AAEP Vaccination Guidelines

Introduction

These guidelines are intended to be a reference for veterinarians who utilize vaccines in their respective practices. They are neither regulations nor directives and should not be interpreted as such. It is the responsibility of attending veterinarians, through an appropriate veterinarian-client-patient relationship, to utilize relevant information coupled with product availability to determine optimal health care programs for their patients. Based on the professional judgment of those involved with the development of these guidelines, the recommendations for vaccine administration in this document may differ from the manufacturer's recommendation. However, it is incumbent on each individual practitioner to reach a decision on vaccine usage based on the circumstances of each unique situation and his or her professional experience.

Information provided in these guidelines addresses only those products licensed by the United States Department of Agriculture (USDA) for use in horses (including draft and pony breeds). There are limited data regarding the use of vaccines in other equidae (i.e. asses, donkeys, mules, miniature horses, and zebra); vaccination of these animals is at the discretion of the attending veterinarian

Principles of Vaccination

A "standard" vaccination program for all horses does not exist. Each individual situation requires evaluation based on the following criteria:

- Risk of disease (anticipated exposure, environmental factors, geographic factors, age, breed, use, and sex of the horse)
- Consequences of the disease (morbidity/mortality, zoonotic potential)
- Anticipated effectiveness of the selected product(s)
- Potential for adverse reactions to a vaccine(s)
- Cost of immunization (time, labor and vaccine costs) vs. potential cost of disease (time out of competition; impact of movement restrictions imposed in order to control an outbreak of contagious disease; labor and medication if, or when, horses develop clinical disease and require treatment, or loss of life.)

Note: The use of antibody titers or other immunological measurements to determine if booster vaccination is warranted is not currently practiced in the horse as standardized tests and protective levels of immunity have not been defined for most diseases. A correlation between antibody levels and protective immunity under field conditions has not yet been identified.

Clients should have realistic expectations and understand that:

- Vaccination alone, in the absence of good management practices directed at infection control, is not sufficient to prevent infectious disease.
- Vaccination serves to minimize the risks of infection but cannot prevent disease in all circumstances.
- A properly administered, licensed product should not be assumed to provide complete protection during any given field epidemic.
- Protection is *not* immediately afforded the patient after administration of a vaccine that is designed to induce active immunity. In most instances, a priming series of multiple doses of a vaccine must be administered initially for that vaccine to induce protective active immunity.
- The primary series of vaccines and booster doses should be appropriately administered prior to likely exposure.
- Each horse in a population is not protected to an equal degree nor for an equal duration following vaccination.
- All horses in a herd should be vaccinated at intervals based on the professional opinion of the attending veterinarian
- Although rare, there is potential for adverse reactions despite appropriate handling and administration of vaccines.

(Ideally, the same schedule is followed for all horses in a population, thus simplifying record keeping, minimizing replication and transmission of infectious agents in a herd and indirectly protecting those horses in the herd that responded poorly to vaccination, thereby optimizing herd-immunity.)

Infectious Disease Control

Programs for the control of infectious diseases are important components of good managerial practices directed toward maximizing the health, productivity and performance of horses. Infectious disease in an individual horse, or outbreaks of infection within a group of horses, occurs when a sufficient quantity of an infectious agent overcomes the resistance acquired through prior natural exposure to the disease agent or through vaccination. (View AAEP Infectious Disease Control Guidelines)

Infectious disease control programs should be directed toward:

- Reducing the exposure to infectious agents in the horses' environment
- Minimizing factors that decrease resistance or increase susceptibility to disease
- Enhancing resistance to those diseases by vaccination

Consistent utilization of such management programs will, in time, lower the incidence and/or severity of infectious diseases.

Occurrence of infectious diseases in populations of horses tends to increase with:

- Increased population density of susceptible horses at a facility.

High population density situations as found on breeding farms, in sales or boarding facilities, in barns of performance and show horses, or at racetracks are often ideal for introduction and transmission of infectious diseases, particularly infections of the respiratory tract.

- Movement of horses on and off the facility.

The introduction of horses from various origins, commingling of horses of different ages, and the high proportion of susceptible horses pose special problems and demonstrate some important considerations in the practice of disease control.

- Environmental and managerial influences.

Examples of external factors that can contribute to increased risk of infectious disease include:

- stress
- over-crowding
- parasitism
- poor nutrition
- inadequate sanitation
- contaminated water source/supply
- concurrent disease
- inadequate rodent, bird and insect control
- movement of people, vehicles, and/or equipment on and off facilities during infectious disease outbreaks.

Copies of the vaccination and health maintenance records should accompany the movement of horses. Similarly, owners of equine facilities should establish health entry prerequisites, including, but not limited to, vaccinal history. Horses should be appropriately vaccinated prior to entering or leaving such a facility in order to produce an adequate immune response before the anticipated exposure.

Strict attention should be afforded to the manufacturer's recommendations regarding storage, handling, and routes of administration of the vaccine to maximize efficacy and safety. However, results of research or clinical experience may support alternate protocols for vaccination that may improve the efficacy of a vaccine without increasing adverse effects.

Vaccine Labeling

Licensed vaccines can afford varying levels of protection. It is important to read and understand product labeling.

Label indications: Data must fully support label indications and accurately reflect the expected performance of the product.

The USDA can grant one of five possible levels-of-protection statements. (Veterinary Services Memorandum No. 800.202; June 14, 2002.) In declining order of level of protection the label claims are:

Prevention of infection:
This claim may be made only for products able to prevent all colonization or replication of the challenge organism in vaccinated and challenged animals.

Prevention of disease*:*
This claim may be made only for products shown to be highly effective (more than 80% efficacy) in preventing clinical disease in vaccinated and challenged animals. The efficacy must be at least 80% in challenge studies comparing appropriately vaccinated animals with non-vaccinated controls.

Aid in disease prevention:
This claim may be made for products shown to prevent disease in vaccinated and challenged animals by a clinically significant amount which may be less than that required to support a claim of disease prevention (see above).

Aid in disease control:
This claim may be made for products that have been shown to alleviate disease severity, reduce disease duration, or delay disease onset.

Other claims:
Products with beneficial effects other than direct disease control, such as the reduction of pathogen shedding, may make such claims if the size of the effect is clinically significant and well supported by the data.

Vaccine Technology

Live Vaccines contain agents capable of replicating within the horse yet have attenuated pathogenicity. Live vaccines stimulate a broad range of immune responses and generally long lasting duration of immunity with the administration of fewer doses. Live vaccines have the potential to induce cytotoxic T-lymphocytes (CTL), or mucosal immunity if administered at mucosal sites, both of which can be very advantageous.

There is potential risk in vaccinating animals whose immune status may be compromised due to disease (i.e. immunodeficiency, hyperadrenocorticism), physiologic states (pregnancy) or medications (i.e. corticosteroids).

Modified Live Vaccines (MLV) are typically derived from the naturally occurring pathogen, and are produced by: 1) attenuation in cell culture, 2) use of variants from other species, and 3) development of temperature-sensitive mutants.

Recombinant Vaccines:

- **Live Attenuated Vector Vaccines** are engineered by incorporation of a pathogen's antigenic peptides into a harmless carrier virus or bacteria.
- **Chimeric Vaccines** are produced by substituting genes from the target pathogen for similar genes in a safe, but closely related organism.
- **DNA Vaccines** consist of a DNA plasmid encoding a viral gene that can be expressed inside cells of the animal to be immunized.

Inactivated/Killed Vaccines lack pathogenicity and can neither replicate nor spread between hosts. These vaccines typically require multiple doses in the primary vaccinal series and regular boosters. Efficacy of inactivated/killed vaccines is often reliant on the use of potent adjuvants.

- **Inactivated/killed pathogen vaccines** contain whole pathogens that have been inactivated with agents such as phenol (bacteria) and formalin or beta-proprionolcatone (viruses).
- **Protein vaccines** include naturally produced components of pathogens. These proteins are typically non-pathogenic and may promote fewer injection site reactions than products containing the entire pathogen.
- **Recombinant subunit vaccines** contain synthetically produced antigens that have been identified as important in developing immunity to a specific pathogen. Currently no such products are licensed for use in equids.
- **Adjuvants** function to modulate and amplify the host immune response to the accompanying antigen, and are critical to the success of inactivated vaccines.

Adverse Reactions

After receiving a vaccine(s) intramuscularly, some horses experience local muscular swelling and soreness or transient, self-limiting signs including fever, anorexia and lethargy. Severe reactions at sites of injection can be particularly troublesome, requiring prolonged treatment and convalescence. Systemic adverse reactions (such as urticaria, purpura hemorrhagica colic or anaphylaxis) can also occur. Other systemic adverse reactions have been anecdotally reported.

Veterinarians should report all adverse reactions to the vaccine's manufacturer. Adverse events may also be reported to the USDA Center for Veterinary Biologics at (1-800-752-6255) or through the agency's Web site.

Vaccine lot and serial numbers should be noted in horses' vaccination records. The ability to provide this information when reporting an adverse reaction will facilitate an investigation.

Adverse reactions are not always predictable and are inherent risks of vaccination. Therefore, it is recommended that horses not be vaccinated in the 2 weeks prior to shows, performance events, sales or domestic shipment. Some veterinarians may elect not to vaccinate horses within 3 weeks of international shipment.

Injection site selection should include consideration of potential adverse reactions. Injection in the gluteal muscles/hip region is not recommended, as gravitational drainage along fascial planes can be obscured. Should an abscess develop, considerable tissue damage can occur and result in eruptions in undesirable locations with lesions that require prolonged time to heal.

The interval from vaccination to scheduled event or a predictable risk of exposure should be sufficient for:

- Generation of a protective immune response to vaccination.
- Recovery from unexpected adverse vaccination reactions that might otherwise interfere with the horse's performance or health prior to, or during shipment.

It should be recognized that:

- Administration of multiple vaccines resulting in administration of both multiple antigens and adjuvants at the same time may increase the risk of adverse reactions.
- Safety and efficacy data are not available regarding the concurrent use of multiple vaccines.
- Administration of MLV and killed vaccines in the same location is discouraged as adjuvants may inactivate the MLV.

Therefore, veterinarians may elect to use a staggered schedule when multiple products are to be administered. Such a schedule should allow at least a 3-4 week interval between inmmunizations.

Vaccines should always be administered by, or under the direct supervision of, a veterinarian, as the possibility of adverse reactions (including anaphylaxis) exists with the administration of any vaccine.

Vaccination and Passive Transfer

It is important to vaccinate broodmares 4 to 6 weeks before foaling for their own protection, as well as to maximize concentrations of immunoglobulins in their colostrum to be passively transferred to their foals. The significant majority of vaccines used in broodmares during late gestation to maximize immunoglobulin transfer via the

colostrum, do not carry a "safe for use in pregnant mare" claim. However, this is an accepted practice and clinical experience indicates these products are safe for this purpose. If the practitioner has specific safety questions or concerns, he or she is encouraged to contact the manufacturer for additional information.

