

Equine Infectious Anemia

What You Need To Know

Answers to the most common questions
and myths about EIA, for horse owners

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What is EIA?

Equine infectious anemia (EIA), also known as “swamp fever,” is a viral disease of horses and other equids (i.e. donkeys, mules, and zebras) that causes recurrent episodes of fever, lethargy and destruction of red blood cells (anemia) and platelets (thrombocytopenia).

The EIA virus is a lentivirus in the family *Retroviridae*, similar to several immunodeficiency viruses in other species, including human immunodeficiency virus (HIV). These viruses cause **persistent, lifelong infection** in their hosts by generating DNA sequences (based on the viral RNA) that become permanently inserted into the DNA of white blood cells. However, unlike other immunodeficiency viruses that cause slowly progressive illness, signs of EIA are usually the most severe when a horse is initially infected, and subsequent episodes of illness gradually become less severe, even though the horse remains infected and a potential source of virus for other horses.^{1,2} These episodes of overt disease, which may occur weeks to months apart, are the result of mutations that occur in the virus over time, thus creating a novel “strain” that causes clinical signs in the same horse, until its immune system responds and is once again able to suppress the virus.³⁻⁶ Other clinical signs of EIA may include swelling (edema) of the limbs and abdomen, rapid weight loss, swollen lymph nodes, and abnormal bleeding tendencies. Infection may also lead to neurological signs (ataxia), abortion, or rarely sudden death. It is not unusual for an EIA-infected horse to have no history of illness due to EIA, especially since mild episodes (e.g. mild fever and anemia for a few days) may go undiagnosed.

The EIA virus is transmitted on the mouth parts of horseflies and deerflies when they feed on an infected horse, and then feed on another horse within a fairly short period (approximately four hours).^{7,8} Stable flies can also transmit the virus, but not as easily.^{9,10} There is no evidence that the virus is transmitted by mosquitoes.^{3,11} Transmission is much more likely to occur from a horse when it is showing signs of illness, because of the increased amount of virus in the bloodstream; however, **transmission from persistently infected but healthy horses is possible**,^{12,13} and immunosuppression from steroid therapy (e.g. prednisolone, dexamethasone) or other stresses can also lead to increased viral load and illness in a previously healthy carrier horse.^{14,15} Foals born to EIA-positive mares are unlikely to be infected, particularly if the mare had no signs of EIA while pregnant.^{1,16} Although foals are susceptible to infection after birth, antibodies in the colostrum from the mare appear to offer some protection for the first several months of life.^{1,17} **The virus can also be transmitted via blood product transfusions and use of blood-contaminated equipment** such as surgical and dental instruments, hoof knives and hypodermic needles. The virus can survive for up to four days on a hypodermic needle at room temperature.^{11,18,19}

There is no treatment available that will allow a horse to fully eliminate the EIA virus from its body once infected, **nor is a vaccine currently commercially available.** The virus poses no risk to humans or other non-equid animals. The disease occurs in horses **all over the world**, but there are many countries (including Canada) where the

prevalence of infection is very low, primarily due to ongoing control programs. Some countries (*not* Canada) have even more strict eradication programs.

Examples of countries that have active EIA surveillance and control programs include Canada, USA and France.⁷

Examples of countries that are considered free of EIA include Japan, Chile and Iceland.²⁰

Examples of countries where EIA is considered endemic include Romania and Italy.⁷

For a full list of countries where EIA has been reported, and those with general and targeted surveillance programs, visit the **World Animal Health Information Database (WAHID)** website maintained by the OIE (World Organization for Animal Health) at:

http://www.oie.int/wahis_2/public/wahid.php/Diseaseinformation/statuslist

Does EIA kill horses?

Yes. While the majority of horses survive initial infection with EIA, a small proportion develop very severe acute anemia and other signs of illness which can be fatal. In some persistently infected horses, disease episodes may become more frequent and severe, resulting in debilitating chronic anemia, thrombocytopenia (low platelet count), edema (swelling) and weight loss, which may lead to euthanasia.²

Why is there a control program for EIA in Canada, but not for other equine diseases?

