If sampling more than one horse, change gloves between each horse sampled.
4. The outside of tubes should be wiped down with a disinfectant wipe to prevent contamination of other samples or gloves of handlers.
5. Consider all waste materials to be infectious including gloves, nasal cleaning cloth and discarded swabs, etc.
6. Any restraining equipment such as twitches, nose chains, etc. must be disinfected after each use.
7. Keep tubes with swabs refrigerated and ship on ice/cooler packs overnight to a diagnostic laboratory of your choice.

#### **Post-mortem Findings**

**EHM:** Fatal outcome in horses infected with EHV-1 are most often associated with the neurologic form of the disease, EHM. Definitive diagnosis of EHM in an individual horse is only possible after histological and immunohistochemical examination of CNS tissues in many cases.

- If nasal swabs and whole blood have not already been collected for testing on suspect EHM cases, they should be collected prior to euthanasia and submitted for testing while the necropsy results are pending



- Examination of fresh CNS tissue by qPCR can also be attempted. This requires dissection of the entire spinal cord, followed by both gross and extensive histological examination of each part of the spinal cord
- This procedure is both time- and labor-intensive, and is typically only practical at a properly equipped necropsy laboratory, typically at a state diagnostic laboratory, or at a school of veterinary medicine
- In the USA, the necropsy facility should be accredited by the American Association of Veterinary Diagnosticians. A full list of accredited laboratories is maintained on [their website](#)
- The complete carcass should be presented for post-mortem examination as soon as possible after death. It is important that a complete history be provided when submitting the horse for necropsy including the suspicion of EHM as a cause of neurologic disease and a request for expedited processing made if the horse is part of a potential outbreak situation.
- The State Animal Health Official should be alerted to any horses euthanized or dead from suspected EHM and where the carcass was taken for necropsy. In some states a permit may be needed to transport the carcass.

**EHV abortion:** When EHV results in abortion the fetus is usually expelled while still in the placenta and within the amniotic membrane. Almost all abortions occur in the last 4 months of pregnancy. Both the placental and fetal tissues should be submitted for necropsy and specific testing to detect EHV. Biosecurity precautions are indicated when handling the placenta and fetus as both can contain high levels of infective virus. It is important to remove all mares from the area where the abortion occurred as soon as possible. Detailed instructions for veterinarians on how to collect and submit aborted equine fetal and other diagnostic samples from the mare are available at the [Animal Health Diagnostic Center at Cornell University](#).

**Neonatal disease:** Foals are generally sick at birth and most die of progressive respiratory failure within 1-3 days. Gross necropsy reveals consolidated lungs, reddened intestinal mucosa, and orange hue to the liver and viscera. Lung tissues are positive for EHV via PCR and/or viral isolation, and histopathologic examination reveals severe necrotizing bronchopneumonia with intralesional Cowdry type A inclusions.

**Shedding of  
Virus  
Following  
Resolution of  
Clinical Signs**

Up to a week but may be longer in exceptional cases.

Recovered horses typically develop latent infections and are capable of shedding virus following reactivation (with or without signs of clinical disease) particularly under conditions of stress, for the remainder of their lives.

Horses with EHM may have residual neurological deficits for weeks to months following cessation of viral shedding and are not considered a risk when determining the countdown to release from isolation.