Recognize that simply vaccinating the mare is not sufficient for protection of the foal; successful passive transfer must also occur. The foal must receive adequate amounts of high quality colostrum and absorb adequate amounts of specific colostral immunoglobulins before absorption of macromolecules ceases (generally 24 to 48 hours post-foaling). Specific colostral immunoglobulins provide protection against field infections for several months but also may interfere with vaccinal antigens and may interfere with foal responses to vaccines; a phenomenon termed "maternal antibody interference."

Although protective concentrations of maternal antibody decline with time, vaccination of a foal while these colostral antibodies are present - even at concentrations less than those considered to be protective - is often of minimal value because of maternal antibody interference. Consequently, a foal may be susceptible to infection before the primary vaccinal series is completed. Management directed at minimizing exposure to infectious agents is key during this interval.

Foals with residual maternal antibodies generally produce a greater serologic response to killed vaccines when an initial series of three doses is administered rather than the 2-dose series recommended by most manufacturers of vaccines for older horses without residual maternal antibodies.

Vaccine Storage and Handling

Proper storage and handling of vaccines is critical to their efficacy and safety.

Per manufacturers' instructions, aseptic technique is to be followed when handling and administering vaccines. Vaccine administration sites (skin / haircoat, mucosa) are to be clean. Each animal should be vaccinated with separate new needles for each vaccine product to avoid cross contamination of products and possible adverse reactions and to reduce the possibility of spreading blood-borne pathogens

Care must be taken to assure that vaccines are administered via the intended route. Intranasal vaccines should NEVER be given via the intramuscular route.

Storage and handling instructions may be product specific. It is important to read and follow the manufacturer's recommendations for each product regarding: storage temperature, exposure to light during storage, and shaking of the product to assure uniform vaccine suspension.

Maintaining vaccines at the appropriate temperature from transport from manufacturer/supplier to patient administration is a very important aspect of proper

immunization delivery programs. Lack of adherence to proper temperature maintenance can result in lack of efficacy, undue vaccine failures, and an increased rate of adverse reactions post vaccination.

The following recommendations can help improve vaccine management practices:

- Have a designated individual responsible for handling and storage of vaccines.
- Maintain a vaccine inventory log, documenting: Vaccine name, manufacturer, lot number and expiration date, date and number of doses received; and arrival condition of vaccine.
- Store vaccines in a refrigerator with a separate freezer compartment.
- Keep a working thermometer in the refrigerator; monitor the temperature twice daily. Maintenance of a log is advisable, particularly if multiple people share responsibility for temperature monitoring.
- Store vaccines in the middle of the refrigerator, **NOT** in the door or against the back of the refrigerator.
- Organize vaccines according to expiration date, avoiding wastage by ensuring that products with earlier expiration dates are used before products with later dates.
- In the event of refrigerator failure, promptly remove vaccines to an adequately refrigerated container.
- In the event of a power failure, keep the refrigerator door closed until power is restored or a suitable location for the vaccine has been identified. Refrigeration can be maintained in a kitchen-sized refrigerator (20-24 ft^3) for 6-9 hours if the doors remain closed. Once power is restored, promptly check refrigerator temperature to determine if vaccines have been exposed to temperatures outside of the recommended range. If power outage is expected to be longer than 6 to 9 hours, remove vaccines to a container that is maintained with ice. Monitor temperature in this container.
- Ambulatory vehicles should have a thermometer in the refrigeration unit or portable cooler in which vaccines are carried. Temperature should be checked each time the container is opened. *(Note: A freezer pack placed in a cooler is not sufficient to maintain vaccines in the proper temperature range throughout the course of a work day.)*
- Consult the manufacturer if vaccine:
    - Is exposed to temperatures outside of the recommended range
    - Undergoes color change during storage
    - Is exposed to ultraviolet radiation

Core Vaccination Guidelines

The AVMA defines core vaccinations as those "that protect from diseases that are endemic to a region, those with potential public health significance, required by law, virulent/highly infectious, and/or those posing a risk of severe disease. Core vaccines have clearly demonstrated efficacy and safety, and thus exhibit a high enough level of patient benefit and low enough level of risk to justify their use in the majority of patients." The following equine vaccines meet these criteria and are identified as 'core' in these guidelines:

Tetanus

All horses are at risk of development of tetanus, an often fatal disease caused by a potent neurotoxin elaborated by the anaerobic, spore-forming bacterium, *Clostridium tetani*. Tetanus toxoid is a core equine vaccine and is indicated in the immunization program for all horses.

Clostridium tetani organisms are present in the intestinal tract and feces of horses, other animals and humans, and are abundant as well as ubiquitous in soil. Spores of *Cl. tetani* survive in the environment for many years, resulting in an ever-present risk of exposure of horses and people on equine facilities. Tetanus is not a contagious disease but is the result of *Cl. tetani* infection of puncture wounds (particularly those involving the foot or muscle), open lacerations, surgical incisions, exposed tissues such as the umbilicus of foals and reproductive tract of the postpartum mare (especially in the event of trauma or retained placenta).

Vaccines: Vaccines currently available are formalin-inactivated, adjuvanted toxoids. Tetanus toxoid is a potent antigen that rapidly induces strong serological responses. Circulating antibody is able to mediate complete protection against tetanus. It is generally accepted that tetanus toxoid administered per manufacturer recommendations is both safe and effective.

A 6-month study comparing serologic responses of equids to commercial vaccines demonstrated significant IgG response for the duration of the study. The end point for antibody persistence was not explored and may potentially be longer than the 6 months stated in the study. Extending the revaccination interval beyond the manufacturer's recommendation for annual revaccination is not advisable due to a veterinarian's liability if label recommendations are not followed.

There are no challenge studies that have been published to document the onset or duration of immunity induced by tetanus toxoid products available for use in horses in the USA. Conclusions regarding the efficacy of products used in the USA are based on serologic response in laboratory animals and field experience. This may be accepted as evidence of vaccine efficacy as antibody alone can mediate protection. Tetanus has rarely been documented in vaccinated horses in the USA, illustrating the variability of response of equids to any biologic product. *Note*: Survival of horses with tetanus was strongly associated with previous vaccination.

Vaccination Schedules:

Adult horses, previously vaccinated against tetanus: Vaccinate annually. Horses that sustain a wound or undergo surgery 6 or more months after their previous tetanus booster should be revaccinated with tetanus toxoid immediately at the time of injury or surgery. *Note:* The severity of the wound does not predict the risk for development of tetanus. Superficial wounds have resulted in clinical tetanus in horses.

Adult horses, previously unvaccinated against tetanus, or of unknown vaccinal history: Administer a primary 2-dose series of tetanus toxoid with a 4- to 6-week interval between doses. Protective concentrations of immunoglobulin are usually attained within 14 days of the second dose of vaccine. Vaccinate annually thereafter.

Tetanus antitoxin is indicated to provide passive immunity in situations where the horse is at risk of tetanus infection and has not been immunized according to labeled recommendations for tetanus. If the veterinarian determines that administration of tetanus antitoxin is indicated, then it should be administered in one site and the initial dose of a priming series of tetanus toxoid vaccinations should be administered at a distant muscular site. The rare, but fatal, risk of Theiler's disease consequent to the use of tetanus antitoxin needs to be taken into consideration when determining if use is indicated.

Pregnant mares previously vaccinated against tetanus: Vaccinate annually 4 to 6 weeks before foaling, both to protect the mare should foaling-induced trauma or retained placenta occur and to enhance concentrations of colostral immunoglobulins.

Pregnant mares unvaccinated against tetanus or of unknown vaccinal history: Administer a 2-dose primary series of tetanus toxoid with a 4- to 6-week interval between doses. Revaccinate 4 to 6 weeks before foaling.

Foals of mares vaccinated against tetanus in the pre-partum period: Administer a primary 3-dose series of tetanus toxoid beginning at 4 to 6 months of age. A 4- to 6-week interval between the first and second doses is recommended. The third dose should be administered at 10 to 12 months of age.

Foals of unvaccinated mares or mares of unknown vaccinal history: Administer a primary 3-dose series of toxoid beginning at 3-4 months of age. A 4- to 6-week interval between the first and second doses is recommended. The third dose should be administered at 10 to 12 months of age. Serologic data indicates that a 3-dose initial series produces a more consistent anamnestic response in all foals, regardless of the age at which the series is initiated. Tetanus antitoxin is indicated to provide passive immunity in situations where a foal is born to a non-vaccinated mare and is at risk of tetanus infection. (See *Tetanus antitoxin* above.)

Horses having been naturally infected with tetanus and recovered: Revaccinate annually.

Eastern, Western and Venezuelan Equine Encephalomyelitis

In the United States, equine encephalitides for which vaccines are available include eastern equine encephalomyelitis (EEE), western equine encephalomyelitis (WEE), Venezuelan equine encephalomyelitis (VEE) and West Nile Virus encephalomyelitis. The distribution of EEE has historically been restricted to the eastern, southeastern and some southern states (but disease incidence is also reported in the upper Midwestern states of Ohio, Michigan and Wisconsin). Outbreaks of WEE have been recorded in the western and mid-western states. Variants of WEE have caused sporadic cases in the northeast and southeast, most notably Florida. VEE occurs in South and Central America but has not been diagnosed in the United States for more than 40 years. The availability of licensed vaccine products combined with an inability to completely eliminate risk of exposure justifies immunization against EEE and WEE as core prophylaxis for all horses residing in or traveling to North America and any other geographic areas where EEE and/or WEE is endemic.

Transmission of EEE/WEE/VEE is by mosquitoes, and infrequently by other bloodsucking insects, to horses from wild birds or rodents, which serve as natural reservoirs for these viruses. Human beings are also susceptible to these diseases when the virus is transmitted to them by infected mosquitoes; however, horse-to-horse or horse-to-human transmission by mosquitoes is highly unlikely, because the level and duration of viremia is insufficient to infect mosquitoes that might feed on a horse affected withEEE or WEE. On the other hand, the viremia that occurs in horses infected with VEE virus subtypes 1AB and 1C is much higher. Direct horse-to-horse or horse-to-human transmission of VEE is possible. Of these 3 encephalomyelitides, WEE has the lowest mortality (approx. 50%). Eastern equine encephalomyelitis is the most virulent for horses, with mortality approaching 90%. Epidemiological evidence indicates that young horses are particularly susceptible to disease caused by EEE virus. Venezuelan equine encephalomyelitis caused by subtypes 1AB and 1C can give rise to mortality rates ranging from 20 to 80%; however, some horses develop subclinical infection that results in lasting immunity.

The risk of exposure and geographic distribution of EEE and WEE vary from year-to-year with changes in distribution of insect vectors and reservoirs important in the natural ecology of the virus. EEE activity in mosquitoes and birds, and resultant disease in humans and equids, continues to cause concern along the East Coast and demonstrates northward encroachment. WEE has caused minimal disease in horses in the last two decades; however, the virus continues to be detected in mosquitoes and birds throughout the Western states. In addition, variants that cause clinical disease in equids have been detected in the eastern U.S.

