Awakening the Dormant Dragon: Neurological Form of Equine Herpesvirus-1

White Paper on Equine Herpes Myeloencephalopathy (EHM)

Prepared by:

Center for Equine Health and the
William R. Pritchard Veterinary Medical Teaching Hospital
School of Veterinary Medicine
University of California, Davis

26 May 2011

UCDAVIS
VETERINARY MEDICINE

Introduction

In recent years a number of equine events and shows, racetracks, private veterinary clinics and university teaching hospitals outside of California were shut down to limit the spread of the neurological form of equine herpesvirus-1 (EHV-1) infection known as Equine Herpes Myeloencephalopathy (EHM). California had at least four reported cases of EHM in 2006 and additional cases in 2007, but no facilities were shut down completely. In preceding years—with the exception of 2003, when there was a large outbreak at a riding school in Ohio—few and sporadic cases were seen in the United States until 2005, when seven cases in the eastern United States were reported.

Prior to January 2011, EHM was not a Regulatory Condition (i.e., reportable) in California. Prior to this year, EHM was a Monitored Condition as EHV-1 and EHV-4, which meant that it was reported to the CDFA on a monthly basis. Therefore, in previous years the Office of the State Veterinarian had limited authority to impose quarantine and movement restrictions. The change was made based on the increased incidence of this disease over the past decade.

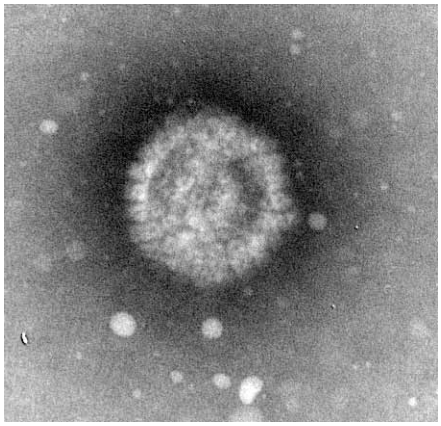
Why does there appear to have been a sudden increase in the number of EHM cases in recent years? Many questions including this one remain unanswered. More research is needed to understand the factors involved in the emergence of the neurological form of EHV-1 infection. This White Paper presents the information we have to date.

Equine herpesvirus-1 is one of a large group of viruses that causes potentially serious disease in horses. EHV-1 infection may occur subclinically or be manifest in three clinical forms that can occur independently or concurrently. The most common form is the respiratory form but the virus can also cause abortion in mares (abortogenic form), or neurological problems in adult horses (neurologic form) secondary todamage to the spinal cord and/or brain. This latter form, now referred to as Equine Herpes Myeloencephalopathy (EHM) is of particular concern because (1) it results in a high death rate, (2) it is resistant to prevention by vaccination, and (3) it affects horses of all breeds and vaccination status. It has the potential to cause catastrophic losses to both the health of horses and the economy of the horse industry.

EHV-1 occurs throughout the world and indeed almost all horses older than 2 years of age have been exposed to it, similar to the herpes simplex type 1 virus in humans, which affects about 85% of the world population sometime during childhood. Following initial exposure, EHV-1 has the ability to develop into an inapparent, latent infection—that is, it remains in a dormant state and does not produce any clinical signs. This ability to reside as a silent and persistent infection in horses provides a reservoir of virus that may play a role in transmission.

According to the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS), the clustering of outbreaks in certain regions of the country could be related to where high-level performance horses are located or where they tend to travel. However, since this disease is not well understood, other factors inevitably play a role in these outbreaks.