Equine infectious anemia has several characteristics that make control of this disease in Canada feasible:

- The virus has no wildlife reservoir, other than wild equids, which have a very limited range in North America.
- Effective tests are available that can clearly and reliably distinguish infected from uninfected animals.
- Control of transmission is relatively straightforward; even though the virus is transmitted by an insect vector, this only occurs over relatively short distances, during particular times of the year, and almost all other transmission is due to human practices (e.g. reusing needles).
- The prevalence of EIA is sufficiently low that taking strict action with the small number of affected horses (i.e. removing them from the population) effectively protects the entire national herd, as well as horses that may travel to and from Canada for sale, competition or other purposes.
- Infection with EIA has long-term repercussions for any horse that becomes infected, as the virus is never entirely eliminated from the body, and the animal remains a risk to other equids as a virus reservoir.



A similar control program is not logical or practical for other equine diseases that spread more easily, are common in the horse population and/or can be effectively eliminated by an infected horse such that there is no long-term risk. The equine industry negotiated to have Canada's EIA control program put in place. As an OIE-listed disease, it is internationally expected that measures of this kind are taken to prevent the spread of EIA within (and from) the country. The program is administered by the Canadian Food Inspection Agency (CFIA), which is responsible for the control of all federally reportable animal diseases.

How good are the tests for EIA?

All commercially available tests for EIA are based on detecting **antibodies** to the EIA virus in blood. None of them detect the virus directly; tests for the EIA virus itself (including pony inoculation, virus isolation in cell culture and real-time RT-PCR) are used for research purposes, but are prohibitively difficult to perform and too expensive to use for routine testing.^{2,9} Because the EIA virus can never be completely eliminated (even if it only replicates at a very low level), **any horse that has produced antibodies to EIA also carries the virus.**

There are a few circumstances that can produce misleading results with these kinds of antibody tests:

- Young foals may acquire antibodies to EIA from their mares via colostrum. Although many foals of EIA-positive mares are virus-negative at weaning,¹ they are at risk of exposure to the virus due to their close proximity to the positive mare, therefore additional quarantine and testing may be needed after the foal is weaned and is at least six months old, in order to determine if the animal is producing its own antibodies against EIA.
- Horses that receive blood or plasma transfusions from EIA-positive horses will also passively acquire EIA antibodies. However, it is highly likely in such a case that the blood product would also contain the virus itself, resulting in infection of the transfusion recipient. As little as 250 mL of blood, even from a healthy EIA-positive horse, is sufficient to transmit the virus.³
- The amount of antibodies produced by individual horses can be quite variable, and particularly in animals that have a low viral load for a long period of time, antibody levels

can drop below the level of detection of the test, even though the horse is infected. Also, horses that were very recently infected (i.e. within a few weeks of being tested) may not yet have produced a sufficient amount of antibodies to test positive (this usually takes about three weeks, but in some cases may take up to three months⁷). A test that can detect very small amounts of antibody, and therefore decreases the risk of a false-negative result, is said to be very *sensitive*.

- Rarely, a horse may produce antibodies against something that is not the EIA virus, but the antibodies are so similar to EIA antibodies that the test is "tricked," thus producing a positive result for a horse that is in fact EIA-negative. A test that will react with only EIA antibodies, and therefore decreases the risk of a false-positive result, is said to be very *specific*.
- In very rare cases, a horse with clinical signs of EIA may have enough virus in its blood to bind all the available antibodies, resulting in a negative antibody test.⁹

The first test for EIA was developed in the early 1970s by Leroy Coggins, and became known as the **Coggins test**.³ It is an agar gel immunodiffusion test (AGID) that detects the presence of EIA antibodies in a horse's bloodstream. Later on the enzyme-linked immunosorbent assay (ELISA) for EIA was developed,¹² which is more sensitive but not as specific as the AGID (i.e. the ELISA can detect smaller amounts of antibody so it is less likely to miss a positive horse (false negative), but it is slightly more likely to misdiagnose a negative horse (false positive)).

A very recent study¹⁴ clearly demonstrated that some equids, particularly mules with positive ELISA test results but weak positive or even negative AGID test results, still had highly variable amounts of virus in their blood over time, meaning they do not necessarily pose a lower risk for virus transmission. These results suggest that using the AGID test alone for screening horses may miss some animals that are still an infectious risk to others, which is another reason horses in Canada are first screened with the ELISA test. The AGID remains the internationally-recognized confirmatory test.