VEE is a reportable foreign animal disease. Epidemics of VEE occur when the virus undergoes genetic change and develops greater virulence for humans and equid species. Viral variants, ;which belong to subtypes 1AB and 1C, are able to multiply to high levels in the horse which serves as a amplifying host of the virus in these outbreaks. Strains of subtype 1E have also been shown to cause morbidity and mortality in horses but on a

much lesser scale.[1,2] Areas of Southern Texas, California, Louisiana, Mississippi, Alabama and the West Coast of Florida are likely at the most risk for natural VEE encroachment from Central and South America. Vaccination against VEE is controversial because:

1) Vaccination against a foreign animal disease may confound testing in the event of an outbreak. However, vaccination against EEE/WEE will also result in cross-reaction to VEE virus in certain serologic tests.

2) Experimental and field data have demonstrated that previous infection with either EEE or WEE may provide cross protection against VEE. It is therefore possible that EEE/WEE bivalent vaccination may provide partial cross-protection, although it is likely to be less than that following infection.

3) A conditionally available modified live (MLV) VEE vaccine has been released during previous outbreaks and provides superior protection against the disease and high titered viremias. Should an outbreak occur, it is likely that this highly attenuated MLV would be released for restricted use subject to certain conditions being met.

In summary, horses that receive annual EEE/WEE vaccines may be partially protected against VEE infection. In the event of an outbreak, the availability of and vaccination with the highly effective MLV product would induce rapid, complete immunity while allowing for accurate surveillance before VEE specific vaccination. The use of killed VEE vaccine should be performed only in high-risk areas of the US, at the discretion of the attending veterinarian, or when necessary, with input from state agriculture officials. The use of the inactivated VEE vaccine is less effective than the MLV VEE vaccine, and will reduce immune responses to the MLV VEE vaccine.

Vaccines:

EEE/WEE vaccines currently available are formalin inactivated adjuvanted whole virus products. Early testing of bivalent (EEE/WEE) vaccines was performed by intracranial challenge with either EEE and WEE; the formalin inactivated preparations were shown to be highly efficacious in protecting against clinical disease.

Currently, the only available VEE vaccines are killed products; a MLV would likely be conditionally released in the face of an outbreak.

Vaccination Schedules EEE/WEE:

Adult horses previously vaccinated against EEE/WEE: Annual revaccination must be completed prior to vector season in the spring. In animals of high risk or with limited immunity, more frequent vaccination or appropriately timed vaccination is recommended in order to induce protective immunity during periods of likely exposure. In areas where mosquitoes are active year-round, many veterinarians elect to vaccinate horses at 4- to 6-month intervals to ensure uniform protection throughout the year, although this practice is not specifically recommended by manufacturers of vaccines.

Adult horses, previously unvaccinated against EEE/WEE or of unknown vaccinal history: Administer a primary series of 2 doses with a 4 to 6 week interval between doses. Revaccinate prior to the onset of the next vector season and annually thereafter.

Pregnant mares, previously vaccinated against EEE/WEE: Vaccinate 4 to 6 weeks before foaling.

Pregnant mares, unvaccinated or having unknown vaccinal history: Immediately begin a 2-dose primary series with a 4-week interval between doses. Booster at 4 to 6 weeks before foaling or prior to the onset of the next vector season—whichever occurs first.

Foals of mares vaccinated against EEE/WEE in the pre-partum period: Administer a primary 3-dose series beginning at 4 to 6 months of age. A 4 to 6 week interval between the first and second doses is recommended. The third dose should be administered at 10 to 12 months of age prior to the onset of the next mosquito season.

In the southeastern U.S., due to earlier seasonal disease risk, vaccination may be started at 2 to 3 months of age. When initiating vaccinations in younger foals, a series of 4 primary doses should be administered, with a 4-week interval between the first and second doses and between the second and third doses. The fourth dose should be administered at 10 to 12 months of age prior to the onset of the next mosquito season.

Foals of unvaccinated mares or having unknown vaccinal history: Administer a primary series of 3 doses with a 4-week interval between the first and second doses and an 8-week interval between the second and third doses. If the primary series is initiated during the mosquito vector season, an interval of 3 to 4 weeks between the second and third doses is preferable to the above described interval of 8 weeks.

NOTE: Foals in the Southeastern USA – The primary vaccination series should be initiated at 3 months of age due to early seasonal vector presence.

Horses having been naturally infected and recovered: Recovered horses likely develop lifelong immunity. Consider revaccination only if the immune status of the animal changes the risk of susceptibility to infection. Examples of these conditions would include the long-term use of corticosteroids and equine pituitary pars intermedia dysfunction (PPID).

West Nile Virus

West Nile virus (WNV) is the leading cause of arbovirus encephalitis in horses and humans in the United States. Since 1999, more than 25,000 cases of WNV encephalitis have been reported in U.S. horses. Horses represent 96.9% of all reported non-human mammalian cases of WNV disease.

This virus has been identified in all of the continental United States, most of Canada and Mexico. Several Central and South American countries have also identified WNV within their borders. The virus is transmitted from avian reservoir hosts by mosquitoes (and infrequently by other bloodsucking insects) to horses, humans and a number of other mammals. West Nile virus is transmitted by many different mosquito species and this varies geographically. The virus and mosquito host interactions result in regional change in virulence of the virus; therefore, no prediction can be made regarding future trends in local activity of the viruses. Horses and humans are considered to be dead-end hosts for WNV; the virus is not directly contagious from horse to horse or horse to human. Indirect transmission via mosquitoes from infected horses is highly unlikely because these horses do not circulate a significant amount of virus in their blood.

The case fatality rate for horses exhibiting clinical signs of WNV infection is approximately 33%. Data have supported that 40% of horses that survive the acute illness caused by WNV still exhibit residual effects, such as gait and behavioral abnormalities, 6 months post-diagnosis. Thus vaccination for West Nile virus is recommended as a core vaccine and is an essential standard of care for all horses in North America.

Three challenge models have been used to license currently available vaccines. The mosquito and needle challenge were the two models used in early studies. These challenge models result in 90% of nonvaccinated control horses developing viremia, while only 10% of these horses demonstrated clinical disease. More recently, the intrathecal infection challenge model (by injection in the atlanto-occipital space) has been employed. In this model, 70 to 90% of nonvaccinated control horses become viremic and 90 to 100% develop grave signs of encephalomyelitis.

West Nile virus vaccines are licensed either as 1) an aid in prevention of viremia, or 2) aid in reduction of viremia, encephalitis and clinical disease, or 3) aid in prevention of disease, viremia, and encephalitis or 4) aid in prevention of viremia and mortality, and an aid in reduction of severity of clinical disease.

Vaccines:

Four USDA licensed vaccines are currently available (two are inactivated whole WN virus vaccines, one is a non-replicating live canary pox recombinant vector vaccine and one is an inactivated flavivirus chimera vaccine):

Inactivated whole virus vaccines with an adjuvant. Label instructions call for a primary vaccination series of two intramuscular injections administered 3 to 6 weeks apart followed by a 12-month revaccination interval. These products are labeled as an aid in prevention of viremia or as an aid in prevention of viremia and mortality and an aid in reduction of severity of clinical disease.

Recombinant canary pox vaccine with protective antigens expressed in a vaccine strain canary pox vector which does not replicate in the horse. The vaccine contains an adjuvant. Label instructions call for a primary vaccination series of two intramuscular injections administered 4 to 6 weeks apart followed by a 12-month revaccination interval. The product is labeled as an aid in prevention of disease, viremia, and encephalitis.

Inactivated flavivirus chimera vaccine with protective antigens expressed in a vaccine strain yellow fever virus vector and contains an adjuvant. Label instructions call for a primary vaccination series of two intramuscular injections administered 3 to 4 weeks apart followed by a 12-month revaccination interval. This product is labeled as an aid in reduction of disease, encephalitis and viremia.

All of the current WN vaccine products carry one-year duration of immunity, with challenge, consistent with their respective label claims.

Vaccination Schedules:

Adult horses previously vaccinated: Vaccinate annually in the spring, prior to the onset of the insect vector season.

For animals at high risk or with limited immunity, more frequent vaccination or appropriately timed revaccination is recommended in order to induce protective immunity during periods of likely exposure. For instance, juvenile horses (<5 years of age) appear to be more susceptible than adult horses that have likely been vaccinated and/or had subclinical exposure. Geriatric horses (>15 years of age) have been demonstrated to have enhanced susceptibility to WNV disease. Therefore, more frequent vaccination may be recommended to meet the vaccination needs of these horses.

Booster vaccinations are warranted according to local disease or exposure risk. However, more frequent vaccination may be indicated with any of these products depending on risk assessment.

Adult horses previously unvaccinated or having unknown vaccinal history:

Inactivated whole virus vaccine: A primary series of 2 doses is administered to naïve horses. A 4 to 6 week interval between doses is recommended. The label recommended revaccination interval is 12 months.

Recombinant canary pox vector vaccine: A primary series of 2 doses is administered to naïve horses with a 4 to 6 week interval between doses. The label recommended revaccination interval is 12 months.

Inactivated flavivirus chimera vaccine: A primary series of 2 doses is administered to naïve horses. A 3 to 4 week interval between doses is recommended. The label recommended revaccination interval is 12 months.

Pregnant mares

Limited studies have been performed that examine vaccinal protection against WNV disease in pregnant mares. Only one of the currently licensed WN vaccines carries a safe for use in pregnant mare label claim. It is an accepted practice by many veterinarians to administer WNV vaccines to pregnant mares as the risk of adverse consequences of WNV infection outweighs any reported adverse effects of use of vaccine.

Pregnant mare previously vaccinated: Vaccinate at 4 to 6 weeks before foaling.

Pregnant mares previously unvaccinated: Initiate a primary vaccination series (see *adult horses previously unvaccinated*) immediately. Limited antibody response was demonstrated in pregnant mares vaccinated for the first time with the originally licensed inactivated, whole virus vaccine. It is unknown if this is true for the other products. Vaccination of naïve mares while open is a preferred strategy.

Foals

Limited studies have been performed examining maternal antibody interference and inhibition of protection against WNV disease. The only data currently available is for the originally licensed, inactivated whole virus product in which foals were demonstrated to produce antibody in response to vaccination despite the presence of maternal antibody. No studies have been performed evaluating protection from disease in foals vaccinated in the face of maternal immunity.

Foals of vaccinated mares

Inactivated whole virus vaccines: Administer a primary 3-dose series beginning at 4 to 6 months of age. A 4- to 6-week interval between the first and second doses is recommended. The third dose should be administered at 10 to 12 months of age prior to the onset of the next mosquito season.