EHM is not a new disease, but the evidence currently supports the observation that it is seen more commonly now than it was in the past. Recent research has identified a specific strain of EHV-1 (the so-called neurotropic or neurogenic strain) that is more likely to cause neurologic disease because it multiplies to higher levels in the blood than "non-neurotropic" strains and is thus more likely to infect neural tissues and produce a fulminating disease (one that occurs suddenly and with great intensity) that can be fatal. It should be noted, however, that this "neurotropic" strain is not a new mutant. It has been in circulation for many decades but the molecular tools to differentiate it from other strains have only recently become available. It should also be noted that the "non-neurotropic strain of EHV-1 can also cause EHM. Approximately 15% of clinical cases are caused by non-neurotropic strains, whereas



The equine herpesvirus as viewed by transmission electron microscopy at a magnification of 167,000 X.

85% are caused by neurotropic strains. Even in the face of outbreaks of EHM, the virus appears to be restricted to latency in some horses and does not cause clinical signs, much like the herpes simplex type 1 virus in humans.

How Horses Become Sick

EHM occurs when large amounts of the virus damage small blood vessels in the brain and spinal cord. This leads to inflammation of the blood vessels and the formation of clots that obstruct the flow of blood through the circulatory system or hemorrhages into the nervous tissue. Ultimately, this results in tissue ischemia (reduced blood supply and oxygen delivery) and potentially infarction (tissue that is dead or dying because of a lack of blood supply). The damage resulting from this restriction in blood supply to regions of the spinal cord and brain leads to dysfunction of the neural tissues. This is not unlike what happens when cardiac blood supply is impaired in human heart attack.

EHV-1 is contagious and is spread by direct horse-to-horse contact, by contaminated hands, equipment and tack, and for a short time, through aerosolization of the virus within the environment of the stall and stable. Therefore, to prevent the spread of infection, it is essential to institute isolation and quarantine measures immediately.

It is also possible that stress factors may reactivate the virus and elicit the onset of clinical signs. These stress factors may include stress from transport, strenuous physical exercise, suppressed immune system, and excessive fatigue.

Clinical Signs of EHV-1

The initial clinical signs of EHV-1 infection may be non-specific and include fever of 102°F or greater. Fever may be the only abnormality observed. Other signs may be combinations of fever and respiratory symptoms of nasal discharge and cough. Some infected horses may have reddish mucous membranes, puffy and red eyes, and swollen legs.

Most horses that become infected with EHV-1 do not go on to develop EHM. Those that do soon become uncoordinated and weak and have difficulty standing. They may also experience difficulty in urinating and defecating. Often the hindlimbs are more severely affected than the forelimbs. Hence, "dog-sitting" is not uncommon in horses

Clinical signs may include redness of the sclera or conjunctiva.

with EHM. Signs of brain dysfunction may occur as well, including extreme lethargy and a coma-like state.

The incubation period for infection is from 2 to 8 days. Once a fever occurs, clinical signs can progress to nervous system involvement over the next 1 to 7 days.

Vaccinations

While several vaccines are available for protection against the respiratory and abortogenic forms of EHV-1, at this time there is no equine vaccine that has a label claim for protection against the neurological form of the virus. More details about the current status of EHV-1 vaccination are presented in a later section.

Until such time as a vaccine is developed to protect horses from EHM, the best way to prevent the spread of disease is through isolation, quarantine and the practice of biosecurity—a series of management steps taken to prevent the introduction of infectious agents into a herd. All of these preventive measures are discussed in the following sections.

Urine dribbling as well as difficulty in urinating and defecating are also clinical signs of EHM.

Isolation and Quarantine Procedures to Prevent the Spread of EHV-1

Isolation of Sick Horses

Horses exhibiting sudden and severe neurological signs consistent with a diagnosis of EHV-1 pose a threat to the surrounding population of horses. Consequently, early intervention to prevent the spread of infection is critical.

If your horse develops fever, respiratory signs (including nasal discharge or cough) and neurological signs (incoordination, weakness, difficulty standing, lethargy, difficulty controlling urination or defecation), immediately notify your veterinarian and do not move other horses in the immediate area. Alert anyone with a horse in the adjacent area to stop all movement of horses in and out of the facility until a diagnosis is confirmed by PCR testing. If horses are exposed and then travel to a new stable or show, the infection may spread to other horses at that new location.

