EQUINE HERPESVIRUS

Animal Group(s) Affected	Transmission	Clinical Signs	Severity	Treatment	Prevention and Control	Zoonotic
Mammals – equids primarily; recombinant EHV1/9 strains have been shown to infect ursids, artiodactylids, camelids, rhinoceros, and rodents.	EHV1: aerosol droplets, contact, fomite Infected foals, etal membranes and aborted fetuses are highly contagious EHV3: sexually transmitted, flies feeding on vaginal discharge of infected mares, fomites EHV4: aerosol droplets, contact, fomite EHV9: unknown, fomite transmission suspected	EHV1: abortion in mares and mild respiratory disease in horses <2 years; neurologic form more common in older animals, signs range from ataxia to paralysis and death EHV3: ulcers along cutaneous mucous membranes, especially genital tract. EHV4: respiratory disease in horses < 2 years old. Depression, nasal discharge, fever. Rarely causes abortion in pregnant mares. EHV9: neurologic signs in affected aberrant hosts, including ataxia, seizures, and progressive disease	EHV1: mild to severe possible, outbreaks if uncontrolled EHV3: generally mild, with lesions resolving within two weeks. EHV4: mild infections, secondary bacterial infections can increase severity EHV9: ranges from mild illness to severe disease, with progression in a short time period	EHV1: supportive care for encephalo-myelitis. EHV3: topical antiseptics to prevent infection and reduce discomfort EHV4: supportive care EHV9: supportive care, seizure control	EHV1: vaccination all pregnant mares, isolation of known cases EHV3: no vaccine available, isolation of cases. EHV4: vaccination of horses <5 years old EHV9: no vaccine available	Not reported.

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Susceptible animal groups: Equids [EHV 1, 3, 4]; exotic/zoo cases of infection with a recombinant EHV1/EHV9 virus have been published in onager (*Equus hemionus*), polar bear (*Ursus maritimus*), Grevy's zebra (*E. grevyi*), plains zebra (*E. quagga*), blackbuck (*Antilope cervicapra*), Thomson's gazelle (*Eudorcas thomsonii*), reticulated giraffe (*Giraffa camelopardalis reticulata*), llama (*Lama glama*), alpaca (*Vicugna pacos*), black bear (*Ursus americanus*), guinea pig (*Cavia porcellus*), and Bactrian camel (*Camelus bactrianus*). Experimental infection has been demonstrated in Syrian hamsters (*Mesocricetus auratus*), domestic dogs (*Canis lupus familiaris*), and domestic pigs (*Sus scrofa*).

Causative organism: Equine viral abortion (Equine Herpesvirus 1 [EHV1]); Equine herpes myeloencephalopathy (EHV1); Equine coital exanthema (EHV3); Equine rhinopneumonitis (EHV4); Gazelle herpesvirus 1 (EHV9)

Zoonotic potential: No evidence for potential zoonosis is associated with any EHV strain.

Distribution: EHV strains are endemic worldwide, with no specific distribution pattern. EHV1/9 can be carried by exotic equids with no clinical signs.

Incubation period:

EHV1: Abortion in pregnant mares 2-4 weeks following exposure. Lifelong infection, with potential for recrudescence during stress or treatment with steroids. Neurologic form incubation averages 3-8 days but up to 14 days

EHV3: As short as 2 days.

EHV4: 2-10 days following exposure.

EHV1/9: recombinant: unknown

Clinical signs:

EHV1 abortion: Sporadic or abortion "storm" can be observed. Spontaneous abortion of fetus within amniotic membranes in pregnant mares with no premonitory signs in the last trimester of gestation. Foals that are born alive are extremely weak and die within days.

EHV1 encephalomyelopathy: Encephalomyelitis varies in severity. Mild cases are noted with slight ataxia, urinary incontinence, flaccid tail, decreased anal tone, limb edema and pyrexia. Severe cases result in paralysis, seizures, blindness, and ultimately death. Paresis and paralysis are often noted with an ascending pattern from the hindlimbs. Colic, ocular lesions, anorexia, and pyrexia are also reported. Mild cases may resolve uneventfully.

