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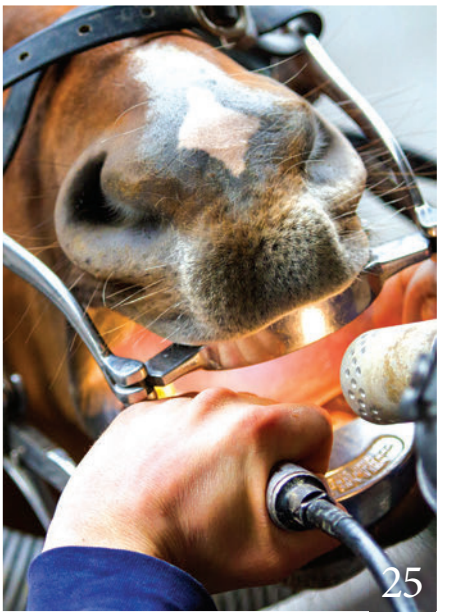

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By Kimberly S. Brown

We've Got It Covered

Practice and patients … finances and fiscal responsibility … business and burnout. Veterinarians of today are not just burning the candle at both ends, but are singeing their fingers on the match that is trying to melt the middle of the candle. There is so much to keep up with and to learn in the field of medicine that it's sometimes hard to remember that you are a business owner.

"But I got in equine veterinary medicine because I love horses more than people!" I've heard a lot of veterinarians say. But if you add up the hours you spend touching horses and the hours you spend with the people who own those horses, you will see that your business is your clients and your practice is your equine patients.

In this issue of *EquiManagement*, we touch on both your business and your equine patients with a range of fiscal, financial and horse health topics. These include everything from dentistry to skin issues, from building your clinic to building relationships with farriers, and from disease prevention and EPM to "Creating the Perfect Internship" and "Training Owners to Keep You Safe."

The Digital Side

I hope you are taking advantage of all the new and unique content that appears on a daily basis on EquiManagement.com. Our two new blogs are getting rave reviews.

"The Business of Practice," which you can also find in the print issues of the magazine, is now a monthly blog on the website. And we appreciate our partner CareCredit for assisting us in bringing Dr. Amy Grice's business insights to you on a regular and more frequent basis.

"The Scoop From the Schools" is also a new blog on EquiManagement to help veterinarians keep up with the news and information from their alma maters and other educational institutions that conduct equine research. Written by Dr. Stacey Oke, "The Scoop From the Schools" is brought to you by our partner Hilltop Bio.

The 60th "Disease Du Jour" podcast episode was released in July 2021. This year we have focused on tips and information for veterinarians in the field. We just concluded our "Triple Crown of Emergency Care," which included podcasts on "Emergency Medicine" and "Suturing," plus a podcast and webinar on "Equine Bandaging." And don't miss our upcoming podcast and webinar on "Dentistry How-To" with Dr. Jack Easley. He will discuss conducting a good oral exam in the field and diagnosing dental problems. The "Disease Du Jour" podcast is brought to you by Merck Animal Health for the second consecutive year.

The "Business of Practice" podcast, brought to you by Dechra Veterinary Products, has touched on some critical topics to your mental, physical and fiscal health. We have covered topics such as "Compassion Fatigue," "Improving Cash on Hand" and "Work-Life Balance Tips."

If you haven't signed up for our two e-newsletters, you are missing out on the "best of the best" of our new and archived content. The EquiManagement Update covers business, veterinarian wellness and industry news related to the veterinary industry. For example, the July Update newsletter featured "Alternatives to 24/7/365 Veterinary Practice," "Veterinarians Communicating Boundaries" and "Improving Cash on Hand."

Research Reports cover equine health and research. In July, for example, we covered "Equine Rabies Confirmed in Florida Horse," "Morris Animal Foundation Funds Equine Lameness Research" and "Determining Synovial Involvement of an Equine Wound."

Don't miss all we have to offer! EM

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By Nancy S. Loving, DVM

Neonatal Diarrhea

During foaling season, equine practitioners expect to treat cases of neonatal diarrhea. At the 2020 AAEP Convention, Nathan Slovis, DVM, DACVIM, of Hagyard Equine Medical Institute in Kentucky, presented a thorough look at what's new in these cases.

Slovis pointed out that more than 20% of foals develop infectious diarrhea by 6 months of age. Due to hypovolemia and/or septic shock, foal diarrhea can be life-threatening.

Malabsorption occurs when poorly absorbed lactose begins to ferment and leads to osmotic diarrhea that decreases absorption of gastrointestinal water and electrolytes. Secretory diarrhea occurs from the effect of bacterial endotoxins and their impact on the enteric nervous system. Endotoxin (lipopolysaccharide) can set off an inflammatory cascade that increase cytokines.

The causes of diarrhea are many, so it is important to obtain a good history, determine whether other animals in the barn are affected, and if so, in what age groups? What is the consistency of the feces? Is there a peculiar odor? (For example, *Clostridium difficile* has a unique smell.) Identify whether any medications have recently been administered to the diarrheic foal. Intestinal ultrasound is useful to demonstrate colitis, enterocolitis or some other GI abnormality.

Lab testing with PCR is very sensitive in detecting DNA of pathogens compared to detection of protein or antibodies by ELISA testing, said Slovis.

Rotavirus Diarrhea. One of the most common causes of neonatal diarrhea is rotavirus, which invades the intestinal epithelial cells, and in particular the sides, tips, villi and the brush border responsible for lactase formation to digest milk. Incomplete milk digestion allows disaccharides to reach the hindgut, where they ferment to cause bloat and diarrhea. The enteric nervous system also creates secretory diarrhea.

This virus tends to affect foals younger than 3 months of age, but especially those that are 1-2 days old. Slovis advised that a foal usually sheds rotavirus for 10 days but can shed up to eight months while remaining subclinical. The PCR test for rotavirus is equine specific—be sure the test is validated for horses.

One complication of rotavirus is development of pyloric/duodenal stenosis. Prevention is possible with a killed vaccine for the G3 strain. (The G14 strain also circulates, but there is no vaccine for it yet.) Pregnant mares immunized at 8, 9 and 10 months of every pregnancy are able to confer immunity to the foal via transfer of colostral antibodies. Rotavirus vaccine reduces morbidity from 80% to 30% as well as decreases duration of diarrhea from 7.3 to 1.8 days. Equally important is the need

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Dr. Nathan Slovis noted that more than 20% of foals develop infectious diarrhea by 6 months of age, and that there are many causes of diarrhea in foals.

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for proper hygiene and disinfection of stalls with phenols or accelerated hydrogen peroxide. Bleach is not effective. Another preventive strategy is to house foals outside.

Clostridial Diarrhea. *Clostridium difficile* can be present in asymptomatic carriers. For example, Slovis reported that >50% of healthy human neonates carry toxicogenic *C. difficile*. In horses, *C. difficile* is reported in up to 3% in foals and 4% in adults. Toxin A destroys tight junctions, so bacteria leaking into the bloodstream can cause endotoxic shock. Toxin A also stimulates sensory neurons, which release substance P when inflamed or stimulated. Mast cells release serotonin, then myenteric ganglia release acetylcholine with subsequent secretion of chloride. All this leads to severe diarrhea.

C. difficile is everywhere. A stressed postpartum mare can shed bacteria, and an udder-seeking foal ingests spores with subsequent increased shedding in the environment. *C. difficile* is identified in 16% of mares and 25% of foals.

One new finding of import is that *Clostridium difficile* can take to the air. Human studies have identified bedside air samples growing *C. difficile*. Consider what happens when stalls are mucked out and how that activity aerosolizes pathogens. In addition, *C. difficile* spores are difficult to eradicate from surfaces.

Diagnosis of *C. difficile* relies on finding toxin in the feces, which is identified via ELISA testing. PCR doesn't detect toxins, but it detects genes responsible for making toxin. One-quarter of *C. difficile* species are non-toxicogenic. The toxins are stable in the refrigerator at 4° C for 60 days. However, Slovis cautioned against storing samples in Styrofoam because it can bind the toxins.

Another protocol tests for glutamate dehydrogenase (GDH), an enzyme produced at high levels with *C. difficile*.

Salmonella. As many as 7-15% of normal horses shed Salmonella. An asymptomatic horse with *Salmonella spp.* might shed 100-200 colonies per gram of feces, whereas a symptomatic carrier sheds 10 million colonies per gram of feces along with exhibiting diarrhea and fever. Postpartum mares typically amplify shedding. One thousand colonies can grow to more than one billion colonies within six to eight hours at 100° F. Slovis said that one fly can carry 6,000 Salmonella bacteria, and maggots in Salmonella-contaminated manure remain Salmonella positive during their four weeks of life. Similarly, mice eat manure and maintain Salmonella positivity in the area.

Studies demonstrated that resistant strains of Salmonella don't decrease long-term survival or increase colic or abnormal feces in hospitalized horses; nor do they increase these risks in herdmates.

Previous recommendations to monitor for Salmonella shedding suggest five negative cultures, but current thinking is that three consecutive negative cultures within a month should be sufficient. Antimicrobial drugs can increase the duration of bacterial shedding. Mare and foal pairs parallel each other's shedding pattern.

Vaccination of a pregnant mare with an oral *S. typhimurium/Newport*-resistant strain done at 9 and 10 months of pregnancy has shown excellent efficacy. This vaccine has a conditional license only in Kentucky at this time. In other states, an equine practitioner can request conditional licensing if anticipating a local problem.