To prevent an infected horse from having further contact with other horses in the stable environment, an individual horse exhibiting any of the clinical signs described above should be removed immediately from the area of other horses and placed in a separate enclosure designated for infectious disease isolation. Anyone handling infected horses should not be in contact with other horses until thoroughly washing their hands and changing clothes and footware. The isolation stall or enclosure should be located well away from high-traffic areas associated with other barns or training areas.

Animal caregivers should take precautionary measures to ensure that they do not transmit disease to other horses through contaminated hands, clothing, footware, equipment, feeders, waterers or tack. It is essential that the isolation facility have supervised oversight by an individual trained in disease control and quarantine procedures to avoid the possibility of contamination.

EHV-1 in infective amounts does not persist in the environment for a long time, but disinfection of premises, stalls, trailers and other equipment or facilities is important. If you handle a horse with EHV-1 and don't wash hands or change clothing, you may spread the infection to other horses.

A solution of 1 part chlorine bleach to 10 parts water is effective for decontaminating equipment and environment, provided that organic material has first been removed by thorough cleaning with disinfectant and water (bleach is not effective as a disinfectant when organic material is present). Other commercial preparations for disinfection are available through your veterinarian.

Segregation of Exposed Horses

Horses known to have had intimate contact with the diagnosed clinical case of EHV-1 should be maintained in their existing barns and segregated from other horses during exercise periods until the sick horse has been confirmed to have EHV-1 by PCR testing.

Quarantine Procedures

Once EHV-1 infection has been confirmed, appropriate focal quarantine measures to restrict the movement of all potentially exposed horses will be necessary to prevent the spread of disease to other locations.

These procedures may begin with initial restrictions such as the quarantine of horses in the immediate area of exposure (i.e., a single barn or other unit of housing) within a horse facility. Horses in the immediate contact area of the clinically affected horse(s) should have their temperatures taken twice daily and if a fever develops be tested for EHV-1, as should any other horse that exhibits fever or other clinical signs consistent with EHV-1 infection. Because stress may play a role in eliciting the onset of clinical signs, horses stabled in areas of known exposure should not be subjected to strenuous physical exercise or long-distance transport until their health status can be determined.

Expanding the Quarantine Area

If new clinically ill or EHV-1 positive horses are identified in other locations within the equine facility, an additional focal quarantine of exposed horses should be instituted at that location. The area under quarantine may be expanded to include other affected barns.

If multiple cases are identified or suspected, the entire stable area may need to be quarantined. The optimum strategy should be prudent imposition of a series of focal quarantine procedures using an expanding series of "concentric rings" (larger and larger rings, as needed) of disease control.

Individual animals that have tested positive for EHV-1 within the designated quarantine area, whether symptomatic or not, should be retested periodically until disease is confirmed or eliminated based on lack of clinical signs for the disease, supplemented as appropriate by PCR testing.

Quarantine measures should be maintained until an absence of further clinical cases and positive tests suggest no new appearance of disease is occurring. At that time, a gradual drawdown of these quarantine procedures can be started. Areas of the facility under focal quarantine may have their restrictions rescinded in a reverse of the concentric-ring approach. The general guideline is to wait for 21 days after the last recorded fever related to EHV-1, or if testing is negative in all exposed horses, quarantines have been lifted sooner.

Horses Outside the Quarantine Areas

Because the positive predictive value of PCR-based tests for EHV-1 in horses with no clinical signs is uncertain at this time, horses outside of quarantine areas or in unexposed stables should not be tested on a random basis. The finding of a positive PCR test result in an asymptomatic horse does not provide conclusive evidence of either active infection or the potential for disease transmission. Because of the known tendency of EHV-1 for latency, low levels of nonreplicating virus (not capable of spreading infection) may be the source of the viral DNA detected by PCR in an asymptomatic individual.

This is the type of portable structure that can be used to create an isolation unit at an equine facility or event.