Data indicates that maternal antibodies do not interfere with the originally licensed, inactivated whole virus vaccine; however, protection from clinical disease has not been prospectively tested in foals less than 6 months of age. Animals may be vaccinated more frequently with these products if risk assessment warrants.

Recombinant canary pox vector vaccine: Administration of a 3-dose primary vaccination series beginning at 4 to 6 months of age. There should be a 4-week interval between the first and second doses. The third dose should be administered at 10 to 12 months of age prior to the onset of the next mosquito season.

There are no data for the recombinant canary pox vector vaccine regarding maternal antibody interference. Protection from clinical disease has not been provocatively tested in foals less than 6 months of age. Animals may be vaccinated more frequently with this product if risk assessment warrants.

Inactivated flavivirus chimera vaccine: Administration of a 3-dose primary vaccination series beginning at 4 to 6 months of age. There should be a 4-week interval between the first and second doses. The third dose should be administered at 10 to 12 months of age prior to the onset of the next mosquito season.

There are no data for the inactivated flavivirus chimera vaccine regarding maternal antibody interference. Protection from clinical disease has not been prospecitvely tested in foals less than 6 months of age. Animals may be vaccinated more frequently with this product if risk assessment warrants.

Foals of unvaccinated mares

The primary series of vaccinations should be initiated at 3 to 4 months of age and, where possible, be completed prior to the onset of the high-risk insect vector season.

Inactivated whole virus vaccines: Administer a primary series of 3 doses with a 4-week interval between the first and second doses and an 8-week interval between the second and third doses. If the primary series is initiated during the mosquito vector season, an interval of 3 to 4 weeks between the second and third doses is preferable to the above-described interval of 8 weeks.

Recombinant canary pox vaccine: Administer a primary series of 3-doses with a 4-week interval between the first and second doses and an 8-week interval between the second and third doses. If the primary series is initiated during the mosquito vector season, an interval of 3 to 4 weeks between the second and third doses is preferable to the above-described interval of 8 weeks.

Inactivated flavivirus chimera vaccine: Administer a primary series of 3 doses with a 4-week interval between the first and second doses and an 8-week interval between the second and third doses. If the primary series is initiated during the mosquito vector season, an interval of 3 to 4 weeks between the second and third doses is preferable to the above-described interval of 8 weeks.

Horses having been naturally infected and recovered
Recovered horses likely develop life-long immunity, but this has not been confirmed. Consider revaccination if the immune status of the animal changes the risk for susceptibility to infection or at the recommendation of the attending veterinarian. Examples of these conditions would include the long-term use of corticosteroids and equine pituitary pars intermedia dysfunction (PPID).

Rabies

Rabies is an infrequently encountered neurologic disease of equids. While the incidence of rabies in horses is low, the disease is invariably fatal and has considerable public health significance. It is recommended that rabies vaccine be a core vaccine for all equids.

Exposure occurs through the bite of an infected (rabid) animal, typically a wildlife source such as raccoon, fox, skunk, or bat. Bites to horses occur most often on the muzzle, face, and lower limbs. The virus migrates via nerves to the brain where it initiates rapidly progressive, invariably fatal encephalitis.

Vaccines: Three vaccines are licensed for rabies prophylaxis in horses. All are inactivated tissue culture derived products. The vaccines are given by intramuscular injection and appear to be safe. Rabies is an excellent immunogen and these vaccines induce a strong serologic response after a single dose.

Challenge studies demonstrating efficacy are required for licensing of all rabies vaccines (including those labeled for use in equids in the USA), and published results are available for the most recently licensed equine Rabies vaccine. The challenge studies are conducted by the vaccine manufacturers as outlined in the Code of Federal Regulations (CFR) from the United States Department of Agriculture.

Vaccination Schedules:
(Veterinarians should read the label for each specific product recommendation.)

Adult horses previously vaccinated against rabies: Annual revaccination.

Adult horses previously unvaccinated against rabies or having unknown vaccinal history: Administer a single primary dose. Revaccinate annually.

Pregnant mares, previously vaccinated against rabies: Vaccinate 4 to 6 weeks before foaling. Alternatively, veterinarians may recommend that mares be vaccinated with rabies vaccine before breeding. Duration of immunity is such that antibodies to rabies virus are maintained at sufficient levels in mares vaccinated prior to breeding as to provide passive immunity through colostrum to the foal. Administration of rabies vaccine prior to breeding of the mare reduces the number and type of vaccines given in the period prior to foaling.

Pregnant mares, previously unvaccinated or of unknown vaccinal history: Vaccinate 4 to 6 weeks before foaling.

Foals of mares vaccinated against rabies: Administer a primary 2 dose series. The first dose of vaccine should be administered no earlier than 6 months of age. The second dose should be given 4 to 6 weeks later. Revaccinate annually thereafter. This schedule avoids maternally-derived antibody (MDA) interference with induction of a serologic response in the foal.

Foals of mares NOT vaccinated against rabies: Administer according to label directions. The first dose of vaccine should be administered at 3 to 4 months of age. Revaccinate annually thereafter.

Foals of mares of unknown vaccinal history - Follow one of two rational options:
1. Assume the mare to be antibody-positive and follow the above recommendations for foals from mares known to be vaccinated against rabies, i.e. the first dose starting at 6 months of age followed by second dose 4 - 6 weeks later. Revaccinate annually thereafter.
2. Document the rabies antibody status of the foal by testing serum collected from the foal at 24 hours of age or older, or from the dam during the peri-parturient period.* If the foal or mare is rabies antibody-negative, follow the above recommendations for foals of mares known not to be vaccinated against rabies. If the foal or mare is rabies antibody-positive, follow recommendations for foals of mares known to be vaccinated against rabies.

*Testing for rabies antibodies using the rapid fluorescence focus inhibition test (RFFIT) is available through the Kansas State Veterinary Diagnostic Laboratory, Mosier Hall O-245, 1800 Denison Avenue, Manhattan, KS 66506-5601.

Horses exposed to confirmed rabid animal*

Horse currently vaccinated against rabies with one of the USDA-approved rabies vaccines: Immediate revaccination by a licensed veterinarian and observation (as directed by public health officials) for 45 days for development of clinical signs of rabies.

Unvaccinated horse: Contact public health officials immediately as they will have established requirements and conditions for the monitoring and/or disposition of exposed, unvaccinated animals. These officials will dictate what options are available for the exposed horse. (These options may include isolation and immediate post-exposure immunization of the horse).

Alternatively, the horse can be euthanatized immediately. If the owner is unwilling to have this done then the horse should be closely monitored under veterinary supervision for 6 months (per approval from the appropriate public health officials).

*Rabies exposure and transmission occur only when the virus is introduced into bite wounds, into open cuts in skin, or onto mucous membranes from saliva or other potentially infectious material such as neural tissue.

Risk-Based Vaccination Guidelines

These are vaccinations included in a vaccination program after the performance of a risk-benefit analysis. The use of risk-based vaccinations may vary regionally, from population to population within an area, or between individual horses within a given population. Disease risk may not be readily identified by laypersons; it is important to consult a veterinarian when developing a vaccination program.

Anthrax

Anthrax is a serious and rapidly fatal septicemic disease caused by proliferation and spread of the vegetative form of *Bacillus anthracis* in the body. Infection is acquired though ingestion, inhalation or contamination of wounds by soil-borne spores of the organism. Anthrax is encountered only in limited geographic areas where alkaline soil conditions favor survival of the organism. (View map of U.S. outbreaks.) Vaccination is indicated only for horses pastured in endemic areas.

Vaccine: The only vaccine currently licensed for use in horses is a live Sterne strain, non-encapsulated spore-form. The vaccine has been shown to be effective; however, vaccination of pregnant mares is not recommended. Adverse reactions to the vaccine have been reported in young, and miniature horses. Local swelling may occur at the injection site, most of which resolves within a few days.

Appropriate caution should be used during storage, handling and administration of this live bacterial product. Consult a physician immediately if human exposure to the vaccine occurs through accidental injection, ingestion, or otherwise through the conjunctiva or broken skin.

Antimicrobial drugs should not be given concurrently, as this may interfere with adequate response to the vaccine.

Vaccination Schedule:

Adult horses previously vaccinated against anthrax: Annual vaccination.

Adult horses previously unvaccinated or of unknown vaccinal history: Administer a primary series of 2 subcutaneous doses of vaccine with a 2 to 3 week interval between doses. Vaccinate annually thereafter.

Pregnant mares: Not recommended.

Foals: There is no specific information available regarding the vaccination of foals against anthrax.

Botulism

Botulism has been observed in horses as a result of the action of potent toxins produced by the soil-borne, spore-forming bacterium, *Clostridium botulinum*:

- *Wound botulism* results from vegetation of spores of *Cl. botulinum* and subsequent production of toxin in contaminated wounds.
- *Shaker Foal Syndrome (toxicoinfectious)* results from toxin produced by vegetation of ingested spores in the intestinal tract.
- *Forage poisoning* results from ingestion of preformed toxin produced in decaying plant material, including improperly preserved hay or haylage, or animal carcass remnants present in feed.

Botulinum toxin is the most potent biological toxin known and acts by blocking transmission of impulses from nerves to muscles, resulting in muscle weakness progressing to paralysis, inability to swallow, and frequently, death. Of the 8 distinct toxins produced by sub-types of *Cl. botulinum*, types A, B and C are associated with most outbreaks of botulism in horses, however, type A is rarely seen east of the Mississippi river in the U.S.

Vaccine:

A killed vaccine (toxoid) directed against *Cl. botulinum* type B only is licensed for use in horses in the United States. Vaccination is warranted for all horses, as *C. botulinum* type B can be found in soil samples from many areas of the country and movement of horses or forage from non-endemic to endemic regions occurs frequently. Vaccination is recommended for horses at increased risk of developing botulism due to residence in (or travel to) endemic regions, including Kentucky and the Mid-Atlantic states. Particularly susceptible groups within those regions include adult horses fed high-risk forages and foals born to unvaccinated mares. The feed sources most commonly linked to "forage poisoning" in adult horses include fermented feeds (haylage or silage) and improperly processed or stored large bales of hay.

Foals born in endemic regions are at risk for toxicoinfectious botulism (Shaker Foal Syndrome) unless protected by colostral transfer of antibodies produced by vaccination of the pregnant mare. Almost all cases of Shaker Foal Syndrome, a significant problem in Kentucky and in the mid-Atlantic seaboard states in foals between 2 weeks and 8 months of age, are caused by *Cl. botulinum* type B. Limited information suggests that foals vaccinated with the toxoid at 2 weeks, 4 weeks and at 8 weeks of age developed adequate serologic response, even in the presence of passive maternal antibodies.

Currently, no licensed vaccines are available for preventing botulism due to *Cl. botulinum* types A or C or other subtypes of toxins. Cross-protection between subtypes does not occur.

Vaccination Schedule:

Previously vaccinated pregnant mares: Vaccinate annually with a single dose 4 to 6 weeks before foaling.