Table 1: Tests currently used in the diagnosis of equine infectious anemia infection.

Test	Sensitivity	Specificity	Technical demands / expense	Use	Used by CFIA
AGID (Coggins)	++	+++	+	Previously primary screening test; still used to confirm ELISA results	Confirmatory test
ELISA (cELISA) (Vira-CHEK ELISA) (SA-ELISA II)	+++	++	+	Primary screening test in many areas; positive results should be confirmed with AGID	Screening test (cELISA)
Western blot (immunoblot)			++	Not a screening test, can be ordered by authorities as a supplemental test if other test results are contradictory	Not used
PCR ^{16,17}	++	+++	++	Can be ordered by authorities as a supplemental test if other test results are contradictory, to confirm clinical cases, or to test foals from infected mares	Not used (research tool only)
Virus isolation / Pony inoculation			+++	Used to confirm clinical cases, typically only used for research	Not used

AGID = agar gel immunodiffusion test

cELISA = competitive enzyme-linked immunosorbent assay

SA-ELISA = synthetic antigen enzyme-linked immunosorbent assay, detects antibodies to two different EIA antigens (p26 and gp45 transmembrane protein)

PCR = polymerase chain reaction (reported sensitivity approximately 80% (Dr. Simard, personal communication via Dr. C. James)).

What happens in Canada when a horse tests positive for EIA?

All EIA testing in Canada is performed at CFIA-approved laboratories only. If a horse tests positive (even a weak positive) at one of these laboratories, the following sequence of events takes place:

- The positive sample is sent to the CFIA EIA National Reference Laboratory in St. Hyacinthe, QC, where the ELISA test is repeated
- If the second ELISA test is also positive, then the AGID test is performed.
- If the AGID test is also positive, the horse is considered a **confirmed positive case**.

By law, CFIA must take the following mandatory actions for any confirmed positive case of EIA:

1. **Quarantine:** The positive horse must immediately be quarantined from all other horses and equids (minimum 200 m distance at all times due to the risk of transmission from insects such as horseflies and deerflies). All other horses that were within 200 metres of the positive horse within the last 30 days must also be quarantined^{18,19}, regardless of whether they are on the same or an adjoining property, or if they were moved to another property elsewhere in that time.
2. **Testing of other horses:** The other horses that were within 200 metres of the positive horse are considered “potentially exposed” and must also be tested for EIA. Because horses can take a few weeks to either show signs of illness and/or to produce antibodies after being exposed to the virus, potentially exposed horses must be tested at least once 45 days or more after their last exposure to the EIA-positive horse before the quarantine is lifted. In Canada, horses may also be tested at the beginning of the quarantine period if further transmission of the virus could occur within the group of quarantined horses (e.g. during fly season). In the US, the same process applies, but horses must be tested twice and the tests must be at least 60 days apart (i.e. at the beginning and end of the quarantine period)^{2,18}.
3. **Re-testing the positive horse:** If the positive horse has no detectable clinical signs of EIA, the CFIA will re-test the horse, if requested. The implications of being EIA-positive for the horse are significant, but no test is perfect, and

sample handling errors can occur. The likelihood of both the ELISA tests and the AGID test producing a false-positive result is extremely remote, therefore the main reason for re-testing at this stage is to ensure that the horse and sample were correctly identified.



If the results of re-testing the confirmed positive case are the same, or if no re-test is requested, then steps must be taken to ensure that the virus can never be transmitted to other horses.

- **If the horse has overt signs of EIA**, the CFIA will order the horse to be humanely euthanized, because horses with clinical signs have high levels of virus in their blood and are therefore a much greater risk to other horses in terms of being a reservoir for transmission of the virus.^{4,6,19}
- **If the horse is healthy**, there are two options:
 1. **Lifetime quarantine:** The horse must be quarantined for the remainder of its life, keeping it at least 200 metres from any EIA-negative horse. In the US, in addition to quarantine, a brand or a lip tattoo is typically applied to permanently identify the horse as an EIA “reactor”. The horse also cannot be moved from the premises at any time except under special permit in a sealed trailer to either a research or slaughter facility, or its home farm^{8,18}.
 2. **Euthanasia:** If a horse must be euthanized due to EIA infection, the CFIA will pay compensation to the owner up to a maximum of \$2000 per animal.