Diagnostic Testing for EHV-1

Infectious diseases such as equine herpesvirus-1 are diagnosed using molecular techniques rather than conventional laboratory techniques of antigen detection, microscopy and culture because the results can be obtained much more rapidly and with a greater degree of accuracy. Polymerase chain reaction (PCR) is the best molecular technology currently in use.

PCR works by detecting and then amplifying the DNA of an infectious agent. In the testing process, a very small amount of DNA or RNA from a virus, for example, can be detected and replicated into a million copies. The amplified specific genetic code sequence for that virus is then compared against a known specific sequence using computer-assisted technology. A test for a specific agent (virus) is made when there is a correlation between the acquired sample and a known viral sequence.

Sometimes some strains of bacteria or viruses may mutate and incorporate a small change in its genetic code for a particular strain of the same virus. This can cause the reaction to miss the sequence it is looking for and elicit an inconclusive result. However, tests are always being improved as new variants are found by scientists. PCR is a useful research and diagnostic tool, but all applications require extreme care and vigilance.

Because EHV-1 is considered to be endemic within the horse population, random testing of normal horses for EHV-1 by PCR can and likely will detect horses with non-replicating (dead) viral DNA, latent (dormant) low levels of virus, or viral levels that are not sufficient to pose a significant risk for disease transmission.

With the current outbreaks of EHV-1, the interpretation of PCR detection for the virus should be done only in the context of presenting clinical signs for disease. If PCR testing for a horse with clinical signs for EHV-1 indicates a high viral load for EHV-1, we recommend that other tests be undertaken as a follow-up to initial PCR testing to determine whether the virus is replicating (also PCR testing to determine RNA transcription). Additional testing can also be used to determine the viral load (amount of virus present in blood or nasal secretion) in any clinically ill horses. Viral load levels may potentially indicate the stage of disease progression for individual patients.

At this time, the significance of a positive PCR test in a horse with no clinical signs of the disease is unknown. There is currently insufficient information to justify or recommend control measures or quarantine procedures for horses testing positive for EHV-1 in the absence of clinical signs, unless they are known to have had close direct or indirect contact with a known clinical case.

Status of Vaccination Against EHV-1 Myeloencephalopathy

In the wake of recent outbreaks of EHM in North America, many managers of equine facilities and events have imposed EHV-1 vaccination requirements for incoming and resident horses in the hope that EHV-1 infection—particularly the neurological form—can be prevented. The efficacy of this approach remains to be proven. In fact, frequent revaccination of mature horses to prevent the neurological form of EHV-1 is not clearly justified in most circumstances for the following reasons:

- Most mature horses have been infected previously with EHV-1 and are latent carriers.

- EHM is a relatively rare disease from a population standpoint.

- EHM has been observed in horses vaccinated against EHV-1 regularly at 3- to 4-month intervals.

- Currently available vaccines do not reliably block infection, development of viremia (virus in the bloodstream) or establishment of latency.

- Currently available vaccines make no claim to prevent EHM.

On the other hand, regular revaccination of pregnant mares and other horses on breeding farms to reduce the risk of EHV-1 induced abortion is strongly recommended.

Commercially available vaccines for EHV-1 include two single-component inactivated vaccines (Pneumabort K and Prodigy) marketed for the prevention of abortion in pregnant mares; several multicomponent inactivated vaccines (Prestige, Calvenza, Innovator); and one MLV vaccine (Rhinomune) for the prevention of respiratory disease induced by EHV-1 and EHV-4. Each of these vaccines induce some, but not all, of the desired components of the immune response in the horse. Therefore, it is not surprising that NONE induces sterile immunity or complete protection from clinical disease. The best that can be hoped for is a reduction in the severity of clinical signs and in the amount of EHV-1 shed by vaccinated horses that do become infected.