Previously unvaccinated pregnant mares: Vaccinate during gestation with a primary series of 3 doses administered at 4-week intervals and scheduled so that the last dose will be administered 4 to 6 weeks before foaling to enhance concentrations of immunoglobulin in colostrum (i.e. months 8, 9, 10 of gestation).

Foals of vaccinated mares (in endemic areas): Administer a primary series of 3 doses, at 4-week intervals, starting at 2 to 3 months of age. As maternal antibody does not interfere with vaccine response, foals at high risk may have the vaccination series initiated as early as 2 weeks of age.

Foals of unvaccinated mares (born in, or moving to, endemic areas): Administer a primary series of 3 doses, at 4-week intervals, beginning at 1 to 3 months of age. Foals at high risk may have the vaccination series initiated as early as 2 weeks of age. Foals of unvaccinated mares may benefit from transfusion of plasma from a vaccinated horse or from administration of *Cl. botulinum* type B antitoxin. The efficacy of these practices needs further study.

All other horses (where indicated): Administer a primary series of 3 doses of vaccine given at 4-week intervals and followed by annual revaccination.

Horses that are naturally intoxicated or exposed: Duration of immunity following natural intoxication is highly variable; clinical experience suggests that in many cases natural intoxication does not stimulate a protective immune response. A primary 3-dose series (given at 4-week intervals between doses) should be initiated as soon as clinical disease is recognized, as serum antibody does not interfere with response to vaccination. In outbreak situations involving unvaccinated animals, an accelerated vaccination schedule is frequently recommended, with the 3-dose series administered at 2-week intervals.

Equine Herpes Virus (Rhinopneumonitis)

Equine herpesvirus type 1 **(**EHV-1) and equine herpesvirus type 4 **(**EHV-4) infect the respiratory tract, the clinical outcome of which can vary in severity from sub-clinical to severe respiratory disease. Clinical infection is characterized by fever, lethargy, anorexia, nasal discharge, cough, and mandibular lymphadenopathy. Infection of the respiratory tract with EHV-1 and EHV-4 typically first occurs in foals in the first weeks or months of life, but recurrent clinical infections are seen in weanlings, yearlings, and young horses entering training, especially when horses from different sources are commingled. Equine herpesvirus type 1 can cause major outbreaks of abortion in naïve mares, the birth of weak nonviable foals, or a sporadic neurologic disease (equine herpesvirus myeloencephalopathy-EHM) secondary to lytic infection of endothelial cells resulting in the development of thombi in the small blood vessels supplying the spinal cord and brain.

Both EHV-1 and EHV-4 spread primarily by the respiratory route, by direct and indirect (fomite) contact with nasal secretions, and, in the case of EHV-1 and infrequently EHV-4, by contact with aborted fetuses, placental and fetal fluids, and placentae. Like herpesviruses of other species, these viruses establish latent infection in the majority of horses, which become asymptomatic carriers of one or both viruses. Such horses may experience reactivation of either virus, resulting in replication in certain white cell elements in the blood and short term shedding of the virus when stressed. Some pregnant mares in which reactivation of virus occurs, may abort. Existence of a carrier state seriously compromises efforts to control these diseases and explains why outbreaks of EHV-1 or EHV-4 can occur in closed populations of horses.

Because both viruses are endemic in many equine populations, most mature horses have developed some immunity through repeated natural infection; thus, most mature horses do not develop serious respiratory disease when they become reinfected but may be a source of infection for other susceptible horses. In contrast, horses may not be protected against the abortigenic or neurologic forms of the disease, even after repeated infection, and mature or aged horses are in fact more commonly affected by the neurologic form of the disease than juvenile animals.

Recently, a genetic variant of EHV-1 has been described (defined by a single point mutation in the viral DNA polymerase [DNApol] gene) that is more commonly associated with neurologic disease (EHM). This mutation results in the presence of either aspartic acid (D) or an asparagine (N) residue at position 752. Molecular diagnostic techniques can identify EHV-1 strains carrying these genetic markers. The finding of a neuropathogenic variant of the virus can have implications for the management of EHV-1 outbreaks, or individual horses actively infected with these strains. It is important to understand that both virus genotypes can and do cause neurological disease. However, infection with D_{752} strains can result in a higher clinical attack rate and a higher case fatality rate. It is estimated that 80-90% of neurological disease is caused by D_{752} isolates, and 10-20% by N_{752} isolates. It is possible that 5-10% of all horses normally carry the D_{752} form (this estimate is based on limited studies at this time). In the face of an active outbreak of EHV-1 disease, identification of a D_{752} isolate may be grounds for increased concern about the risk of development of neurological disease.

Primary indications for use of equine herpesvirus vaccines include prevention of EHV-1-induced abortion, and reduction of severity and duration of signs of respiratory tract disease (rhinopneumonitis) in foals, weanlings, yearlings, young performance and show horses that are at high risk for exposure. Many horses produce post-vaccinal antibodies against EHV, ***but the presence of those antibodies is not indicative of protective immunity***. Repeated vaccination appears to reduce the frequency and severity of disease and limits the occurrence of abortion storms. As with all forms of equine herpes viral disease, biosecurity management is of primary importance for control of abortion caused by EHV-1.

Please check with your state or provincial animal health office on what diseases are reportable.

Vaccines:

Inactivated vaccines

A variety of inactivated vaccines are available, including those licensed only for protection against respiratory disease, and two that are licensed for protection against both respiratory disease and abortion,. Performance of the inactivated respiratory vaccines is variable, with some vaccines outperforming others. Performance of the inactivated abortion/respiratory vaccines is superior, resulting in higher antibody responses and some evidence of a cellular response to vaccination.

Modified live vaccine

A single manufacturer provides a licensed modified live EHV-1 vaccine. It is indicated for the vaccination of healthy horses 3 months of age or older as an aid in preventing respiratory disease caused by equine herpesvirus type 1 (EHV-1).

EHM

None of the available vaccines have a label claim to prevent the neurologic form of EHV-1 infection. It has been suggested that vaccines may assist in limiting the spread of outbreaks of EHM by limiting nasal shedding of EHV-1 and dissemination of infection. For this reason some experts hold the opinion that there may be an advantage to vaccinating in the face of an outbreak. If this approach is pursued, only afebrile and asymptomatic horses should be vaccinated and protection against clinical EHM should not be an expectation. The vaccines with the greatest ability to limit nasal shedding and viremia of the neuro virulent strain include the vaccines licensed for control of abortion (Pneumabort-K® & Prodigy®), the MLV vaccine (Rhinomune® & Calvenza®).

Vaccination schedules:

Adult, non-breeding, horses previously vaccinated against EHV: Frequent vaccination of non-pregnant mature horses with EHV vaccines is generally not indicated as clinical respiratory disease is infrequent in horses over 4 years of age. In younger/juvenile horses, immunity following vaccination appears to be short-lived. It is recommended that the following horses be revaccinated at 6-month intervals:

- Horses less than 5 years of age.
- Horses on breeding farms or in contact with pregnant mares.
- Horses housed at facilities with frequent equine movement on and off the premises, thus resulting in an increased risk of exposure.
- Performance or show horses in high-risk situations, such as racetracks. More frequent vaccination than at 6 months intervals may be required in certain cases as a prerequisite for entry to the facility. See here for USEF Vaccination Rule.

Adult, non-breeding horses unvaccinated or having unknown vaccinal history: Administer a primary series of 3 doses of inactivated EHV-1/EHV-4 vaccine or modified-live EHV-1 vaccine. A 4 to 6 week interval between doses is recommended.

Pregnant mares: Vaccinate during the fifth, seventh, and ninth months of gestation using an inactivated EHV-1 vaccine licensed for prevention of abortion. Many veterinarians also recommend a dose during the third month of gestation and some recommend a dose at the time of breeding.

Vaccination of mares with an inactivated EHV-1/EHV-4 vaccine 4 to 6 weeks before foaling is commonly practiced to enhance concentrations of colostral immunoglobulins for transfer to the foal. Maternal antibody passively transferred to foals from vaccinated mares may decrease the incidence of respiratory disease in foals, but infection is common in these foals and may result in clinical disease and establishment of the carrier state.

Barren mares at breeding facilities: Vaccinate before the start of the breeding season and thereafter based on risk of exposure.

Stallions and teasers: Vaccinate before the start of the breeding season and thereafter based on risk of exposure.

Foals: Administer a primary series of 3 doses of inactivated EHV-1/EHV-4 vaccine or modified-live EHV-1 vaccine, beginning at 4 to 6 months of age and with a 4 to 6 week interval between the first and second doses. Administer the third dose at 10 to 12 months of age.

Immunity following vaccination appears to be short-lived and it is recommended that foals and young horses be revaccinated at 6-month intervals.

The benefit of intensive vaccination programs directed against EHV-1 and EHV-4 in foals and young horses is not clearly defined because, despite frequent vaccination, infection and clinical disease continue to occur.

Outbreak mitigation: In the face of an outbreak, horses at high risk of infection, and consequent transmission of infection, may be revaccinated. Administration of a booster vaccination is likely to be of some value if there is a history of vaccination. The simplest approach is to vaccinate all horses in the exposure area—independent of their vaccination history. If horses are known to be unvaccinated, the single dose may still produce some protection. It is essential to understand that strict quarantine, isolation, and monitoring protocols are more effective at controlling outbreaks than any vaccination protocol.

Controversy persists among experts regarding possible association between frequent vaccination against EHV and the risk of developing EHM. The absence of any controlled challenge studies designed to examine this question makes it unwise to offer any definitive conclusion

Horses having been naturally infected and recovered: Horses with a history of EHV infection and disease, including neurological disease, are likely to have immunity consequent to the infection that can be expected to last for 3 to 6 months (longer in older horses). Booster vaccination can be resumed 6 months after the disease occurrence.

Equine Influenza

Equine influenza, caused by the H3N8 orthomyxovirus, equine influenza A type 2 (A/equine 2), is one of the most common infectious diseases of the respiratory tract of horses. The influenza A/equine 1 virus (H7N7) appears to have been extinct in nature for many years. Since the early 1980s, the equine influenza A/equine 2 viruses have diverged into two distinct evolutionary lineages, Eurasian and American, of which the American lineage predominates and has been responsible for almost all outbreaks worldwide in recent years. Continued antigenic drift has resulted in three distinct American sub-lineages, a South American lineage, a Kentucky lineage (also known as classic American lineage), and a Florida lineage. The latter has been responsible for most of the outbreaks in North America, Europe and elsewhere in the world during the last decade. Further genetic evolution of the Florida sub-lineage has resulted in two groups of viruses referred to as Florida sub-lineage clades 1 and 2. Clade 1 representatives include Ohio 2003, South Africa 2003, Japan 2007 and Australia 2007 viruses. Clade 2 representatives are present in Europe, India and China and include Richmond 2007.