Although this may seem extreme, these steps help to protect every horse with which the infected animal may otherwise come into contact over the course of its lifetime, as well as all the horses with which those animals may come into contact, and so on.

Why do horses that are confirmed positive for EIA have to be permanently quarantined or euthanized?

Although the risk of transmission from EIA-positive horses that are not showing signs of disease is low, it is not zero^{10,21,22}, and the disease is unpredictable. An infected horse can have virus circulating in its bloodstream at any time, and if the horse's immune system becomes weakened from stress, pregnancy, drug therapy or other diseases, the amount of virus in its bloodstream can increase, and the horse may show signs of EIA^{11,23,24}. In order to eradicate the virus, these reservoirs need to be eliminated (euthanized) or separated from all other susceptible animals (quarantined) in order to ensure the transmission cycle is broken.

If every infected horse infected just one new horse in its lifetime, EIA would continue to survive in the equine population indefinitely.

If some of those horses manage to infect more than one new horse, then the infection will gradually become more and more common, making it harder to keep EIA-negative horses from being exposed. It has been shown that if horses are at least 48 metres (160 feet) apart, 99% of horseflies will continue to feed on the same animal rather than fly to a different horse if their feeding is interrupted^{13,25}.

Separating infected horses from other horses by at least 200 metres therefore effectively minimizes the risk of EIA transmission by these insects.

The ability to effectively control EIA exists because the prevalence is currently low, such that only a relatively small number of EIA-positive horses would need to be euthanized or quarantined in order to protect the entire current and future equine population.

In Canada, testing for EIA is *voluntary* (and therefore paid for by horse owners), but the response when an EIA-positive horse is identified (quarantine or euthanasia) is *mandatory*, and enforced by the CFIA, because this is the program that was established at the request of the equine industry. As a federally reportable disease under the *Health of Animals Regulations*^{15,19}, all suspected or confirmed cases of EIA must be reported to the CFIA.



What would happen if Canada stopped testing for EIA?

- The virus would likely spread within the Canadian horse population from the small number of EIA-positive horses that are already present in the country. The spread would likely be very slow at first, but as more horses became infected the speed of spread would rapidly increase. Clinical illness due to EIA, including debilitating or potential fatal infections, would also become more common.
- As a result of this increased risk of EIA, people might stop bringing their horses to events in Canada.
- Other countries that are trying to control or eradicate EIA would still require a negative EIA test in order for horses from Canada to cross their borders. In the worst case, some countries may stop allowing horses from Canada to be imported altogether due to the increased risk that the animals may be carrying EIA, which may infect the resident population.

EIA occurs in horses all over the world, but there are many countries where the prevalence of infection is very low, primarily due to ongoing control programs. The equine industry negotiated to have Canada's EIA control program put in place. As an OIE-listed disease, it is internationally expected that measures of this kind are taken to prevent the spread of EIA within (and from) the country.

Can horses be vaccinated against EIA?

There is currently no commercially available vaccine against EIA in North America or Europe.

One of the controversies with developing a vaccine against EIA is ensuring that vaccinated horses can be distinguished from infected horses. If the antibodies produced following vaccination are identical to those produced by natural infection, current tests will no longer be suitable for detecting EIA carriers, and spread of the virus through the population could be “masked” in the wake of widespread vaccination.

Developing an effective vaccine against a lentivirus such as EIA is extremely challenging. Many of the same problems have been encountered in the efforts to develop a vaccine for HIV in humans, which is a related virus. An attenuated live vaccine for EIA was developed in the early 1970s and was used extensively in China from 1975-1990. The vaccine was effective for reducing the prevalence of the disease, but now that the prevalence is low, use of this vaccine has been discontinued in favour of the test-and-quarantine/slaughter strategy, and to avoid the testing complications that can occur with vaccine use, as described above^{1,9}. Use of a live vaccine of this kind comes with additional risks, because lentiviruses like EIA (as well as live EIA vaccines) are very prone to mutation, and they become permanently integrated into the host cells^{1,9}, thus creating a small risk of the vaccine strain becoming a new pathogenic virus.