There is evidence that viral shedding is reduced in horses with high circulating titers of virus-neutralizing (VN) antibody, as well as in those that have been vaccinated recently with the Rhinomune MLV vaccine. Of the available inactivated vaccines, Calvenza and both high antigenic mass vaccines marketed for prevention of abortion (Pneumabort K and Prodigy) stimulate the highest levels of VN antibody in experimental horses. One recent study to test the efficacy of Rhinomune against challenge with a "neuropathogenic" strain, and a challenge study performed almost 30 years ago to test the efficacy of Pneumabort K in preventing abortion, provided some evidence that these vaccines may have a place in control of outbreaks of EHM. The low number of horses enrolled in these studies justifies caution in interpretation of the results; however, a lower proportion of recently vaccinated horses developed EHM after challenge as compared to control unvaccinated horses in both studies.

On premises with confirmed clinical EHV-1 infection (any form), booster vaccination of horses that are likely to have been exposed already is not recommended. However, it seems rational to booster vaccinate nonexposed horses as well as horses that must enter the premises with one of the four vaccines listed above if they have not been vaccinated against EHV-1 within the past 60 days. This approach relies on the assumption that the immune system of most mature horses has already been "primed" by prior exposure to EHV-1 antigens through field infection or vaccination and can therefore be "boosted" within 7 to 10 days of administration of a single dose of vaccine.

While this approach does not guarantee protection of individual horses against the potentially fatal neurological form of EHV-1, the hope is that reduced nasal shedding of infectious EHV-1 by recently vaccinated horses will indirectly help protect other horses by reducing the dose of virus to which they are exposed.

Ultimately, enforcement of strict biosecurity measures and hygiene practices are likely to be more effective than widespread vaccination in reducing the risk of acquiring EHV-1 infection.

Everyday Biosecurity Considerations for Your Horse

Recent outbreaks of equine herpesvirus-1 have brought awareness of the need to handle our horses in a manner that prevents transmission of infection. The term for this is *biosecurity*, which means taking measures that prevent transmission of an infection.

Three ways that horses and humans may catch infectious diseases are by direct contact, indirect contact or fomite spread, and/or by aerosol spread via the air.

Direct contact means physical contact with a horse that has an ongoing active infection or is in the early incubation period of infection and ready to break with a fever. It is possible, however, to catch a virus or bacteria from a horse without that horse having a fever or other signs of infection.

Fomite (indirect contact) transmission occurs when a person touches a horse and has the agent on their hands, clothing or footware, or when infected material is carried on tack, bridles, saddle pads, buckets, grooming equipment, trailers, feedersor other contaminated equipment-that is used on another horse. Herpes viruses are largely spread by direct contact and fomites, although aerosol transmission can also occur.

Aerosol spread means that the infectious agent travels through the air and causes infection after being breathed in by a susceptible horse. Most respiratory viruses of the influenza group spread this way. Indeed these viruses can travel significant distances, depending on air flow, temperature and other environmental conditions. Horses with strangles may cough and spread that bacteria in a barn or stable, although direct contact and fomite spread are the main means of transmission for strangles.

Although EHV-1 can be spread by aerosols, coughing is not common in horses with EHM. Thus, aerosol transmission is less likely than spread by direct contact or fomites.

Biosecurity Measures

■ Keep your horse in a place where direct contact with other horses is minimal. If there is contact with other horses, it should be preferably with horses that do not leave the premises and return frequently.

■ Have a policy for your stable for horses that leave and attend horse events. Horses returning from distant events should have minimal contact with other horses. Upon returning to the stable, travel horses should ideally be isolated from the home stable population for at least 2 weeks.

■ While traveling to or attending an equine event, take your horse's temperature twice daily and report a fever (102°F or greater) to the stable manager and your veterinarian.

■ Avoid petting and touching other horses to minimize the chance of infecting your horse.

■ Wash your hands or use hand sanitizers between horses, or wear a fresh set of disposible gloves for each horse. Use separate water buckets, feed troughs, tack and grooming equipment for each of your horses. If equipment must be shared, it should be washed, disinfected and dried before use with another horse.