EHV3: Vesicular and ulcerative lesions are noted on the superficial mucosa of the external reproductive organs. Lesions are transient and heal in several weeks, leaving spots of depigmented skin. Stallions may be reluctant to breed. Affected horses may become life-long carriers, with flare-ups possible.

EHV1/4 respiratory disease: Most common in foals older than 2 months, when maternal immunity is waning. Increased rectal temperature, serous to mucopurulent nasal discharge, anorexia, and depression, with recovery by 3 weeks. Clinical signs are uncommon in horses over 2 years of age. Abortion in pregnant mares may occur rarely.

EHV1/9 recombinant: Range of clinical signs, usually results in neurological disease in affected animals. Polar bears and black bears have been reported with tremors, excessive blinking, ptyalism, opisthotonos, seizures and progressive neurologic disease. A giraffe was euthanized due to ataxia, incoordination, abdominal pain, and a progressively deteriorating condition. Thomson's gazelles have been reported with recumbency, seizures, and progressive neurologic disease. EHV related abortion has been reported in a Asian rhino.

Guinea pigs housed in the same building as affected Thomson's gazelles were reported with abortion,

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hindlimb paralysis, and ataxia.

Post mortem, gross, or histologic findings:

EHV1 abortion: splenomegaly, grey necrotic foci in liver and pleural/peritoneal edema in aborted fetuses. Herpesviral intranuclear inclusion bodies in affected tissue.

EHV1 encephalomyelopathy: Cases are noted with areas of hemorrhage throughout the CNS, and vasculitis and thrombosis of neural endothelial cells, with ischemic necrosis histologically.

EHV3: ulcers and vesicles on the vaginal, vestibular, vulvar, preputial, or penial mucosa of affected horses. Similar lesions may also be noted on oral mucosa or teats.

EHV1/4 respiratory disease: Focal areas of necrosis in liver, spleen, and lungs with intranuclear inclusion bodies. Bronchointerstitial pneumonia may be noted when infected with secondary bacterial infections.

EHV1/9 recombinant: Nonsuppurative encephalitis, with or without lymphohistocytic cuffing, multifocal gliosis, and vasculitis have been reported in a variety of affected species. Intranuclear inclusion bodies are sporadically reported.

Diagnosis:

EHV1 abortion/encephalomyelopathy:

- Pathology: Based on gross and histologic pathology in aborted foals, increased likelihood if intranuclear inclusion bodies are noted. Vasculitis in CNS tissue of encephalomyelitis cases.
- IHC: demonstrates viral presence in affected tissues
- CSF analysis: positive EHM horses typically have xanthochromia with increased protein. A monocytic pleocytosis is variably present. CSF samples are not accurate for PCR or ELISA testing.
- Viral isolation: (gold standard) Growth in horse and rabbit cell cultures, allows differentiation from EHV4 which only grows on equine cell cultures. Isolation from nasal swabs or blood samples of neurological horses, best results when taken during initial pyrexia. High viral burdens are more likely to have rapid turnaround time.
- PCR: can detect viral presence in collected tissues, including nasal swabs or uncoagulated (EDTA) blood, at low levels. Non-quantitative is run more routinely, but quantitative real-time is available.
- Paired serology: fourfold or greater increase in virus neutralizing antibody titers, or a single titer of 1:256 or higher, are consistent with positive diagnosis. However, this approach cannot distinguish between EHV1 and EHV4.
- ELISA: test pregnant mare serum when fetal tissues are not available to diagnose.

EHV3:

- Clinical: based on physical exam findings
- Paired serology: comparison of acute and convalescent serum samples for a rise in antibody titers.
- Electron microscopy: investigation of clinical samples, including scrapings from the affected mucosa
- Virus isolation: growth in equine cell cultures

EHV4:

- Clinical signs
- Virus isolation: growth only on equine origin cell lines
- ELISA: can distinguish EHV4 from EHV1
- Paired serology: comparison of acute and convalescent serum samples for a rise in antibody titrers.