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What can I do to protect my horse from EIA?

1. The best way to protect your horse from EIA is to avoid exposure to EIA-positive horses; because many EIA-positive horses look healthy most of the time, a strong testing and reporting program is needed.
 - Whenever possible, ensure that all horses that come within 200 metres of your horse are tested for EIA. This includes only taking your horse to shows and events where all horses are required to be tested for EIA before being allowed on the premises, and requiring testing of any new horses coming to your property or boarding facility.
2. Control horseflies, deerflies and stable flies on and around your horse at all times, and especially at any large gathering of horses, as these are the natural means of transmission of EIA between horses. Insect control includes appropriate use of repellants and insecticides, as well as management of manure and environmental moisture to discourage insect breeding.^{11,18}
3. Ensure that any blood products (including plasma) given to your horse are from EIA-negative donors. Do not reuse hypodermic needles, and any medical equipment (e.g. surgical and dental instruments, hoof knives) that may be contaminated with blood must be thoroughly disinfected between uses on different horses. The virus is easily killed by almost any disinfectant if the surface or object is not visibly dirty.

The CFIA provides maps showing areas in which horses have been diagnosed with EIA on an annual basis. Regions where positive horses have been reported (particularly over several years) would be considered higher risk for other horses that travel or live there. These maps are available on the CFIA website at <http://www.inspection.gc.ca/> under Animals > Terrestrial Animals > Reportable Diseases > Equine infectious anemia.

A shorter version of this information about EIA in Canada is available on the Worms & Germs website under Resources > Horses. Visit:

www.wormsandgermsblog.com

1. Positive horses that are healthy have eliminated the virus and pose no risk to other horses.

False. Horses that become infected with EIA are infected for life^{6,7} - the virus actually incorporates its genetic code into the DNA of certain cells. It has been shown that even in animals with no signs of illness, the level of virus in their bloodstream fluctuates over time, and when it increases the virus can be transmitted from these “healthy” equids to other equids via biting flies like horseflies and deerflies, or via blood-contaminated equipment such as hypodermic needles^{14,15,20,26}.

2. EIA testing is just another scam so veterinarians can make more money.

False. The EIA control program in Canada is in place to help protect the Canadian equine industry, in terms of the overall health of the national herd, and particularly in terms of international trade and competition. The program is based on international disease control standards set forth by the World Organization for Animal Health (OIE)^{7,9}. Without the control program, many countries would not allow Canadian horses to be imported for breeding, sale or competition, and they would not allow their horses to travel to and back from Canada for the same purposes, due to the risk of EIA spreading to their own animals. The cost of the EIA test paid by owners does not even cover the CFIA’s operating costs for the program - this is done as a service to the industry^{2,19}.

3. EIA tests are not accurate and horses can be euthanized because of false results.

Mostly false. While no test is perfect, and false results are possible with any test (including those used for EIA), no healthy horse is ever ordered destroyed based on a single test. In Canada, all EIA-positive samples are tested again with the same test (ELISA) at the EIA National Reference Laboratory, and are then tested a third time *with a different test* (AGID) to confirm the results. The owner of the horse is then also given the option to have the horse retested (using both the ELISA and the AGID) on a second blood sample. The likelihood that all of these tests would give the same false positive result is extremely remote, so this additional testing ensures that only truly positive horses are euthanized or quarantined.

4. EIA is only found in wild or feral horses and does not affect my horse.

False. The EIA virus can infect any equid (e.g. horse, donkey, mule, zebra), feral or domestic. The vast majority of cases diagnosed are in domestic horses that are either travelling or competing, as these are the animals that are tested most frequently. Feral horses are rarely if ever tested due to the difficulty of obtaining blood samples, therefore it is extremely difficult to confirm the prevalence of EIA in a population of wild horses. However, because wild horses do not travel outside of their home territory, they can only be infected by insects that have fed on other (domestic) equids that live nearby, and likewise they can only spread the virus, via the same insects, to other nearby horses. *Therefore domestic horses that live in proximity to wild herds can act as sentinels of infection in the feral animals, and controlling EIA in the domestic population will also help prevent introduction of the disease into wild herds, where it would be much more difficult to eradicate (and could serve as a reservoir for infecting more domestic horses).*

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Additional resources

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