Enterococcus durans. *Enterococcus durans*, previously named *Streptococcus durans*, colonizes the small intestinal mucosal surfaces between 2-10 days of age to cause diarrhea in affected foals. The organism is found in blood, joints and the umbilicus. Slovis suggested

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easy sample acquisition for a PCR test by using a Swiffer on catheter and foaling carts.

Biosecurity practices are essential in all situations dealing with foals. It is important to disinfect foaling kits, and Slovis recommended getting away from leather halters. Dip pans should be used regularly along with new or disposable boot covers for entry into stalls. Hand hygiene is critical using soap and water and/or alcohol sanitizer.

Uveitis—A New Paradigm

Tim Knott, BSC (Hons), BVSc, Cert-Vet Ophthal, MRCVS, of the Equine Eye Clinic in Britain, presented on uveitis at the 2019 BEVA Congress. He described how classic equine recurrent uveitis (ERU) is likely not just a number of recurrent episodes of acute anterior uveitis with periods of quiescence and lack of clinical signs, but rather is a long-term inflammatory process that involves acute episodes. He refers to ERU as a recurrent "acute on chronic" inflammatory disease that includes a "spectrum" of diseases.

Knott divides the spectrum into the following:

- Simple uveitis that has an identifiable cause such as blunt trauma, ocular perforation, corneal infection or systemic disease that damages the blood ocular barrier;
- Complex or syndromic uveitis that is either a) chronic uveitis +/- acute uveitis with an identifiable cause such as leptospirosis, or b) equine autoimmune uveitis (EAU) with no identifiable cause.

He also classifies ERU into these clinical syndromes:

- Type 1 equine autoimmune uveitis (EAU);
- Type 2 chronic uveitis secondary to systemic disease, such as endoparasites or liver abscess;

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- Type 3 chronic uveitis secondary to ocular disease, including leptospirosis or stromal abscess.

Knott remarked that no matter the cause, any horse with uveitis is at risk of developing EAU. He recommended ruling out systemic disease and implementing aggressive anti-inflammatory measures with systemic steroids, NSAIDs and ocular steroids. The blood-ocular barrier can be stabilized with atropine.

Ocular steroids—either topical or subconjunctival—can be used for a month following clinical resolution, but other immunosuppressive treatments can be used. These can include suprachoroidal cyclosporine implants or injection of cyclosporine-like drugs and steroids.

He suggested that intravitreal low-dose gentamycin (4 mg with no preservatives) could be useful for confirmed leptospirosis lesions, but this is still only an experimental treatment. At the 2020 AAEP Convention Table Topic on Ophthalmology, Carol Clark DVM, DACVIM, noted that there have been reports of detached retinas and catastrophic ocular changes following use of intravitreal gentamycin.

In all cases of uveitis, Knott stressed that it is important to protect and support the cornea, which tends to develop problems secondary to uveitis. He likes to use autologous serum and hyaluronate for this purpose.

Concern About Colic with Ocular Atropine

At the 2020 AAEP Convention, questions arose at the Table Topic on Ophthalmology about the use of twice-daily atropine in the eye to manage uveitis. Carol Clark, DVM, DACVIM, and Leslie Easterwood, DVM, emphasized that atropine in the eye is important for healing. It dilates the pupil, decreases the pain from spasms of the ciliary apparatus, decreases vitreous flare and decreases leakage of proteins.

However, there has been a concern about colic with use of ocular atropine.

In many cases, Clark and Easterwood observed that it is not necessarily the atropine that elicits colic but rather the change in management such as locking a horse in a stall and administering NSAIDs. That probably has more to do with colic episodes of a horse being treated for uveitis.

To best manage a horse's confinement, Clark and Easterwood recommended walking the horse at least twice a day.

Studies have not appreciated a reduction in intestinal motility with the use of topical eye atropine. The only caveat is to use it with caution in foals. EM

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Veterinarians noted that cases of colic after administration of ocular atropine might have more to do with changes in management—such as putting a horse in a stall—than with the uveitis treatment.

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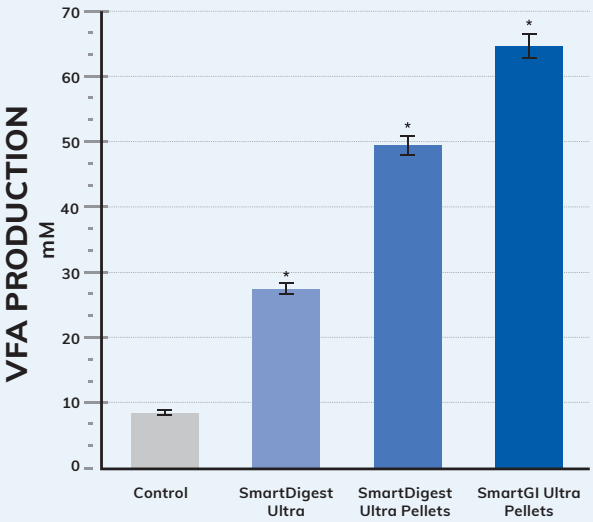

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By Amy L. Grice, VMD, MBA

Keeping Teams Engaged

A thriving practice team generally follows when there is high employee engagement and well-being. Higher engagement leads to higher well-being, and vice versa. Together, they decrease burnout and increase productivity. Clearly, keeping your team engaged is important!

Employee "engagement" is the extent to which employees feel passionate about their jobs, are committed to the organization and put discretionary effort into their work. It is not the same as employee satisfaction. While the two ideas are related—satisfied employees are more likely to be engaged; engagement is a strong indicator of satisfaction—one does not guarantee or replace the other.

Think of engagement as an emotional state where workers feel passionate, energetic and committed toward their work. In turn, they fully invest their best efforts in the work they do.

According to Gallup, 85% of employees globally are either not engaged or are actively disengaged at work, and the management of the business accounts for 70% of the variance in engagement. Those companies that have employee engagement that ranks in the top quartile of engagement have 21% higher profitability than those organizations in the bottom three quartiles. Higher profitability, improved well-being and decreased burnout are the results of increased employee engagement.

Great! But how do you achieve it?

A successful employee engagement strategy is built on communication and trust between employees and employers. Good management is a primary factor. Practice leaders should model the organization's core values, show pride in their teams, encourage professional development and hold every member of their teams accountable.

When an employee is committed to the company's mission, engagement follows. Engaged employees feel valued by the practice and see value in the work they do—they believe in the good work done by the practice and understand how their roles contribute to its success.

ISTOCK

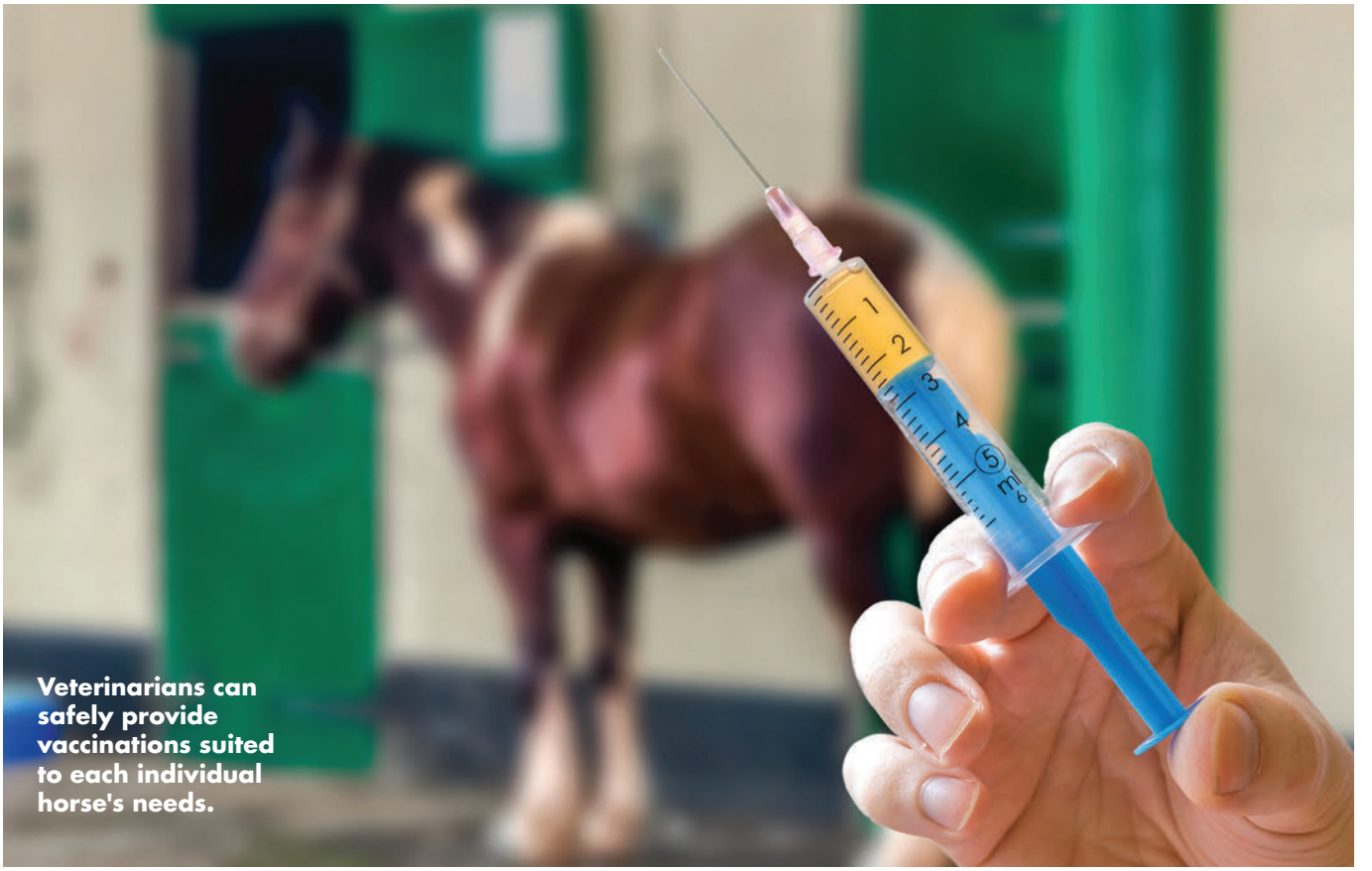
Workers want feedback on their performances, and that influences their level of engagement. Establishing regular review sessions with the team can be an ongoing tool to improve employee engagement. Employees want to know that the practice owners see and appreciate their efforts, so taking the time to acknowledge team members is important.