EHV1/9 recombinant:

- PCR: analysis of collected tissue samples
- Western Blot: detection of viral proteins in neurologic tissue

Material required for laboratory analysis:

EHV1: Serum for ELISA testing, fetal tissue (lung, thymus, spleen) for histologic diagnosis, nasal swabs or

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blood (EDTA) for virus isolation or PCR analysis.
EHV3: serum, scrapings of mucosa from affected areas.
EHV4: nasal swabs, whole blood, serum for various testing modalities.
EHV1/9: recombinant: nasal swabs, serum, CNS tissue

Relevant diagnostic laboratories: Real-time PCR analysis offered by:
http://www.aphis.usda.gov/vs/nahss/equine/ehv/ehv_ehm_recommendations_051611.pdf
http://www.vetmed.ucdavis.edu/ceh/ehv1_diagnostic.cfm

Treatment:
EHV1 encephalomyelopathy: Strict isolation, supportive care for encephalomyelitis. Urinary bladder decompression and rectal evacuation for incontinent patients and sling support if recumbent. Corticosteroids given IV once to twice daily for 3-5 days, followed by a tapered regimen, to decrease CNS inflammation. Treatment with antiviral medications has not been investigated, although good *in vitro* efficacy has been demonstrated.
EHV3: Antiseptic lotions and ointments to prevent secondary infection or discomfort. Discontinue breeding until all lesions are healed.
EHV1/4: respiratory disease: Supportive care.
EHV1/9 recombinant: Supportive care.

Prevention and control:
EHV1 abortion: Inactivated vaccines have been used to prevent abortion, with dosing at 5, 7, and 9 months of pregnancy. Literature does not currently indicate a protective effect of vaccination, but vaccines are successful at producing a high antibody response and limit nasal shedding. In cases of outbreaks, prophylactic vaccination of all horses is controversial. Isolation of pregnant mares and maintenance of closed groups is recommended to prevent further outbreaks in cases of infection. Any horse with respiratory signs also should be isolated. Horses will become infected life-long, with possible recrudescence during times of stress.
EHV1 myeloencephalopathy: quarantine exposed horses. No vaccine has been shown to be protective; however, it is recommended to vaccinate with inactivated vaccines to increase antibody titers and decrease shedding. Concerns have been noted that horses that have been vaccinated frequently are more likely to develop myeloencephalopathy.
EHV3: No vaccines are available. Isolation of affected horses. Horses will become infected life-long, with possible recrudescence during times of stress.
EHV1/4 respiratory disease: Immunity after natural infection is short lived. Modified-live vaccines available for pneumonia, inactivated vaccines are also capable of inducing a high antibody response. Vaccine will decrease severity/incidence but still not prevent the disease. Horses <5 years old should have the first vaccination at 3-4 months of age, with boosters every 6 months, or as determined by the product. Horses will become infected life-long, with possible recrudescence during times of stress.
EHV1/9 recombinant: No vaccine available, maintain separation of potential host species from aberrant hosts that have demonstrated susceptibility.

Suggested disinfectant for housing facilities: Being an enveloped virus, EHV is susceptible to most disinfectants and detergents.

Notification: No special notification requirements for any viral strain.

Measures required under the Animal Disease Surveillance Plan: None currently for any viral strain.

Measures required for introducing animals to infected animal: It is recommended that an isolation period of 21-28 days be placed on any animal that has tested positive or exhibited clinical signs of any form of the disease. Affected animals will remain latently infected following the quarantine period, and may continue to shed virus during times of stress.

Conditions for restoring disease-free status after an outbreak: EHV infected animals will remain latently

infected for the duration of their lives. They should remain isolated from healthy individuals.

Experts who may be consulted:

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