Influenza is endemic in the equine population of the United States and throughout much of the world, with the notable exceptions of New Zealand and Iceland. Australia has also regained its equine influenza-free status after the extensive outbreak of 2007. Equine influenza virus does not typically circulate asymptomatically within large groups of horses. Sporadic outbreaks of EIV result from the introduction of an infected horse. This epidemiologic finding and the rapid elimination of the virus by the equine immune response suggest that infection can be avoided by preventing entry of the virus into an equine population by the quarantine of newly arriving horses for at least 14 days, and by appropriate vaccination before exposure. All horses should be vaccinated against equine influenza unless they live in a closed and isolated facility.

To date, the most important factors associated with increased risk of infection have been identified as:

1) Age: Horses 1 to 5 years old are more susceptible, although a recent study demonstrated an increased incidence of EIV among older horses (6-10 years old) and horses previously vaccinated against EIV within the previous 12 months. These results help support the belief that immunity to EIV can be overwhelmed in horses frequently exposed at shows or similar athletic events or when the current strains of EIV circulating within a given horse population become antigenically distinct from the vaccine strains contributing to incomplete clinical protection.

2) Serum concentrations of influenza virus-specific antibody, particularly HA-specific antibody, are a correlate of protection stimulated by vaccination and / or natural infection. Low concentrations of HA-specific neutralizing antibody titers and / or a mismatch between antibody and virus causing the infections may increase risk of infection. Local mucosal protection, although difficult to quantitate, also plays an important role in protection against viral infection.

3) Frequent contact with large numbers of horses.

Equine influenza is highly contagious and the virus spreads rapidly through groups of horses in aerosolized droplets dispersed by coughing. The severity of clinical signs depends on the degree of existing immunity, among other factors. Horses that are partially immune can become subclinically infected and shed virus. Immunity to the same (homologous) strain of virus following natural infection persists for approximately one year. Immunity following vaccination with inactivated influenza vaccines can be short-lived, allowing recently vaccinated horses to become infected and shed virus, thereby contributing to maintenance and spread of infection within the equine population. For these reasons, only vaccines of proven efficacy should be selected for use.

Although influenza is endemic in many countries and circulates continuously in the equine population, explosive outbreaks occur at intervals of several years when the immunity of the equine population wanes, and sufficient antigenic drift in the virus has occurred, allowing the virus to evade vaccinal immunity. Antigenic drift, by generating antigenically heterologous viruses, reduces the degree and duration of protection conferred by previous infection or vaccination using vaccines that confer protection primarily by generating protective concentrations of neutralizing antibodies targeting the surface glycoproteins of influenza. Although antigenic drift of equine influenza virus is slower than that of human influenza virus, it is still recommended that equine vaccines contain killed viral antigens from clinically relevant isolates obtained within recent years. The 2010 and 2014 OIE Expert Surveillance Panels on equine influenza vaccine composition had a number of findings and recommendations:

- All equine influenza virus isolates between 2008 and 2014 were H3N8 viruses of the Florida sub-lineage, and comprised two sub-lineages, clades 1 and 2. The viruses identified in the USA in 2014 were characterized as clade 1 viruses, whereas those detected in France, Germany, Ireland, Sweden and the UK were clade 2 viruses. Global surveillance is likely insufficient to assure that these geographic restrictions are absolute but it seems likely that the equine influenza viruses circulating in North America are all from Clade 1: i.e. A/South Africa/2003-like or A/Ohio/2003-like.
- Because of the antigenic differences between Florida Clade 1 and Clade 2 it is possible that vaccination with only one of these antigens will not fully protect against disease caused by the other. However, at this time there is no evidence of a vaccine failure resulting from this phenomenon. This means that North American horses vaccinated with a Clade 1 virus, such as A/Ohio/2003-like, should be protected from current circulating North American influenza viruses,

but may not be fully protected if they travel overseas, or in the event that Clade 2 viruses are introduced to North America, for example in a horse transported here for competition.

- The OIE panel recommended that vaccines contain examples of both Clade 1 (e.g. A/South Africa/2003-like or A/Ohio/2003-like) and Clade 2 (A/Richmond/2007) viruses particularly for horses traveling internationally.
- The absence of any isolation of Eurasian lineage influenza virus or the A/equine 1 virus for many years means that these viruses no longer need to be included in vaccines.

Historically, equine influenza vaccines have been administered at intervals as short as 3 months to horses considered at high risk of infection. All currently marketed equine influenza vaccines are likely to provide protection of at least six months duration. This is true for both of the modified live vaccines on the market today, and for inactivated vaccines. This performance depends on the quality of currently marketed vaccines, and maintaining this performance will depend on the inclusion of any new antigenically distinct equine influenza viruses that may appear in the horse population in the future.

See here for USEF Vaccination Rule.

Vaccines:

There are three types of equine influenza virus vaccine currently marketed:

Inactivated vaccines

Each of these has been shown to be efficacious in providing protection against clinical disease and viral shedding when used appropriately. These vaccines frequently include multiple strains of equine influenza virus A2 representing the major circulating strains; however, none contain strains isolated during the last 5 years. The majority of these vaccines require two-dose priming regimens, although a three-dose priming regimen is recommended here as described below; a 3-dose regimen is required for at least one of the most effective inactivated vaccines. These vaccines are well suited to pre-foaling boosters designed to increase colostral antibody levels against influenza virus.

Modified-live (MLV) cold-adapted equine influenza /A2 vaccine

This product is administered intranasally. The vaccine has proven to be very safe and a single administration to naïve horses is protective for up to 12 months, although only a 6-month claim is made on the product data sheet. Circulating antibody responses in naïve horses post-vaccination are minimal, suggesting that other factors, such as local protection at the nasal mucosa may be enhanced by this vaccine. The product is licensed for vaccination of non-pregnant animals over 11 months of age using a single dose of vaccine, followed by boosters at 6-month intervals. Generally, horses shed vaccinal virus for less than 1 week after vaccination. However, the amount and duration of shed vaccinal virus is so minimal that other horses in contact with them will not be vaccinated.

Incorporation of the MLV vaccine into a program that previously used inactivated vaccine can be easily accomplished by substituting the MLV when routine boosters are scheduled.

Experience strongly supports the safety of the MLV intranasal vaccine when administered to foals less than 11 months of age. Similarly, the vaccine is protective when administered to foals six months of age or older. The onset of protection in previously unvaccinated naïve horses has been documented as early as seven days after vaccination. The vaccine is not recommended for vaccination of mares in late pregnancy to boost colostral antibodies, as data available to date suggest that circulating antibody responses to vaccination are low.

Canary pox vector vaccine

This product is to be administered by intra-muscular injection and has been shown to provide protection of at least six months duration. A two dose priming regimen is recommended, with boosters at a six month interval. The vaccine is safe to use in foals as young as four months of age, and there is some evidence of efficacy in the face of maternal immunity. Because this vaccine induces high levels of antibody, it is likely to be suitable for pre-foaling boosters.

Vaccination Schedules:

Adult horses, previously vaccinated: Mature performance, show, or pleasure horses constantly at risk of exposure should be revaccinated at 6 month intervals. Other adult horses could be vaccinated as infrequently as once a year.

Adult horses, unvaccinated or having an unknown vaccination history: Either one dose of the MLV intranasal vaccine or a 2-dose series of canary pox vector vaccine at a 4 to 6 week interval (revaccinate semi-annually) or a primary series of 3 doses of the inactivated-virus vaccines is recommended. The ideal intervals between these vaccinations are three to four weeks between the first and the second vaccination, followed by an interval ideally as long as three to six months before the third vaccination. This regimen generally induces higher and more persistent antibody titers than those induced by use of the previously recommended 2-dose initial series. Subsequent revaccination should be at intervals of 6 to 12 months, depending on the age of the horse as well as the degree and duration of risk of acquiring infection.

Pregnant broodmares, previously vaccinated: Vaccinate 4 to 6 weeks before foaling using an inactivated-virus vaccine or the canary pox vectored vaccine.

Pregnant broodmares, unvaccinated or having an unknown vaccination history: Use a 3-dose series of the inactivated-virus vaccines, with the second dose administered 4 to 6 weeks after the first dose and the third dose administered 4 to 6 weeks pre-partum. With a canary pox vector vaccine, a 2-dose series is recommended with the second dose administered 4 to 6 weeks after the first dose but no later than 4 weeks pre-partum.

Foals of vaccinated mares: Administer either a single dose of the MLV intranasal vaccine (2 doses are recommended if foal is less than 11 months of age, 1st dose at 6 to 7 months of age and second dose at 11 to 12 months of age) or a primary series of 2 doses of canary pox vector vaccine at a 5 week interval or a 3-dose series of inactivated-virus vaccine beginning at 6 months of age. The recommended intervals between these vaccinations with an inactivated-virus vaccine are 4 to 6 weeks between the first and the second vaccinations. The third dose should be administered between 10 and 12 months of age.

Foals of nonvaccinated mares: Administer either a single dose of the MLV intranasal vaccine (2 doses are recommended if foal is less than 11 months of age, 1st dose at 6 to 7 months of age and second dose at 11 to 12 months of age) or a primary series of 2 doses of canary pox vector vaccine at a 5 week interval or a 3-dose series of inactivated virus vaccine at 6 months of age (see above), unless there is an unusual threat that warrants earlier vaccination. Because some maternal anti-influenza antibody is still likely to be present, a complete series of primary vaccinations should still be given after 6 months of age.

Outbreak Mitigation:

Vaccination to boost immunity in the face of an outbreak may be a valuable strategy if the outbreak is detected early enough. In previously vaccinated horses, any vaccine can be used for this purpose. In unvaccinated horses, or horses with an unknown vaccination history, the early onset of immunity after administration of the intranasal product (protection within 7 days), may recommend it for use. The use of a canary pox vectored vaccine may also be considered for this purpose. (View AAEP Infectious Disease Control Guidelines on Influenza)

Equine Viral Arteritis

Equine viral arteritis (EVA) is a contagious disease of equids caused by equine arteritis virus (EAV), an RNA virus that is found in horse populations in many countries. While typically not life-threatening to otherwise healthy adult horses, EAV can cause abortion in pregnant mares; uncommonly, death in young foals; and establish a long-term carrier state in breeding stallions. While various horse breeds appear equally susceptible to EAV, the prevalence of infection can vary widely, with higher seropositivity rates occurring in Standardbreds and Warmbloods.

Historically, outbreaks of EVA have been relatively infrequent. However, the number of confirmed occurrences appears to be increasing, likely attributable to increases in:

1. Global movement of horses
2. Accessibility of carrier stallions
3. Utilization of shipped cooled or frozen virus-infective semen

Transmission most frequently occurs through direct contact with virus-infective respiratory secretions leading to widespread dissemination of the virus among susceptible horses in close proximity. Venereal transmission by infected stallions has a significant role in virus spread on or between breeding farms. Equine arteritis virus can be very efficiently spread through artificial insemination and the use of fresh-cooled or frozen semen. There is limited evidence that virus can also be transmitted via embryo transfer where the donor mare is bred with infective semen from a carrier stallion. The virus has been shown to remain viable for considerable periods of time in raw, extended or frozen semen held at temperatures equal to or less than 4°C. Indirect transmission, though less significant, can occur through contact with virus-contaminated fomites.