Practice owners must also show their passion for their work; a positive attitude is contagious. Team members want to follow an inspired leader. Being a part of something bigger than simple commerce encourages engagement. Employees who love horses can be filled with pride in working for a practice that is helping horses with compassion and skill. When practice leaders are burned out, everyone in the practice suffers.

Utilizing employee engagement surveys can help practices understand what is working in their organizations, and it will make employees feel valued. Giving each individual the opportunity to voice an opinion encourages honest, open communication.

Team building activities can be as simple as a volleyball game at a summer picnic for the practice family. What is important is having some time together doing something enjoyable as a group. Belonging is a strong human desire. A practice where employees feel they belong to something special is a practice where engagement is strong.

In summary, practices should live the values of the people, leaders should inspire followers with their passion, and team members should have high-level communication, mutual trust and excellent management. With these things in place, engagement will follow. EM



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Veterinarians can safely provide vaccinations suited to each individual horse's needs.

Vaccination: Vet to Owner

In this article, we look at ways for veterinarians to help horse owners better care for their horses through appropriate vaccination programs.

Brought to you by Boehringer Ingelheim

By Nancy S. Loving, DVM

Helping horse owners keep their equine partners "as healthy as a horse" takes a little strategy and fine-tuning. The life expectancy of many horses has a lot to do with the quality of health care provided throughout their lives, which means a long vet-client-patient association.

An invaluable strategy for a horse's health relies on preventive care, with veterinary immunization programs being a large part of the process of proper wellness care.

In this article, we look at ways for equine veterinarians to help horse owners better understand diseases and vaccines, and offer tips to help owners care for their horses through appropriate vaccination programs.

Communication is important when recommending vaccinations, especially to owners who have horses in areas with year-round biting insects that can transmit diseases.

This article contains information to help veterinarians better communicate the "why," "when" and "how" of equine vaccination.

Feel free to use this *EquiManagement* article for owner education, courtesy of Boehringer Ingelheim.

Core Vaccines

Core vaccines are recommended by the American Association of Equine Practitioners (AAEP) to be given annually to all horses, no matter their geographical

ISTOCK/ALINA

All horses should have the AAEP-recommended core vaccines.

area. Core vaccines include protection against:

- Eastern and Western equine encephalitis (EEE and WEE, aka sleeping sickness)
- Tetanus
- West Nile virus (WNV)
- Rabies

A key point to bring up to horse owners is that available vaccine products to immunize against these devastating diseases have high efficacy with minimal risk of adverse reactions.

Other than rabies, none of the core diseases are communicable between horses or from horses to people. Most core vaccines are manufactured using inactivated or "killed" antigens, meaning the virus is not able to create disease or spread it between horses. West Nile virus vaccine has a number of different recombinant forms besides the killed version, but none use live virus.

Vaccine Administration

Owners must understand that vaccines for horses need boosters. Many vaccines are started when a foal is 4 to 6 months of age. The vaccines often are given as a "primary" series of two injections spaced four to six weeks apart, and a third injection given at 10-12 months of age. If a dam was not immunized prior to foaling, a third injection might be given eight weeks after the second injection, or sooner if in the midst of mosquito season.

Generally, protection is not conferred until a couple of weeks following the second vaccine dose. A booster is given annually, although it might be given twice a year in areas with endemic disease problems—such as West Nile virus or encephalitis—in areas of the country that experience a lengthy mosquito season.

Mosquito-Borne Viruses: EEE and WNV

Mosquitoes serve as vectors for Eastern (EEE) and Western (WEE) forms of equine encephalomyelitis as well as West Nile virus (WNV). The best efficacy of these vaccines lasts for five to six months, although many products are labeled as protective for a year. For maximum protection, immunize against EEE, WEE and WNV at least two to four weeks prior to the onset of mosquito season. Mosquito hatching varies between geographic locales, so veterinarians should discuss with owners the best time to schedule a horse's spring and/or fall vaccines. In warm climates without a winter freeze, it might be best to boost twice a year against these mosquito-borne viruses.

Transmission of EEE and WNV is simple: Mosquitoes bite birds carrying the virus, then those carrier mosquitoes bite a horse (or human). People and horses are considered "dead-end hosts" because they don't have enough infective virus in their bloodstreams for transfer of infection to mosquitoes or to another animal. Immunizations are a primary line of defense against mosquito-borne disease, but other control measures minimize exposure, particularly environmental management against insects.

Equine veterinarians should counsel

ARND BRONKHORST PHOTOGRAPHY

Prevention through vaccination is the best way to avoid respiratory illness.

horse owners about mosquito control on their properties.

Tetanus

The organisms that create tetanus—caused by *Clostridium tetani*—are always present in a horse's environment. *Clostridium tetani* bacteria form spores that reside in the soil, the horse's intestinal tract and in feces. *Clostridium tetani* spores can enter any open wound, incision, the umbilicus of foals or a retained placenta from a postpartum mare. Once the spores enter a wound—even the smallest, seemingly insignificant puncture—they proliferate and excrete a neurotoxin that causes tetanus signs.

Vaccination against tetanus usually is included with the annual spring immunizations. Veterinarians should advise owners that a tetanus booster is recommended for a horse that incurs a wound or is undergoing surgery. This disease is not contagious between horses.

Rabies

Horses live outside at least part of the day or night with ample opportunity to encounter wildlife. Wildlife interactions account for 93% of rabies cases each year, with raccoons foremost, followed by bats, skunks, foxes and coyotes. Usually a bite cannot be identified on a horse that has been bitten by a rabid wild animal, and in many cases a rabid horse exhibits non-specific signs.

Rabies is preventable, which is important because there is risk of zoonotic infection from an infected horse to people. Equine rabies vaccine is started after 4 months of age and boosted annually at either the spring or fall vaccine visit. Available rabies vaccines for horses are 100% effective and quite safe.

Risk-Based Vaccines: Respiratory

Just as core vaccines are given as a primary series of two to three injections, most risk-based vaccines follow similar schedule protocols. Risk-based vaccines are just that—they should be given if there is a risk of the horse being exposed to the causative agent as advised by a veterinarian familiar with your area.

Boosters are given once or twice a year, depending on the product and the local risk of exposure. This is where veterinary counseling becomes paramount to protecting horses.

Both spring and fall vet visits should include vaccination boosters for common risk-based diseases, namely against the respiratory viruses equine influenza virus (EIV) and equine rhinopneumonitis virus (herpesvirus or EHV-1/4). Sickness from EIV or EHV leads to time lost in training and competition in addition to the potential for a horse to develop pneumonia or chronic respiratory problems, such as equine asthma. Prevention through vaccination is the best approach to avoid respiratory illness.

Immunity from respiratory vaccines persists for about four to six months. Vetes need to emphasize to owners that twice-annual boosters against EIV and EHV-1/4 are especially important for horses that travel to clinics, competitions or trail rides where they mingle with horses from other areas.

ARND BRONKHORST PHOTOGRAPHY

Owners need to understand that horses infected with influenza virus are contagious even before showing clinical signs or developing fever.

Horse owners need to understand that horses infected with equine influenza virus are contagious *even before showing clinical signs* of fever, cough or nasal discharge. Transmission is by aerosolized droplets expelled by coughing that can expose horses up to 165 feet away.

Herpesvirus (EHV-1 and EHV-4) usually infects horses at an early age, with estimates that 80-90% of the horse population have encountered herpesvirus exposure before the age of 2. Herpesviral presence persists for the life of a horse following an initial infection.

EHV-1 undergoes a period of latency during which time an affected horse shows no clinical signs of infection, yet still can actively shed virus.

Educate owners that EHV-1 is highly infectious and transmissible through fomites (objects or materials likely to carry infection), aerosols, an aborted fetus or placental parts, or through direct horse-to-horse contact.

The equine herpesvirus vaccine for EHV-1 and EHV-4 does not protect against the neurologic form of equine herpesvirus myeloencephalopathy (EHM); it only confers immunity against respiratory and abortigenic forms.

Note that the AAEP advises that "repeated vaccination against EHV-1 appears to reduce the frequency and severity of disease and limits the occurrence of abortion storms."