<b>Environmental Persistence</b>	Environmental persistence of EHV-1 is estimated to be no more than 35 days under ideal conditions and probably less than 7 days in most practical field situations. While direct contact with infected animals and exposure to aerosols, infected respiratory secretions, placenta and uterine fluids, and fetal tissue from aborted fetuses remain the most common and direct pathways for EHV transmission, indirect pathways through environmental and fomite contamination may play a more important role in viral transmission than previously thought, particularly in outbreak situations.
<b>Specific Control Measures</b>	EHV and/or EHM is reportable to the State Animal Health Official in many states. The veterinarian should know their responsibility for reporting of suspect or confirmed cases in the state where the horse(s) has been sampled. In many states the State Animal Health Official will place or hold order or official quarantine on the premises where affected horses are located and may perform trace out to identify potentially exposed horses. They may also put in place requirements for testing and biosecurity protocols. Further information regarding the role of the State Animal Health Official in EHV response can be found in the <a href="#">USAHA Equine Herpesvirus Myeloencephalopathy Incident Guidelines for State Animal Health Officials</a>
<b>Biosecurity</b>	<p>Please view and follow the <a href="#">AAEP Biosecurity Guidelines</a>.</p> <p>Clinically normal horses housed within the primary perimeter may be permitted segregated exercise periods outside the perimeter. Precautions should be taken, and may include the following:</p> <ul style="list-style-type: none"><li>● Exercise scheduled after general population's exercise period to avoid potential virus transfer to unaffected horses/barns</li><li>● Access to starting gate or similar equipment denied.</li><li>● Shared equipment, if permitted, should be thoroughly disinfected between horses.</li><li>● Restricted use of ponies/outriders' horses- horses housed within the primary perimeter may only be escorted by horses housed within the same facility</li><li>● Direct horse-to-horse contact is to be avoided</li><li>● Prompt post-contact use of alcohol hand sanitizer by individuals having contact with horses during exercise. Contaminated clothing can also be a source of transmission.</li></ul>
<b>Vaccination</b>	<u>EHM</u> : There are no licensed vaccine products with label claims for prevention or control of EHM. Some EHV-1 vaccines reduce nasal shedding of EHV and in some cases, reduce viremia. These products may therefore have some theoretical value against EHM (by reducing viremia), and certainly against spread of the virus by reducing viral shedding in the environment. Booster vaccination of healthy animals in both primary and secondary contagion control perimeters may have some value. Vaccination in these circumstances is controversial, as some authorities speculate that certain aspects of the immune





response in recently vaccinated horses with subsequent exposure to EHV-1 may play a role in the development of EHM. While this remains unproven, it is a possibility. The use of vaccination is therefore a risk-based decision.

If animals are unvaccinated prior to an outbreak there is unlikely to be time to administer an effective vaccination series in time to provide protection during the at-risk time period. Furthermore, if vaccination is implemented in the face of an outbreak, some horses may develop a slightly elevated temperature post-vaccination, this can complicate the implementation of outbreak response. Do not vaccinate clinically ill animals. Please see [AAEP Vaccination Guidelines](#) For Respiratory disease: There are labeled vaccines for protection against respiratory disease caused by EHV-1 or EHV-4. Please see [AAEP Vaccination Guidelines](#).

For Abortion: Vaccines are available for and specifically labeled for protection against abortion caused by EHV-1. Please see [AAEP Vaccination Guidelines](#).

### Release of animals from isolation

Maintain isolation procedures for 14–28 days after last clinical signs are detected or as required based on orders from the State Animal Health Official in the state where the horses are located, basing the release date on risk analysis.

1. No horse had a fever (temperature taken at least one time every 24-hour period and without any treatment of non-steroidal anti-inflammatory drug)
2. No horse had an abortion
3. No new cases of neurologic disease (Note: Neurological clinical signs are considered to be resolved when they stabilize, i.e., residual neurological signs are not considered in determining a day 0 for countdown of release of restrictions/isolation.)
4. In some cases, state animal health officials may allow that horses be released from quarantine/isolation prior to 21-28 days from the last detected fever. This generally involved testing of all affected and exposed horses for EHV-1 by qPCR on nasal swabs and confirming their negative status. EHV-1 testing of horses considered exposed or infected would allow for increased confidence in the release of restrictions/isolation prior the 28-day time period. All quarantine decisions should be compliance with requirements by state animal health officials for the duration of quarantine and testing.

### Biosecurity Issues for Receiving Animals

#### **Horses having been housed within primary perimeter:**

Isolate from the general population for 28 days with twice daily temperature recordings. If the horse develops a fever, then the isolation period is extended to 28 days after the temperature returns to normal or the horse should be tested for EHV.



**Horses having been housed within secondary biosecurity perimeter:**

After having determined its level of risk-aversion, the recipient facility may consider the following:

1. Vaccination requirements for entrance into facility
2. Health certificate specifications
3. Test findings (a negative qPCR result on a nasal swab)

Update vaccination for horses at recipient facility before arrival of potentially infected/exposed animal.

**Zoonotic Potential**

None known.

**References**

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7. [Equine Herpesvirus Myeloencephalopathy Incident Guidelines for State Animal Health Officials](#)

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