The majority of primary EAV infections are subclinical or asymptomatic. EVA can vary in clinical severity both between and within outbreaks. EVA cannot be diagnosed based on clinical signs alone, as case presentation is similar to various other infectious and non-infectious equine diseases. Laboratory confirmation is required for diagnosis.

Clinical signs, if they occur, typically develop 3 to 7 days post-infection and are variable but may include any combination or all of the following: fever; depression; anorexia; dependent edema (lower limbs, scrotum and prepuce or mammary glands); localized or generalized urticaria; supra or periorbital edema; conjunctivitis; lacrimal discharge and serous to mucoid nasal discharge. Abortion is a frequent sequel to infection in the unprotected, pregnant mare. When pregnant mares are exposed to the virus very close to term, they may not abort but give birth to a congenitally infected foal, affected with a rapidly progressive and fulminant interstitial pneumonia. Foals infected with EAV during the first few months of life can develop a life-threatening pneumonia or pneumoenteritis.

A carrier state can develop following EAV infection in the post-pubertal colt or stallion. The virus can persist in the reproductive tract of stallions for many years and may result in lifelong infection. The carrier stallion is widely accepted as the natural reservoir of EAV and the source of diversity among naturally occurring strains of the virus.

Vaccine: The current licensed vaccine in North America is a highly attenuated, modified live virus product. It has been shown to be safe and effective in stallions and non-pregnant mares. Mild post-vaccinal febrile reactions with transient lymphopenia have been observed in a small percentage of first-time vaccinated horses. Primary vaccination provides clinical protection against EVA but does not prevent re-infection and limited replication of challenge virus. However, in first-time vaccinates, the frequency, duration, and amount of vaccine virus that is shed via the respiratory tract is significantly less than that observed with natural infection.

Vaccination in the face of an EVA outbreak has been successful in controlling further spread of the virus within 7 to 10 days. Immunization with the MLV vaccine stimulates a rapid protective response, which in turn restricts development of the cell-associated viremia and viral shedding via the respiratory tract in horses naturally exposed to infection. As a consequence, the amount of EAV in circulation is greatly decreased, limiting further spread of the virus.

Vaccination Schedules:

In planning a vaccination program against EVA, it is important to consult with state and/or federal animal health officials to ensure that any such program is in compliance with the state's control program for EVA, if one exists.

The indications for vaccination against EVA have been:

1) To protect stallions against infection and subsequent development of the carrier state.

2) To immunize seronegative mares before being bred with EAV-infective semen.

3) To curtail outbreaks in non-breeding populations.

Note: It is not possible to differentiate vaccine-induced antibody response from that due to natural infection. It is strongly recommended that *prior to vaccination,* serum from all first-time vaccinates be tested and confirmed negative for antibodies to EAV by a USDA-approved laboratory. Mares intended for export should be similarly tested.

Stallions

Breeding stallions, previously vaccinated: Should receive an annual booster vaccination against EVA every 12 months and no earlier than 4 weeks before the start of each breeding season.

Breeding stallions, first-time vaccinates: Prior to initial vaccination, all stallions shall undergo serologic testing and be confirmed negative for antibodies to EAV. Testing should be performed shortly prior to, or preferably at, the time of vaccination. Negative certification is of importance should a vaccinated stallion be considered for export at a later date. All first-time vaccinated stallions should be isolated for 3 weeks following vaccination before being used for breeding.

Teasers can play a role in the introduction and dissemination of EAV within a breeding population. Vaccination against EVA is recommended on an annual basis.

Mares to be bred to carrier stallions or to be bred with virus-infective semen should first be tested to determine their serological status for EAV antibodies.

Seronegative mares should be vaccinated against EVA and isolated from any other seronegative horses for 3 weeks. The purpose of the isolation period is twofold:

1) To enable the vaccinated mare adequate time to develop immunity against the disease before being exposed to EAV infection during breeding.

2) To afford ample opportunity for cessation of possible post-vaccinal viral shedding via the respiratory tract.

Following insemination, first-time vaccinated mares must be isolated for an additional 3-week period as they are likely to experience a limited re-infection cycle with the strain of EAV present in the semen. Should such mares fail to become pregnant, they can be bred back to a carrier stallion or with infective semen without the need for revaccination or an additional 3-week isolation period post-insemination.

In the case of embryo transfer, it is recommended that both donor and recipient mare, if seronegative, be vaccinated against EVA if the donor mare is to be bred with virus infective semen.

Seropositive mares, having tested serologically positive for antibodies to EAV, can be bred to a carrier stallion or with infective semen for the first time without the need for prior vaccination against EVA. After breeding, such mares should be physically separated from unvaccinated or unprotected horses for 24 hours to avoid possible risk of mechanical transmission of infectious virus from voided semen.

Pregnant mares: The manufacturer does not recommend use of this vaccine in pregnant mares, especially in the last two months of pregnancy. Under circumstances of high risk of natural exposure to infection, the vaccine has been administered to pregnant mares in order to control outbreaks of the disease. Based on early experimental studies and field experiences using this vaccine, the last 1 to 2 months of pregnancy represent the time of greatest risk for a possible adverse effect on pregnancy. This was most recently illustrated in the aftermath of the 2006 multi-state occurrence of EVA when a very limited number of abortions associated with the vaccine virus were confirmed in mares vaccinated within the final 2 months of gestation.

Nurse mares can play a role in the introduction and spread of EAV among resident equine populations and should be vaccinated annually according to recommended protocols.

Foals

The manufacturer does not recommend use of this vaccine in foals less than 6 weeks of age unless under circumstances of high risk of natural exposure to infection.

Colt (male) foals

Especially in EAV endemic breeds, colt foals should be vaccinated between 6 and 12 months of age to protect against the risk of becoming carriers later in life. Colts should be confirmed seronegative for antibodies to EAV prior to vaccination as described above and kept isolated for 3 weeks following vaccination. Because foals of EAV-seropositive mares can carry colostrally-derived antibodies for up to 6 months, testing and vaccination should not be performed prior to 6 months of age.

Outbreak Mitigation:

Non-breeding population: Vaccination is an effective strategy in containing outbreaks, particularly in congregated groups of horses where isolation may be problematic. Serologic testing, as described above, should be performed on intact males and females that may be intended for future breeding purposes and/or export.

Breeding population: Outbreaks of EVA can be complex and can have far reaching implications. Vaccination is a component of outbreak management but should be performed only under the direct supervision of a veterinarian. (View AAEP Infectious Disease Control Guidelines)

Vaccination and Exporting of Horses:

In instances where there is uncertainty or concern over whether vaccination against EVA could prevent the export of a horse to a particular country, it is advisable to consult the area federal veterinarian or assistant director in charge in the state to determine the specific import requirements of that country. There are a number of countries that bar entry of any equid that is serologically positive for antibodies to EAV, regardless of vaccination history. Countries that do accept EVA vaccinated horses, regardless of gender, typically require stallions or colts to have a certified vaccination history and confirmation of pre-vaccination negative serological status.

Leptospirosis

Equine leptospirosis is typically a sporadic disease. The primary leptospiral-associated equine clinical disease presentations include; recurrent uveitis, late-term abortion and acute renal failure. Infection is acquired through exposure to the organism via the mucous membranes or abraided skin. The leptospiral organisms are shed in the urine of infected horses (additionally the placenta, fetal fluids and urine of the mare in abortion cases) and a number of wildlife hosts which can shed *Leptospira spp*. in the urine.

Seroprevalence data from healthy horses indicate that it is common for horses to carry titers to multiple serovars. Multiple serovar titers can result from direct exposure to these serovars, cross-reactivity of the MAT (microscopic agglutination test) between different serovars or both. In diseased horses, *Leptospira interrogans* serovar *pomona* is the most commonly incriminated pathogen/serovar in the U.S.

Vaccine: There is currently one vaccine approved for use in horses. It is a killed, whole cell bacterin.

The product is labeled for vaccination of healthy horses 6 months of age or older as an aid in the prevention of leptospirosis caused by *Leptospira interrogans* serovar *pomona*. The vaccine has demonstrated safety in foals as young as 3 months of age. Efficacy of this product was demonstrated utilizing an intraperitoneal Leptospiral challenge model. Vaccinated horses did not develop leptospiremia or leptospiuria as compared to controls.

The duration of immunity of this product has not been determined.

Vaccination Schedule:

Horses 6 months of age or older: Initial two dose series, 3 to 4 weeks apart. Annual revaccination.

Pregnant mares: The product has demonstrated safety in pregnant mares during the 2nd trimester. Additional safety studies in pregnant mares are ongoing.

Potomac Horse Fever (Equine Neorickettsiosis)

Equine neorickettsiosis is caused by *Neorickettsia risticii* (formerly *Ehrlichia risticii*). Originally described in 1979 as a sporadic disease affecting horses residing in the eastern United States near the Potomac River, the disease has since been identified in various other geographic locations in the United States and Canada. The disease is seasonal, occurring between late spring and early fall in temperate areas, with most cases in July, August, and September with the onset of hot weather.

Clinical signs are variable but may include: fever, mild to severe diarrhea, laminitis, mild colic, and decreased abdominal sounds. Uncommonly, pregnant mares infected with *N. risticii* (usually in the middle trimester between 90 and 120 days) can abort due to fetal infection at 7 months of gestation.

If Potomac Horse Fever has been confirmed on a farm or in a particular geographic area, it is likely that additional cases will occur in future years. Foals appear to have a low risk of contracting the disease. Vaccination against this disease has been questioned because field evidence of benefit is lacking. Proposed explanations for this include lack of seroconversion and multiple field strains whereas only one strain is present in available vaccines.

Vaccine:

The currently available commercial vaccine is a killed, adjuvanted product, which is also available combined with rabies vaccine. The current vaccine does not carry a label claim for the prevention of abortion.

Vaccination Schedules:

Due to the seasonal incidence of disease, vaccination should be timed to precede the anticipated peak challenge during the summer months or fall.

Adult horses, previously vaccinated: Manufacturers recommend revaccination at 6- to 12-month intervals. However, veterinarians may consider an interval of 3 to 4 months for horses in endemic areas because protection following vaccination can be incomplete and short-lived.

Adult horses, previously unvaccinated or with unknown vaccinal history: Administer a primary series of 2 doses, at a 3- to 4-week interval. Peak protection occurs 3 to 4 weeks after the second dose.

Pregnant mares previously vaccinated against PHF: Vaccinate semi-annually to annually. Schedule 1 dose to be administered 4 to 6 weeks before foaling. To date no studies have been published that examine the efficacy of PHF vaccines to prevent *N. risticii* induced abortion.