Both EIV and EHV immunizations administered by veterinarians are required at six-month intervals to participate in USEF (United States Equestrian Federation) shows, while the FEI (Fédération Équestre Internationale) requires proof of annual influenza vaccination following the initial series protocol.

For horses that travel away from the farm and those in active competition or breeding ventures, respiratory viral vaccines are highly recommended along with good biosecurity measures to protect resident horses on the farm. Remind owners that it is good practice to boost immunity for respiratory viruses for horses that don't leave the farm. Traveling horses might show no clinical signs of respiratory disease upon return home, yet could carry a virus that is infective to resident horses that have less robust immunity.

And of course remind owners that if

immunized horses do contract disease, the seriousness and duration are much reduced in vaccinated horses compared to the circumstances if they had not been immunized.

To confer the best herd immunity, all horses on the farm should be immunized on a similar schedule. The concept of herd immunity is best described as "the resistance to the spread of a contagious disease within a population that results if a sufficiently high proportion of individuals are immune to the disease, especially through vaccination."

The more horses that develop protective antibodies to a disease, the less chance of horses shedding infective organisms. This lessens the chance of an outbreak.

Equine Strangles

Strangles (*Streptococcus equi*) is a risk-based respiratory disease for which there is an intranasal vaccine. Strangles vaccine tends to only be used in high-risk situations due to the potential for complications from the modified live virus intranasal vaccine that can cause abscesses in other parts of the body. It is best given following administration of other injectable vaccines or on a separate occasion. In high-risk areas, horses might need to be immunized twice a year against *Streptococcus equi*.

Other Risk-Based Vaccines

Potomac horse fever (PHF, caused by *Neorickettsia risticii*) is a serious diarrheal disease that occurs in horses in some parts of the country. The vaccination against PHF usually is given in late summer or fall due to the seasonal nature of this disease correlated with the hatch of aquatic insects.

Botulism develops from a soil-borne, spore-producing bacterium, *Clostridium botulinum*, which produces a potent neurotoxin that blocks transmission of nerve impulses to muscles. This results in progressive weakness leading to flaccid paralysis, poor tongue tone and a notable inability to swallow. Mortality is high in affected individuals that don't receive supportive treatment; even with treatment, mortality runs about 50%.

A horse or foal can acquire botulism in three ways:

1. Types A and B—infection through contaminated wounds;
2. Types A and B—vegetation of ingested spores in the intestinal tract to elicit Shaker Foal syndrome;
3. Type C—ingestion of decaying plant material or animal carcass remains that causes the horse to develop forage poisoning.

Type B botulin toxoid is the only vaccine available for horses of any age. Because foals are at a high risk, pregnant mares should be immunized in advance of foaling. Foals in areas endemic for botulism are also given botulin type B toxoid at 2, 4 and 8 weeks of age even if the mare was immunized prior to the foal's birth.

Anthrax (*Bacillus anthracis*) spores remain dormant in soil, especially alkaline soil, for years. The spores proliferate if ingested or inhaled, if they contaminate wounds or are injected through insect bites. Ingestion of long-dormant spores occurs following heavy rain that moves spores through the soil onto grazed grasses or during drought conditions when grasses are cropped close to the soil. Ingestion is the most common route of infection, which causes septicemia that rapidly progresses to a high fatality rate within two to four days. Clinical signs include high fever, breathing difficulty, swelling of the chest and underside of the neck, lethargy, poor appetite, bloody diarrhea, colic and seizures.

Anthrax vaccine is recommended only for horses living in areas known to harbor anthrax spores. This disease is transmissible to humans, so it is a reportable disease through the state's veterinary animal health department.

Other risk-based vaccines include **equine viral arteritis** (EVA), **Leptospirosis**, **rotavirus** diarrhea vaccine and **snakebite** vaccine. These vaccines are not commonly used and are only administered by a veterinarian when the risk of not immunizing is weighed against the benefit of having protection.

Why Get Your Vet Involved in Immunizations?

Many horse owners need to be reminded of the reasons it is best to have a veterinarian involved in equine immunizations. These include:

- The vaccine source is reputable.
- The vaccine has been handled properly and kept at proper temperatures during multiple transfers from manufacturer to distributor to the veterinarian's office to your horse.
- The vaccine is not outdated.
- The choice of vaccines is the most appropriate for your unique geographic location and competition pursuits.
- When your vet administers immunizations, she/he also checks for anything "off kilter" with your horse through a visual and physical exam. This helps to identify subtle and not-so-subtle health problems.
- Vaccines ordered online come from bulk purchases with no guarantee that the product has been handled correctly at all times.
- Online pharmacies also do not provide counsel or help in the event of an adverse reaction, but your veterinarian will.
- Safe techniques used by your vet for administering vaccines incur the least risk to your horse and protect you from being injured by a horse that objects to a needle. Even with excellent injection technique and proper handling of vaccines, transient side effects—muscle soreness, fever, malaise or an uncommon post-injection abscess—can occur. Transient adverse reactions are usually a consequence of a horse's immune response to an antigen (protein) or from reaction to the adjuvant (carrier agent) in individual

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Veterinarians should encourage owners to discuss an appropriate vaccination program for each horse.

vaccines; some vaccine products are more reactive than others.

- Adverse post-vaccination signs usually resolve within 48-72 hours. Use of the purest vaccine products results in fewer than 2% of horses reacting. Veterinarians have knowledge of which manufacturers produce vaccines with the least likelihood of adverse reactions.

Let owners know that if their horses develop adverse reactions following immunization, they should advise you as soon as possible, and the veterinarian should note that in his/her records to prepare the horse and owner in advance of the next booster.

Another product made by a different manufacturer can be used and/or the horse pre-medicated with NSAIDs (phenylbutazone or flunixin) prior to immunizing to avoid some minor injection-site reactions.

For some sensitive individuals, the various vaccines can be separated into individual shots or they can be given at different times rather than immunizing with multiple vaccine products all at one vet visit.

Another important point to help horse owners understand the importance of having a veterinarian involved with immunization administration has to do with insurance.

If your horse is insured and you administer any medication, including vaccines, that induces a health problem or a life-threatening or fatal anaphylactic reaction, the insurance company might not honor your insurance claim.

The Bottom Line

Veterinarian and horse owner communities are fortunate that so many effective vaccines are available to combat a large number of infectious viral and bacterial diseases that could otherwise decimate the horse population. Most equine immunizations are relatively low in price, especially when compared to the cost of treating an infection or losing a horse to a fatal infectious disease.

Veterinarians should encourage horse owners to discuss an appropriate vaccination program with them and set up an immunization frequency that works for that client's situation. Prevention through immunization is a far better cost-saving strategy than not vaccinating, and it confers health advantages for your horse, adding to his longevity. EM

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A proper dental exam is critical to the evaluation, diagnosis and treatment of equine dental concerns.

Equine Dentistry Update

Modern equine dentistry has advanced the veterinarian's ability to address dental issues in a safe and humane manner.

By Nancy S. Loving, DVM

A proper dental exam is critical to the diagnosis and treatment of equine dental health. Advances in dental equipment have enabled better visualization of structures within the mouth through the use of high-definition oroscopy and small-diameter flexible scopes. The use of specialized motorized and battery-operated equipment with smaller sizes and lower weights facilitates use of motorized tools for dental maintenance and repair.

The use of newer techniques in dental radiology allows for increasingly accurate diagnoses. Rather than waiting for a horse to show signs of a clinical problem, a proactive approach to dentistry enables early diagnosis of problems as well as implementation of prophylaxis to avert ongoing tooth degeneration.

At a 2020 AAEP Convention Dentistry Round Table, Travis Henry, DVM, DAVDC, NSS, DAVDC Eq, described five essentials of a thorough dental exam:

1. Extra-oral findings of the head, such as nasal discharge, enlarged mandible, bony swelling and eye drainage
2. Oral soft tissues such as the tongue and lymph nodes
3. Periodontal status, including gingival abscess, diastema malformation or non-abutting teeth
4. Endodontic status examining internal components of each tooth
5. Occlusion status

Heather Hoyns, DVM, of Evergreen Equine in Redding, Vermont, suggested that an equine vet needs to use good sedation, an oral speculum, an effective headlamp or spec light, and a dental mirror to conduct a complete oral exam. He/she should look for tooth fracture or split, caries, diastema, extra teeth or other dental abnormalities. Increasingly, the use of an oral endoscope is being used.

Henry recommended using a mirror to look at the buccal side of teeth for bleeding, recession, feed packing and slope. Because the lingual side of the rear mandibular molars is difficult to see due to tongue interference, it is best to sedate and use a mirror or scope. He advised palpating every interdental space look-

ARND BRONKHORST PHOTOGRAPHY

Keeping good dental records can assist in doing a better job at annual exam time.

ing for unerupted teeth, displaced teeth, masses, lumps or swellings.

Understanding of the intricacies of structures within the mouth is essential to evaluation and diagnosis. Periodontium has a particular structure and function, and current studies have identified a rich blood supply that aids in repair and regeneration. The gingiva wraps around the top of bone with tight attachments—disruption of the attachment can lead to bone loss.

Periodontal ligaments are present in the gap between alveolar bone and cementum of each external tooth. Cementum fulfills several functions: a) holds a tooth within the alveolus; b) withstands masticatory forces; and c) allows for continual eruption of hypsodont teeth. (Hypsodont teeth have a high crown and enamel extending past the gum line to provide extra material for wear.)