Biosecurity Measures for Different Situations

The following recommendations from the U.S. Department of Agriculture Plant and Animal Health Inspection Service are based on the belief that you are the best protection your horses have. These guidelines are intended to reduce the chances of an infectious disease being carried onto your farm by people, animals, equipment or vehicles, either accidentally or on purpose.

Showing Your Horse

■ Use your own trailer whenever possible. Don't ship your horses with horses from unknown farms.

■ Ship only in a trailer or van that has been cleaned and disinfected. If you can "smell horse" in the empty trailer, it has not been cleaned and disinfected properly.

■ Don't let your horse touch unknown horses, especially nose to nose.

■ Wash your hands, especially after helping other people with their horses.

■ Don't let strangers pet your horse, especially those with horses at home.

■ Before leaving the show grounds, clean and disinfect tack, boots, equipment and grooming supplies. Brush off dirt or manure; then disinfect (spray or wipes are easy to take with you).

■ When you get home, shower, blow your nose and put on clean clothes and shoes before going near other horses.

Visiting Other Farms, Horse Shows or Auctions

■ Have a pair of shoes or boots that you save for visiting and don't wear around your own horse or wear plastic shoe covers.

■ If you are going to be working with horses on another farm, wear coveralls or plan to change clothes before returning home to your horses.

■ If there are farms you visit all the time and you can't change clothes and shoes, be sure their vaccination program and biosecurity practices are as good as your own.

For Visitors to Your Farm or Horse

■ It is best to have only one public access to your farm. Mark this as the main entrance.

■ Park away from the horses. Doing that will help keep disease-carrying organisms from being tracked from car floors or tires to your horses.

■ Ask all visitors to wear clean clothes and shoes. Give visitors plastic shoe covers or brush dirt off their shoes and spray them with disinfectant.

■ If you have many visitors such as at a farm tour or open house, make a footbath for them to walk through (see below).

Bringing Horses Back from a Show

■ If one or more horses travel to horse shows, all horses on the premises should be vaccinated. Horses that show can bring home infectious agents. Discuss with your veterinarian what vaccinations the horses need and how often.

■ If possible, keep horses that were off the farm isolated for at least 2 weeks. At the very least, make sure there is no nose-to-nose contact between horses in the stable.

Bringing in New Horses

This is the most likely way for infectious diseases to come in, especially if horses are coming from other states or from foreign countries.

■ Keep every new horse isolated for 30 days. Don't use pitchforks, grooming tools, or feed and water buckets on any horse but the new one. Mark these with red tape or use red brushes, etc., only for the isolation area.

■ Work with the isolated horse last each day. Alternatively, wear boots and coveralls when working with the isolated horse and remove them before working or going near other horses. You can keep these in a plastic-covered tub near the horse. Exercise the isolated horses, alone, at a separate time from others in the stable.

■ Always wash your hands and blow your nose after working with the new horse. You could carry germs to your other horses in your nose.

Making an Easy Footbath

You will need:

■ A low plastic pan or bin, wide enough to fit an adult's foot, shallow enough to step into easily

■ A plastic doormat (the "fake grass" mats work well)

■ A disinfectant that works when manure or dirt is present is best, such as Tek-trol or One Stroke Environ. A 1:10 Clorox solution is also an effective viralcidal if the solution is replenished often and kept out of direct sunlight.

■ Water

Directions:
Mix the disinfectant with water following label instructions. Put the doormat in the plastic pan. Add disinfectant so that the bottom of the "grass" is wet. Ask visitors to walk through the footbath, wiping their feet on the mat. The "grass" scrubs their shoes a bit as they wipe them, and applies the disinfectant. When the liquid starts to get dirty, empty it and put in new disinfectant.