Pregnant mares unvaccinated or with unknown vaccinal history: Administer a primary series of 2 doses, at a 3- to 4-week interval. Schedule so that 2nd dose is administered 4 to 6 weeks before foaling.

Foals: Due to the low risk of clinical disease in young foals and the possible maternal antibody interference, primary immunization for most foals can begin after 5 months of age. The manufacturer's recommendation is for a 2-dose series administered at a 3 to 4 week interval. However, as with other killed products, a third dose at 12 months of age is recommended. If the primary series is initiated when foals are less than 5 months of age, additional doses should be administered at monthly intervals up to 6 months of age to ensure that an immunologic response is achieved.

Horses having been naturally infected and recovered: Administer a primary series (as described above) or booster vaccine (if previously vaccinated) 12 months following recovery from natural infection.

Rotaviral Diarrhea

Rotavirus, a non-enveloped RNA virus, is a major infectious cause of foal diarrhea and has been documented to cause 50% or more of foal diarrhea cases in some areas.

While rotavirus diarrhea morbidity can be high (50% of susceptible foals), mortality is low (<1%) with veterinary intervention.

Equine rotavirus is transmitted via the fecal-oral route and damages the small intestinal villi resulting in cellular destruction, maldigestion, malabsorption, and diarrhea.

As many as 70% of all foals in the United States will have at least one diarrheal episode prior to weaning. Mare owners need to be aware that strict biosecurity and disinfection during the foaling season also mitigates the morbidity associated with most types of infectious foal diarrhea and other contagious diseases.

Vaccination of mares results in a significant increase in foals' rotavirus antibody titers. Field trials of rotavirus vaccination in pregnant mares have shown a decrease in incidence and severity of foal diarrhea on farms that historically had annual rotaviral diarrhea cases. Other studies have shown increased rotavirus antibody in vaccinated mares' colostrum.

Vaccine:

The only available vaccine is conditionally licensed, contains inactivated rotavirus Group A, and is indicated for administration to pregnant mares to enhance concentrations of colostral immunoglobulins against equine rotavirus (Group A). The vaccine has been used in mares since 1996 in the USA and is considered to be safe.

Vaccination Schedules:

Pregnant mares (regardless of vaccination history): Should receive a 3 dose series of intramuscular vaccinations at 8, 9, 10 months of gestation.

Concentrated horse breeding areas in the US routinely use rotavirus vaccine in pregnant mares. Pregnant mares that will be shipped to regions that have had a history of rotaviral diarrhea should also be considered candidates for vaccination.

**It is essential that the newborn foal receives an adequate amount of colostrum and absorbs sufficient anti-rotavirus antibodies from rotavirus-vaccinated mares.

Newborn foals: There are no data to suggest that vaccination of the newborn foal with inactivated rotavirus A vaccine has any benefit for preventing or reducing the severity of infection.

As colostral-derived antibody titers wane at approximately 8 weeks of age, foals may develop rotaviral diarrhea. However, the severity of diarrhea is generally milder and of shorter duration than in foals that become ill within the first 4 weeks of life.

Other adult horses: Vaccination is unnecessary

Snake Bite

Venomous snake bite of equids occurs in certain areas of North America. The risk of rattlesnake envenomation may justify the use of Crotalus atrox (Western Diamondback Rattlesnake) toxoid vaccine in equids. Pre-exposure vaccination may be recommended for those animals in geographic areas or for those traveling to areas where exposure to venomous snakes justifies vaccine usage.

Vaccine:

There is one conditionally licensed inactivated (Crotalus atrox Toxoid) vaccine for use in healthy horses 6 months of age or older as an aid in the reduction of morbidity and mortality due to intoxication with Crotalus atrox toxin.

The label claim for the vaccine is that it may also provide protection against the venoms of the Western Rattlesnake (including the Prairie, Great Basin, Northern and Southern Pacific varieties), Sidewinder, Timber Rattlesnake, Massasauga and the Copperhead.

Partial protection may be obtained against Eastern Diamondback Rattlesnake venom. This vaccine does not provide protection against venom from the Water Moccasin (Cottonmouth), Mojave Rattlesnake or Coral Snake.

Vaccination Schedule:

Use in healthy horses 6 months of age or older.

Adult horses: Administer a primary series of three doses at one month intervals. Booster doses are recommended at 6 month intervals.

Pregnant mares: Manufacturer information claims the product is safe for use in pregnant mares, however this information does not appear on the product label. It is recommended veterinarians contact the manufacturer with questions regarding use in pregnant mares.

Foals: (6 months of age and older) Administer a primary series of three doses at one month intervals. Booster doses are recommended at 6 month intervals. There is no specific information available regarding the vaccination of foals less than 6 months of age.

Strangles (*Streptococcus equi*)

Streptococcus equi subspecies *equi* (*S. equi var. equi)* is the bacterium which causes the highly contagious disease strangles (also known as "distemper"). Strangles commonly affects young horses (weanlings and yearlings), but horses of any age can be infected. Vaccination against *S. equi* is recommended on premises where strangles is a persistent endemic problem or for horses that are expected to be at high risk of exposure. Following natural infection, a carrier state of variable duration may develop and intermittent shedding may occur. The influence of vaccination on intermittent shedding of *S. equi* has not been adequately studied.

The organism is transmitted by direct contact with infected horses or sub-clinical shedders, or indirectly by contact with water troughs, hoses, feed bunks, pastures, stalls, trailers, tack, grooming equipment, nose wipe cloths or sponges, attendants' hands and clothing, or insects contaminated with nasal discharge or pus draining from lymph nodes of infected horses. *Streptococcus equi* has demonstrated environmental survivability particularly in water sources and when protected from exposure to direct sunlight and disinfectants, and can be a source of infection for new additions to the herd.

Infection by *S. equi* induces a profound inflammatory response. Clinical signs may include fever (102-106^{o} F); dysphagia or anorexia; stridor; lymphadenopathy (+/- abscessation); and copious mucopurulent nasal discharge.

S. equi and *S. zooepidemicus* are antigenically similar organisms. However, exposure to, or vaccination against, one does not confer reliable immunity to the other.

Following natural or vaccinal exposure to streptococcal antigens, certain individuals may unpredictably develop purpura hemorrhagica, an acute, non-contagious syndrome caused by immune-mediated, generalized vasculitis. Clinical signs develop within 2 to 4 weeks following natural or vaccinal exposure to streptococcal antigens. Clinical signs may include urticaria with pitting edema of the limbs, ventral abdomen and head; subcutaneous and petechial hemorrhage; and sloughing of involved tissues. Severe edema of the head may compromise breathing. Immediate medical attention should be sought for individual horses suspected of having purpura hemorrhagica.

Vaccines:

Vaccination in the face of an outbreak should be carefully considered, as there is significantly increased risk of adverse reactions in exposed horses. Purpura hemmorrhagica can be associated with vaccine administration. In a recent retrospective study of 53 horses with purpura hemorrhagica, 5 cases were vaccinated with a S. equi M protein vaccine. Outbreak mitigation and the prevention of spread of *S. equi* infection are centered on management of horses, personnel, and facilities.
(View AAEP Infectious Disease Control Guidelines—*S. equi*.; view ACVIM Strep equi consensus statement)

Killed vaccines:

Killed vaccines are an adjunct to the prevention of strangles. Vaccination with these products should not be expected to prevent disease. However, appropriate pre-exposure vaccination with these products appears to attenuate the severity of clinical signs in affected horses, should disease occur, and has been shown to reduce the incidence of disease by as much as 50% during outbreaks.

All injectable, inactivated *S. equi*. vaccines, can be associated with an increased rate of injection site reactions as compared to other equine vaccines. Due to the limited variability between commercially available vaccinal bacteria and field isolates, autogenous bacterins are not advocated.

Modified live vaccine:

An intranasal product has been shown to stimulate a high level of immunity against experimental challenge. The inductive sites are the pharyngeal and lingual tonsils. Vaccinal organisms must reach these sites in sufficient numbers to trigger protective responses; therefore, accurate vaccine delivery is critical to vaccine efficacy. In a small percentage of cases, residual vaccinal organism virulence may result in formation of slowly developing mandibular or retropharyngeal abscesses. The risk of vaccine-associated adverse events is increased when the product is administered to young foals.

Maternal antibody interference with respect to the development of mucosal immunity needs to be studied further.

In order to avoid inadvertent contamination of other vaccines, syringes and needles, it is advisable and considered a good practice to administer all parenteral vaccines or other injectables before the handling and administration of the intranasal vaccine against *S. equi*.

Vaccination Schedules:

Adult horses previously vaccinated: Vaccinate every 6 to 12 months based on risk assessment and manufacturers' recommendations.

Adult horses unvaccinated or having unknown vaccinal history

Killed vaccine:

Manufacturers' recommendations are for primary vaccination with a series of 2 or 3 doses administered at intervals of 2 to 4 weeks, depending on the product used, followed by annual revaccination. Revaccinate at 6- month intervals, regardless of the injectable product used.

Modified live vaccine:

Administer intranasally a 2-dose primary series with a 3-week interval between doses. Semiannual (6-month intervals) or annual revaccination is recommended.

Broodmares previously vaccinated

Killed vaccine:

Vaccinate 4 to 6 weeks pre-partum with approved products that contain inactivated M-protein. Maternal antibody interference is not known to occur when injectable, M-protein vaccines are administered.

Broodmares previously unvaccinated or having unknown vaccinal history
Administer primary series of killed vaccine containing M-protein (see above, *Adult horses unvaccinated)* with final dose to be administered 4 to 6 weeks pre-partum.

Foals

Killed vaccine:

For foals at high risk for exposure to strangles, administer a 3-dose primary series of an M-protein product beginning at 4 to 6 months of age. An interval of 4 to 6 weeks between doses is recommended.

Modified live vaccine:

Administer intranasally at 6 to 9 months of age a 2-dose primary series with a 3-week interval between doses. This vaccine has been safely administered to foals as young as 6 weeks of age when there is a high risk of infection, such as occurs during an outbreak, but the efficacy of its use in very young foals has not been adequately studied. If administered to young foals in this manner, a third dose of the modified live vaccine should be administered 2 to 4 weeks before the foal is weaned to optimize protection during that time of high risk of infection. The risk of vaccine-associated adverse events is increased when the product is administered to young foals.

Horses having been naturally infected and recovered: Following recovery from strangles, most horses develop a durable immunity, persisting in over 75% of animals for 5 years or longer. This indicates that stimulation of a high level of immunity is biologically feasible given appropriate presentation of protective immunogens. Currently, a diagnostic test is available and may be used to assess the level of immunity conferred by natural exposure or vaccination. Since natural exposure or vaccination can provide variable levels of immunity, use of this test may provide a guideline in determining the need for current or future vaccination. Additional testing information is available from; ACVIM Strep equi consensus statement.

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