Periodontal disease is reported to be the most painful mouth malady and can occur in up to 60% of horses older than 15 years [Casey, M.A. New Understanding of Oral and Dental Pathology of the Equine Cheek Teeth. *Vet Clin Equine* 29 (2013) 301–324; http://dx.doi.org/10.1016/j.cveq.2013.04.010].

Caries

Metabolism of dietary carbohydrates (grains and high-fructan grasses) and acid-containing forage components produce acids that might dissolve mineralized tooth tissues to form dental caries, especially of molar teeth. Cementum lines the periphery of all teeth and the infundibulae of cheek teeth, especially the maxillary (upper) cheek teeth. Even in conditions with less acid, cementum is more readily demineralized due to its low mineral content.

One thought is that caudal cheek teeth are more prone to dental caries due to longer duration of food content in the back of the mouth along with adherence of small particles to tooth surfaces. Saliva, with its basic pH-buffering capacity, tends to collect more in the front of the mouth, where salivary ducts are position behind the lower incisors and in the cheek lateral to the mid-upper arcade. More saliva is generated by eating hay compared to consuming a pelleted feed, grain or concentrate.

Use of non-water-cooled equipment or techniques can lead to necrosis in the pulp cavity (see below) due to adverse effects on blood supply, or a badly infected tooth might develop pulpitis and decay. With advancing dental techniques, an injured tooth can receive a form of root canal to clean out the pulp cavity. Then the veterinarian can pack and cap it with appropriate dental materials. This might need to be repeated every year or two as a horse's teeth continue to erupt until old age. In unusual cases, it is reported that a diseased tooth can be removed, the pulp cavity cleaned and the tooth re-implanted into its original location.

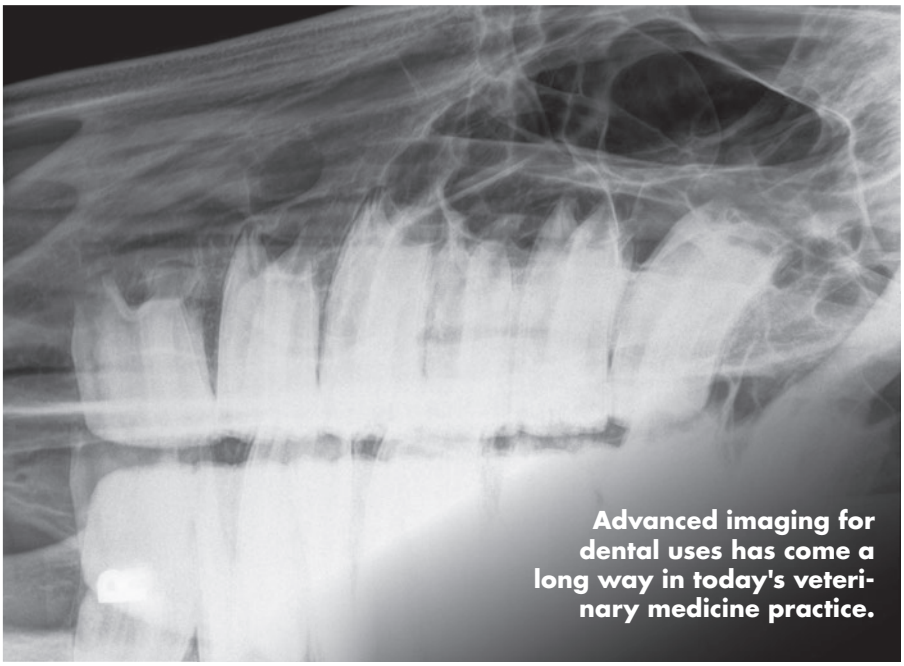
Fractures

Fissure fractures could provide an entry for bacterial invasion of pulp tissue, with a prevalence as high as 72% in some studies. Forces of mastication diminish with advancing age, yet aging horses have an increased incidence of fissure fractures. Dental fissure fractures are categorized into three distinct types. Type 1B has the greatest likelihood of forming a full slab fracture. Type 1A or Type 2 might develop enough depth to facilitate bacterial infection of pulp tissues and tooth disease.

Some small breaks in teeth can be repaired with resins and amalgams used in human dentistry. Then, as the tooth continues to erupt, the small fracture might simply "grow out." Large defects can benefit from caps or crowns.

Diastema

Cheek teeth within a normal mouth are packed together tightly with no spaces in between. However, a small pocket can form as a gap at the gum line to form a pocket diastema with age-related



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Advanced imaging for dental uses has come a long way in today's veterinary medicine practice.

reduction in coronal cross-sectional area, reserve crown length, injury, an inadequate cheek tooth angle or teeth that are too far apart.

Henry described the formation and consequences of diastema: Food entrapped in a slim opening (diastema) allows food to enter and impact between cheek teeth. Bacteria and fermentation create acid production with resultant inflammation, gingival ulceration, necrosis and potential cemental destruction.

The slim occlusal opening of a "valve diastema" works like a one-way valve as maxillary teeth chew. It is widest at or below the gingival margin and narrowest at the occlusal level, unlike an open diastema that is of similar width in both locations. Food gets crammed into spaces, resulting in discomfort and halitosis.

Diastema tends to develop more commonly between caudal mandibular teeth. Hoyns noted that "Occlusal surfaces of the teeth may touch each other, but a gap at the gum line allows packing of food. At times, occlusal surfaces don't quite touch due to the presence of an opposing high tooth or with irregular wear."

An acquired malocclusion can result from tooth version (shifting or displacement) that necessitates tooth extraction so other teeth can drift toward the gap. Supernumery teeth might cause formation of a diastema, as can tooth loss with resultant drift. In geriatric horses, narrowing toward the root, especially along the palatal edge of upper teeth, allows a gap to form.

"Loss of interproximal cementum caused by peripheral caries may physically predispose to the formation of diastema," noted an article in the *Equine Veterinary Journal*. "Conversely, it has also been suggested that periodontal disease caused by diastema may lead to dysbiosis and thus a higher propensity for cariogenic microorganisms in the adjacent environment" [Barnett, T.P. Clinical Insights: Equine Dentistry. *Equine Veterinary Journal* 2019, vol 51, pp. 277-279; DOI: 10.1111/evj.13083].

Computed tomography correlates well with diagnosis of periapical infection, with 97% corroboration of gross and histopathological findings. This compares to identification of 53% of apical infection issues with radiography—root fragmentation, intrapulpar gas, irregular pulp horn margins and heterogeneous pulp tissue density.

"Teeth are mobile, and as they erupt, roots of front cheek teeth tend to push teeth distally (caudally) while caudal (distal) teeth roots push forward and toward the midline of the face," observed Hoyns. "Then the occlusal surface acts as one big tooth."

Treatment of diastema is approached from several approaches:

- Float to decrease the overly long occlusal transverse ridges of opposing teeth.
- Decrease the crown of affected and opposite teeth.
- Mechanically widen the diastema to decrease accumulation of material. Channel from the chewing surface to outside 4-5 mm depth or straight down between teeth. This is especially useful with a narrow mouth or leaning teeth.
- Research by Manfred Stoll, DVM, FNCED, Dipl. EVDC, suggested that instead of opening a whole space, only open the distal (i.e., caudal) area by burring a little bit off the leading edge. Then, the natural mobility of teeth allows closure of the space without having to remove excess tooth. Check in three to six months and tweak accordingly.
- Mouth rinses and local therapy with dilute chlorhexidine a couple times a week are helpful, especially for geriatric horses.
- Diet modification to decrease roughage that more readily packs in diastemas.
- Advanced cases might need extraction of one or both teeth.

EOTRH

Equine odontoclastic tooth resorption and hypercementosis (EOTRH) occurs mostly on the incisors, sometimes the canines, and rarely on the second premolars. (Canine teeth might develop plaque accumulation, particularly on the lower mandible, to result in resorptive lesions.)

EOTRH tends to come on slowly. Incisors in the upper jaw seem more affected than incisors in the lower jaw.

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The proper use of power dental tools has improved the veterinarian's ability to more skillfully address equine dental issues.

Hoyns explains that the etiology of EOTRH is still under investigation: "The incisors loosen, roots are exposed and painful teeth lead to reduced food intake. The first thing often noticed is that a horse is reluctant to bite a carrot or eat from a hay net. Tartar accumulations are visible on teeth, exposed roots and around gums. The gums are inflamed and often ridged with lumps over the roots rather than having a normal smooth appearance. Tiny gum abscesses also might be present over the roots."

Hoyns urged, "If the horse is long in the tooth, i.e., older, and you see root exposure, think EOTRH."

EOTRH involves two processes: resorptive lesions and inflammation of surrounding periodontal tissues, ligament and alveolar bone occurring at the same time there is an attempt at repair with cementum deposition at the reserve crown. One form of EOTRH is referred to as "external replacement resorption," which involves gradual disappearance of the periodontal space with progressive replacement of root tissues with alveolar bone. The other form is "external inflammatory resorption," which results in loss of dental tissues (such as disintegrating roots) along with adjacent alveolar bone [Barnett, T.P. Clinical Insights: Equine Dentistry. *Equine Veterinary Journal* 2019, vol 51, pp. 277-279; DOI: 10.1111/evj.13083].