How to Set Up a Disease Isolation Unit at a Farm or Horse Show

A horse with an infectious disease should be isolated from other horses to prevent the spread of infection. It is also important to prevent exposure by indirect contact from those handling an infected horse and spreading the infection to other horses via touching, equipment and so forth. Isolation can occur by stall confinement if the stall is secure and the horse is not in contact with others that walk by or are housed next to the horse. Often housing at shows is in tight quarters and contact can occur, so extreme care and vigilance in control of these isolation units are required.

If a horse has a fever and neurological signs that would suggest EHV-1 infection, it may be carrying high levels of the virus and become a primary source of spread. The horse should immediately be moved to an isolation area, preferably off site.

Any horses that were adjacent to the infected patient that has been moved out should be restricted in their movements and have their temperatures taken twice daily until the nature of the infection is determined. A perimeter and quarantine of that focal area of the barn should be instituted and access to and from the area limited. Horses in that area should be exercised at times when other horses are not in the arena or area. The length of the movement-restriction period will depend on whether other horses develop a fever during the next 7 to 10 days. The end of the quarantine period will be determined by the last horse to develop fever or clinical signs of disease, supplemented by PCR testing as appropriate.

An isolation barn that is effective has these characteristics:

■ It is well separated from other barns and main horse traffic contact.

■ It can be contained. Movement by people in and out can be regulated and controlled.

■ Each stall is isolated and prevents direct contact with horses adjacent to each other.

■ It has cleanable surfaces, including walls and flooring (mats). Use of liquid laundry detergent is useful in stalls and trailers with large volumes of water. A 10% bleach solution is a good general disinfectant if it is changed and replenished once or twice a day. Remember, bleach is inactivated by organic material and direct sunlight. Other commercial disinfectants can be obtained through your veterinarian.

■ It is reserved ONLY for use by infectious disease suspects and is not used by other horses at any time.

■ It has water buckets and separate equipment (wheelbarrows, pitchforks, bedding, etc.) used ONLY by the isolation unit.

■ It has a sink for handwashing and treatment area. Space must be supplied for storage of things needed for biosecurity such as gloves, disposable coveralls, boots, disinfectant, footbath stations (rubber tubs), and garbage collection and holding for disposables used on the horses. This can be another stall converted into a storage area.

■ A person to oversee the isolation stall is designated. This individual should have prior training in biosecurity. Their responsibility is to ensure that all activities meet with the biosecurity plan outlined for the facility.

■ In an ideal situation, an isolation facility would be equipped with an overhead beam or other means for lifting or supporting a down horse, similar to the UC Davis Large Animal Lift (www.vmth.ucdavis.edu/home/VERT/LART/lal.html).

■ The designated biosecurity supervisor ensures that people allowed to enter the facility follow appropriate sanitation measures: Rubber boots are dipped in a prescribed foot bath; disposable or dedicated coveralls are used only for one horse stall; disposable gloves are worn; and a treatment coat is worn over the reusable coveralls. If during treatment of the horse facial or other contamination of the caregiver occurs, the caregiver must shower and change clothes before touching other horses.

■ Hands are washed for 60 seconds (sing "Happy Birthday" twice at normal tempo) before entering or leaving the isolation area. Use disposable towels and leave in a covered waste container at the site of handwashing.

■ A perimeter is set up around the stall area to limit vehicular traffic and entry. This perimeter could be designated with ropes, fencing used for construction sites, and so forth. Random access should be restricted, with only one entry and exit to the area.

■ There is appropriate lighting.

Equipment Needed for Setting Up An Isolation Barn

- Treatment carts or smocks
- Painter's disposable coveralls
- Disposable gloves
- Rubber boots
- Foot bath containers
- Garbage bags
- Garbage cans with secure lids
- Disposable plastic shoe covers
- Thermometer for each horse
- Equipment for each horse (drugs in sealed plastic container for that horse, stomach tube, twitch, lip chain, etc.)

Pictured above is Royal Brass, who recovered from EHM after being treated at UC Davis. He finished fourth in his first start back since his recovery. Photo courtesy Vassar Photography, 2007.