A German study identified incisor resorption in "all" horses over age 14, although many are asymptomatic. The most accurate means of identifying this problem is via radiography of occlusal and apical areas to evaluate bone loss and to identify gingivitis and periodontitis.

Another study yielded sobering results: 88.2% of asymptomatic horses were diagnosed with incisor resorption via radiography while 20.7% had signs of hypercementosis.

EOTRH is diagnosed via radiographs by seeing:

- Hypercementotic roots—large and bulbous, look corrugated
- Disintegrating roots appear mottled.

Early diagnosis can mitigate inflammation and possibly slow progression of this form of EOTRH.

Hoyns reported that the solution is to remove the diseased teeth. Usually within 48 hours, the horse is eating better.

"Expect the gum to ooze blood for a few days, and leave the clot alone," he said. "The resulting large extraction site will slowly granulate in. Despite the loss of incisors, horses learn to graze with their lips."

One downside to alert the owner about: Sometimes the tongue tip hangs out in the absence of incisors to block it.

Extraction

Historically, extraction of a tooth required general anesthesia for the difficult task of hammering the tooth out with brute force. Currently, equine dental extractions are performed in the sedated, standing horse: "Careful periodontal tissue separation in a mesial to distal direction has replaced the brute force of the past, using interdental spreading of the tissues and careful sustained rotational forces on the tooth within the alveolus" [Barnett, T.P. Clinical Insights: Equine Dentistry. *Equine Veterinary Journal* 2019, vol 51, pp. 277-279; DOI: 10.1111/evj.13083].

For teeth with poor crown integrity, the best suggestion is a partial coronectomy to "facilitate interdental spreading at a more apical position" to improve tooth mobility for extraction.

Extraction carries its own set of problems, such as overgrowth of the opposing tooth due to an absence of on-going wear. The horse will require regular dental care for reduction of such tooth overgrowth for the rest of its life. Another problem is if food material continually packs in the large gap. Surrounding teeth tend to migrate to compensate for the gap and could result in a narrow diastema. Monitoring is important.

Odontoplasty

Hoyns observed, "For routine odontoplasty, we've come a long way from using hand floats, especially with the advent of new power equipment, which is effective in the properly trained hands of a veterinarian. When used appropriately, power tools can be precise and achieve a better outcome for horse, owner and veterinarian."

If a horse has a normal mouth with no dental pathology, it might be appropriate to remove sharp edge points. The upper jaw is wider, so points usually occur on the upper (buccal) outer and lower

(lingual) inner teeth; it is important to identify if points exist in unexpected places.

"Power floating puts a schmear layer to seal over microscopic damage to protect teeth," said Hoyns.

Hoyns remarked that a horse needs some dental edges for chewing to break down forage. "Don't take off so much that it is difficult for a horse to eat or break down fiber—this is a case when 'less is more.' " Removal of excess tooth develops a "Chicklet mouth," which is an abnormally smooth mouth that makes it difficult for the horse to chew, she said. Removal of too much tooth can result in damage to the pulp cavity.

Bit Seats and Wolf Teeth

Bit seats are now passé and no longer recommended, said Hoyns. "Historically, it was thought that the bit may pull tissue against the first cheek tooth, especially in some horses with excessive tissue in their mouths," explained Hoyns. "The horse tosses its head, resists the bridle and may develop bruising. That said, the bit should not fit against the teeth in the first place."

She explained that bit seats were performed by removal of a large amount of the mesial portion of lower premolar 2, but this potentially opens into the pulp and could create problems. "It is better to check for sharp edges at premolar 2 rather than to burr away the tooth," she advised.

"Wolf teeth do not necessarily need to be taken out. For an older horse that is performing well, it is fine to leave them," added Hoyns.

Water Cooling

Dental procedures rely on hand and motorized tools to address each tooth and surrounding tissue. Equipment advances combine high- and low-speed drills with suction, as well as air or water flushing, to facilitate procedures and maintain good visualization.

Jon Gieche, DVM, FAVD Eq, AVDC Eq, of Kettle Moraine Equine Hospital in Wisconsin, gave a presentation that was hosted by Horse Dental Equipment during the 2020 AAEP Convention to explain the importance using water cooling for dental procedures.

Gieche emphasized that water cooling is critical to maintain safe tissue temperatures for odontoplasty, sectioning and diastema treatment when using high-speed hand-held dental equipment. Studies have demonstrated significant effects from overheating and thermal damage of dental tissues:

- Increase in pulpar temp by 3.3° C leads to reversible changes.
- Increase 5° C leads to pulpitis or pulpar necrosis in 15% of teeth [Zach, L.; Cohen, L. Pulp response to externally applied heat. *Oral Surgery* 19, 515-530].
- Without water cooling, 30 seconds of procedures increase thermal insult to 5.5° C in 20% of teeth, which results in an irreversible pulpal necrosis rate of 3%.
- Increase of >16.1° C leads to pulpar necrosis in all teeth.
- Odontoplasty of 30 seconds with removal of 5 mm of dental tissue results in excess pulpal heat 20% of the time [EVJ 2018, vol 45, 355-360].

Gieche's recommendation is to restrict the thermal load to <5.5° C, but even better is to maintain temperature <3.3° C to mitigate risk of any damage. He also suggested waiting three to six months to rework a patient's dentition following the initial procedure. Water cooling is also recommended for work on incisors, with the same precautions followed to not exceed the thermal threshold and to pay attention to contact time with each tooth.

Time, pressure and coarseness of abrasive correlate to heat generation. A tooth doesn't cool down as fast as it heats up [Jacobs, Thompson, Brown. Heat transfer in teeth. *J Dental Res* 1973, vol. 52, 243-252]. Thermal damage results in pain and potential death

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of a tooth, resulting in the potential need for root canal or extraction.

The use of water cooling decreases the risk of thermal risk by a factor of 7, stressed Gieche. Water cooling also offers these additional benefits:

- Improves visibility
- Decreases suspended dental dust produced during odontoplasty
- Increases lubrication to a) decrease soft tissue damage; b) increase instrument maneuverability; c) decrease digital clutch activation of equipment thereby increasing safety and efficiency; d) improve burr/disc efficiency by keeping the burr clean; and e) increases lifetime longevity of the disc

To give one a gauge of how much tooth can be removed with odontoplasty, Gieche related the depth of tooth removal to the depth of a US penny:

- Two pennies = 3 mm thickness
- Three pennies = 4.5 mm thickness

He stresses that floating (odontoplasty) should be limited to removal of no more than 3-4 mm. (Normally, horses wear their teeth by 2-3 mm/year until no more tooth erupts.) If power tools are used without water, then he advised limiting contact time to one spot for <15 seconds, use a sharp burr, and keep hands moving.

Hoyns emphasized the importance of proper dentistry training to avoid excess grinding.

It is important to deliver a controlled amount of water while actively performing a procedure on a site. Distilled water is best for the equipment. Ideally, equipment should have a separate water control with an appropriate and adjustable volume, as well as a main power on/off switch. Take care to avoid applying too much water, as that could result in aspiration. When the volume of water is adjusted correctly, it will drain from the mouth without ongoing repositioning of the patient. If necessary, drop the horse's head out of the stand or halter to let the mouth drain.

Excess water has the potential to contribute to clinician discomfort in winter climates, along with posing safety hazards from a wet and slippery floor. In cold climates, water can be warmed before putting it in the water backpack.

Gieche stressed the importance of wearing a PPE mask and glasses to decrease inhalation of dental debris and bacteria. Ear protection and eye protection (providing it doesn't fog up) are also invaluable when using power dental tools.

Nerve Blocks, Sedation and Pain Relief

Advances in equine dentistry have led to less invasive surgical techniques and the advent of more standing procedures without the need for general anesthesia. Horses need pain relief for removal of teeth and for other pain-inducing manipulations within the mouth.

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Modern equine dentistry allows a veterinarian to address dental issues in a safe and humane manner.

Hoyns noted that regional nerve blocks are increasingly used in equine dentistry. Sedation (such as with dormosedan) acts somewhat on pain, but it is often necessary to perform additional nerve blocks, especially for extractions.

Examples of some popular nerve blocks:

- Mental foramen blocks in the lower jaw numb incisors and part of canines.
- Mandibular blocks work on lower cheek teeth, canines and incisors. Hoyns advised not to anesthetize both sides at the same time, because the horse might then lacerate its tongue.
- Infraorbital blocks address the upper incisors, but some horses are extremely resistant to administration in this area even if sedated.
- Maxillary blocks, as described in *Equine Dentistry* (3rd edition by Easly, Dixon, Schumacher), block the upper cheek teeth, canines and incisors. Hoyns said she found these useful for extraction of upper incisors in horses that are resistant to an infraorbital block.
- Wolf teeth or gum procedures can be addressed with local anesthetic infusion. Often local anesthesia is used in conjunction with nerve blocks.

To avoid repeated intravenous injections for lengthy procedures, Hoyns discussed use of a continuous-rate infusion of sedation via a catheter and an IV drip of dormosedan with or without butorphanol.

"Pre-medicate with dormosedan + butorphanol +/- flunixin, then put 5 cc dormosedan into ½-liter bag (or 10 cc into 1-liter bag). This can run over 30-90 minutes, depending on the horse and the procedure."

She reminded the veterinary audience that despite sedation and the resultant degree of unsteadiness, a horse often still throws its head.

"Stocks are great to use when possible not only because everything is on hand, but it also safely restrains the horse to achieve the most efficiency for procedures," said Hoyns.

Take-Home Message

Modern equine dentistry has advanced the ability of the equine veterinarian to address dental issues in a safe and humane manner for the horse and the practitioner. Veterinarians should seek continuing education on new techniques that provide improved diagnostics and treatments for equine dental issues. EM

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EPM Update from VMX

New information on EPM was presented at the VMX by Dr. Nicola Pusterla.

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By Nancy S. Loving, DVM

Dr. Nicola Pusterla

The focus on equine protozoal myelitis (EPM) has subsided over the past several years, but in some regions of the country, it is still a pressing concern. New information brings to light some key facts to help guide diagnosis and management of this protozoal disease. Nicola Pusterla, PhD, DACVIM, AVDC-Eq, of the University of California, Davis, presented a webinar (sponsored by Merck Animal Health) during the 2021 VMX (Veterinary Meeting and Expo put on by the North American Veterinary Community) to discuss new findings. In this article, we'll summarize some of the research findings from Pusterla's webinar as well as personal communications.

Most horses in North America have been exposed to *Sarcocystis neurona* and will have a positive serum titer even if not actually infected. Seroprevalence of *S. neurona* is 78% while seroprevalence of *Neospora hughesi* is 34%. Pusterla emphasized that if a CSF tap is negative despite positive serology, then the horse is not infected with EPM or could be in the very early stages of infection. However, a positive CSF tap correlates with EPM provided there is not blood contamination of the tap or diffusion of antibodies across the blood-brain barrier. He cites a normal serum:CSF antibody ratio of 130:1 to 250:1.

A new revelation showed that *Toxoplasma gondii* might be another causative agent of EPM. This organism poses a potential public health hazard leading to abortion and ocular disease. A study of 210 serum and CSF samples from horses suspected of having EPM looked at IFAT (immunofluorescent antibody testing) results. A serum:CSF ratio ≤64 is considered positive. Incidence of *T. gondii* in this study was 7.1%. Warmblood breeds have a higher association with this parasite, possibly due to environmental issues and barn cats, which are the definitive host.

If routine diagnostic testing doesn't support antigen evidence in cases of clinical suspicion of EPM, an additional qPCR test for *S. neurona*, *N. hughesi*, and *T. gondii* can be valuable. Pusterla cautions that horses with a history of antiprotozoal treatment are more likely to test negative for *S. neurona* on qPCR of CSF.

Several studies evaluated prophylactic/metaphylactic treatment using daily diclazuril (Protazil 1.56% by Merck) at 0.5 mg/kg. Foals and controls were started in the study at one month of age. After one year, 88% of untreated foals tested positive for EPM compared to 6% of treated foals.

While there is a concern that low-dose treatment could stimulate parasitic resistance, this is a minimal risk because the horse is a dead-end host. With this in mind, another study looked at use of diclazuril at 0.5 mg/kg every three to four days for 12 months in 20 horses in areas with high exposure rates. The horses were assessed clinically each day and tested monthly with serology for *S. neurona* and for trough diclazuril levels. Low-dose treatment reduced the numbers of serum-positive horses; diclazuril levels remained in excess of the mean inhibitory concentration (MIC) to inhibit *S. neurona*. This regimen uses 75% less diclazuril than a 28-day regular course of treatment, so a horse can be treated for 28 weeks at a similar cost to the daily treatment regimen. EM

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[1] Hunyadi L, Papich MG, Pusterla N. Pharmacokinetics of a low-dose and DA-labeled dose of diclazuril administered orally as a pelleted top dressing in adult horses. *J of Vet Pharmacology and Therapeutics* (accepted) 2014, doi: 10.111/jvp.12176. The correlation between pharmacokinetic data and clinical effectiveness is unknown

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EMS and Adipose Tissue

Researchers encouraged owner education about unhealthy obese adipose tissue.

By Nancy S. Loving, DVM

Research continues to advance our understanding of metabolic problems in horses. Equine metabolic syndrome (EMS) is known for its multiple risk factors for laminitis due to insulin dysregulation, genetic predisposition and obesity.

A Scottish study looked at the response of adipose tissue to excessive calorie intake. Internal adipose tissue—visceral and retroperitoneal—appears to experience the strongest pathologic disruptions [Reynolds, A.; Keen, J.A.A.; Fordham, T.; and Morgan, R.A. Adipose tissue dysfunction in obese horses with equine metabolic syndrome. *Equine Veterinary Journal* Nov 2019, vol 51 (6); pp. 760-766; doi: 10.1111/evj.13097].

EMS horses (n=6) used in the study were older than 2 years with a body condition score >4/5, fasting basal insulin >20 ml U/L, current or history of laminitis, plasma ACTH within the seasonal reference range and pituitary histologic score <3/5. Healthy horses (n=9) had body condition <4/5 and had no clinical or laboratory signs of insulin dysfunction; nor had they been treated with glucocorticoids in the previous three months. All horses selected for the study, including the "healthy" controls, were destined for euthanasia. Samples of peri-renal and retroperitoneal fat were taken at necropsy. Due to the difficulty in obtaining a representative sample of subcutaneous nuchal crest and rump fat, the researchers on this project chose to evaluate visceral and retroperitoneal depots. Internal adipose deposits not only are consistently present in lean and fat horses but also expand rapidly in obese individuals.

Adipocyte size and hypertrophy occur with excess calorie intake and these characteristics are associated with insulin resistance and dyslipidemia in humans. EMS horses experienced marked adipocyte hypertrophy and subsequent inflammation and circulating cytokines. Marked leptin gene expression also occurs in EMS horses and is related to adipocyte volume.

The authors stated: "Our data demonstrate that adipocyte hypertrophy, inflammation and increased CCL2 (cytokine) expression are features of obese adipose tissue in horses, but fibrosis and altered adipose tissue expression of insulin-signaling genes are not consistent features. Visceral and retroperitoneal adipose tissue of horses with obesity and EMS is markedly dysfunctional with a hypertrophic-inflammatory phenotype."

They encouraged owner education about the "unhealthy" nature of such obese adipose tissue and how it affects the rest of the body by "inducing or worsening whole body insulin dysregulation." EM

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Mentoring the future leaders of the equine veterinary profession can be extremely rewarding.

Creating the Perfect Internship Program

New graduates expect to work hard in an internship, but in return they expect to learn a plethora of skills under the guidance of experienced veterinary mentors.

By Amy L. Grice, VMD, MBA

As the equine veterinary profession struggles with attracting and retaining veterinarians, the experience that new graduates have in their internship programs can markedly influence their future paths. As the number of veterinary students with equine interest has diminished, opportunities for learning basic skills in veterinary school have also been depleted.

With an increase in private referral hospitals across the U.S., many universities now see mostly complicated cases that are not representative of general practice. Students must work hard to find circumstances where they can develop the basic skills that are essential for an entry-level equine veterinarian. Many employers do not have the time or the temperament to mentor a new graduate this intensely. In addition, clients' expectations have become increasingly sophisticated.

Well-constructed internships might offer the best way for new graduates to acquire the skills they need for a successful career in equine practice.

Unfortunately, some practices that offer internships have a business model that utilizes interns as low-paid technicians and provide little formal skill acquisition and mentoring in return. In order for internships to be the bridge to a great career in equine practice, there must be a mutually beneficial exchange

where the practice takes pride in the mentoring relationship and the intern emerges with the skillset and confidence of a much more experienced practitioner.

AVMA-AAEP Survey Results

The 2016 AVMA-AAEP Survey of Equine Practitioners provided a window into the experiences of those veterinarians who undertook internships—their reasons for pursuing this advanced training, their satisfaction with the experience and how successful they felt it was in achieving their learning goals. Survey respondents also ranked a series of clinical skills with regard to their importance for an entry-level veterinarian.

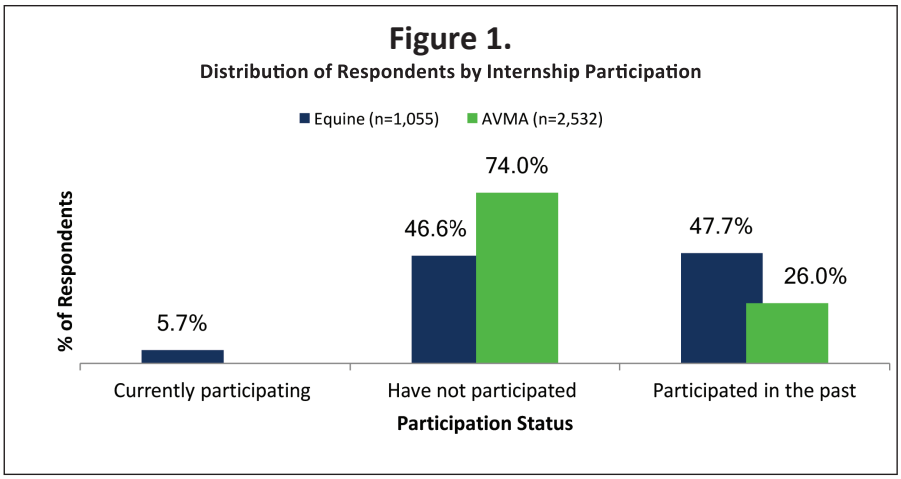
These insights can help practices and veterinary schools plan more successful internship and veterinary school programs. They can also help veterinary students evaluate potential internships, as well as assist young practitioners in directing their continuing education efforts.

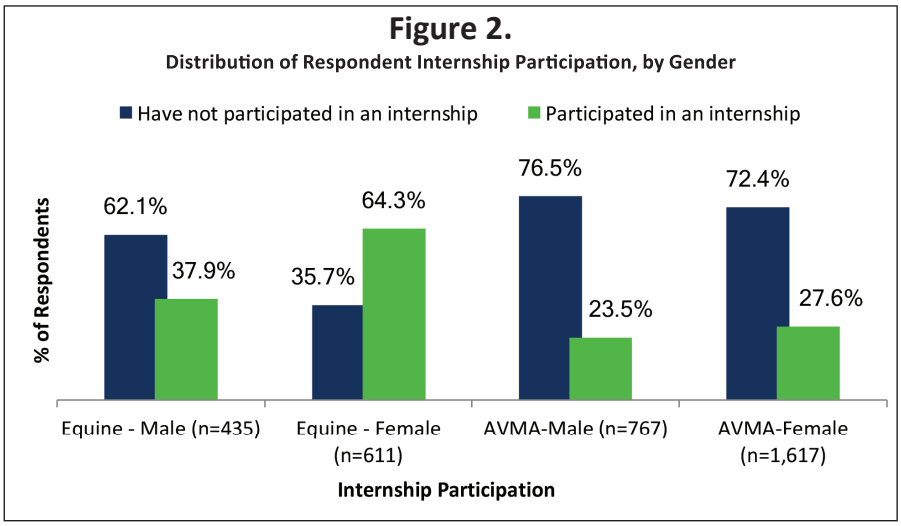
A strong majority (81.2%) of 2016 AVMA-AAEP Survey of Equine Practitioners respondents participated in externships during their veterinary school years, and of those, 33.4% participated in four to six and 50.0% in one to three externships. Subsequently, 55.4% applied for an internship at one or more of the practices where they did externships.

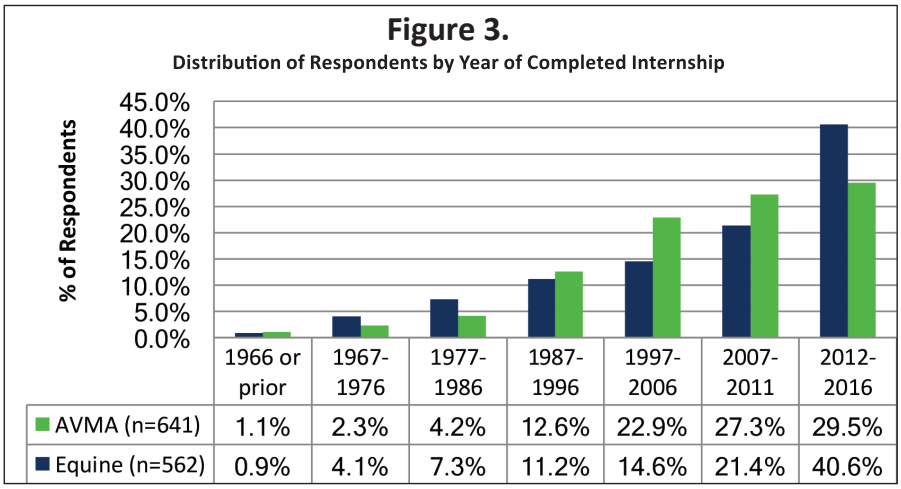
Participating in an internship was found to be much more common among equine respondents than those in companion animal, who make up the strong majority of respondents in a similar AVMA member survey (see Figure 1). Learning basic clinical skills for equine practice frequently does not occur in veterinary school; thus employment at an equine practice frequently requires an internship. Busy practice owners often do not have the time, aptitude or temperament for providing the close mentoring that new equine graduates generally require.

Of the 562 respondents in the 2016 AAEP AVMA Economic Survey that participated in an internship, 393 were females and 165 were males. More equine practice females (64.3%) than equine practice males (37.9%) participated in internships. This is substantially different than the respondents in the AVMA survey of predominately companion animal veterinarians, which reported nearly equal participation rates between males (23.5%) and females (27.6%) (see Figure 2).

When the distribution of respondents by the year they completed their internship was examined, it was revealed that more than half of the total number of







	1966 or prior	1967-1976	1977-1986	1987-1996	1997-2006	2007-2011	2012-2016
AVMA (n=641)	1.1%	2.3%	4.2%	12.6%	22.9%	27.3%	29.5%
Equine (n=562)	0.9%	4.1%	7.3%	11.2%	14.6%	21.4%	40.6%

respondents in both samples completed an internship in the past 10 years.

Participation in internships was uncommon prior to 1996. More than 40% of the 562 equine respondents that participated in an internship did so in the past five years (see Figure 3). It is not clear whether this is because there are more internships now available in private practice, or whether currently graduating students or prospective employers lack confidence in the newly graduating veterinarians' entry level skills, or whether this phenomenon is driven by another factor entirely.

The most common reasons given by the survey respondents for undertaking an internship were "to practice better-quality veterinary medicine," "to get more training before entering veterinary practice," "plan/planned to apply for a residency," and "to be more competitive in applying for available jobs."

The internships varied in their strategies for providing additional education to interns. It was reported that most internships offered an opportunity to experience primary emergency duty with mentoring, and two-thirds had clinical case rounds. About half held a journal club, about a third had procedural rounds to learn techniques and about a quarter had radiology rounds. Overnight treatment duty by interns was expected by more than half of the practices. Performance evaluations of interns and specific skills training were offered by only about a third of practices. Almost 17% put interns on emergency duty without any mentor being available (see Figure 4).

Salaries for interns in 2012-2016 was an average of about $27,000. Free housing was included in the compensation of 34% of internships reported by the respondents. Over time, benefits received by interns have increased (see Figure 5).

A specific question in the 2016 AVMA-AAEP Survey of Equine


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Figure 4. Internship Responsibilities	Freq.	Percent
Primary on-call emergency duty with mentoring available	418	82.1%
Primary client communication responsibility for cases	357	70.1%
Clinical case rounds	347	68.2%
Overnight treatment duty on a regular basis	310	60.9%
Independent case management without oversight	274	53.8%
Journal club	268	52.7%
Periodic performance evaluations	173	34.0%
Procedural rounds with teaching horses specifically for learning a skill or technique	161	31.6%
Radiology rounds	120	23.6%
Primary on-call emergency duty without mentoring available	86	16.9%

Figure 5. Benefits	1966 or prior (n=5)	1967-1976 (n=30)	1977-1986 (n=37)	1987-1996 (n=62)	1997-2006 (n=86)	2007-2011 (n=114)	2012-2016 (n=168)
Health insurance	80.0%	43.3%	40.5%	74.2%	67.4%	61.4%	65.5%
PLIT insurance (professional liability/malpractice)	20.0%	16.7%	32.4%	54.8%	66.3%	77.2%	71.4%
Continuing education expenses	0.0%	26.7%	32.4%	46.8%	67.4%	64.0%	75.6%
License fees	0.0%	16.7%	8.1%	43.5%	57.0%	66.7%	75.0%
Association dues (AVMA, AAEP, etc.)	0.0%	13.3%	13.5%	37.1%	51.2%	68.4%	75.0%
Continuing education leave (paid days off to attend)	20.0%	20.0%	21.6%	46.8%	52.3%	58.8%	59.5%
Practice-owned cell phone	20.0%	6.7%	0.0%	17.7%	46.5%	62.3%	50.6%
Paid vacation	60.0%	36.7%	24.3%	38.7%	39.5%	34.2%	45.8%
Discounted veterinary care for personal animals	20.0%	20.0%	8.1%	17.7%	26.7%	40.4%	59.5%
Paid personal or sick days	60.0%	20.0%	24.3%	32.3%	29.1%	26.3%	33.9%
Paid holidays	20.0%	33.3%	24.3%	32.3%	26.7%	24.6%	19.0%
Disability insurance	40.0%	30.0%	24.3%	25.8%	18.6%	19.3%	20.8%
Personal use of vehicle	0.0%	10.0%	18.9%	12.9%	11.6%	15.8%	22.0%
Retirement plan	60.0%	13.3%	5.4%	12.9%	9.3%	14.0%	4.2%
Other	0.0%	6.7%	8.1%	3.2%	3.5%	1.8%	3.0%
None of the above	20.0%	20.0%	18.9%	6.5%	3.5%	0.0%	1.2%

Practitioners asked respondents "for each procedure below, please indicate whether or not it is important for new associates to have mastery of it to work in the practice you own or are employed at."

About 90 percent of the AAEP respondents stated that it was important for new associates to have mastery of diagnosing and treating foot abscesses, and examining and repairing simple lacerations.

Diagnosing uncomplicated lameness using diagnostic nerve blocks, obtaining diagnostic radiographs of limbs, performing a complete physical or ophthalmic exam, placing IV catheters and subpalpebral lavage systems, setting up preventative health protocols, and working up, treating and making recommendations for a colic case in the field were reported to be essential basic skills by more than 80 percent of AAEP respondents.

Fewer than 20 percent of respondents considered the ability to perform gastroscopy or a standing castration entry-level skills. About a third of AAEP respondents considered applying a foot or limb cast, obtaining diagnostic radiographs of the neck, performing abdominocentesis, thoracocentesis, a transtracheal wash, rectal biopsy or other similar diagnostic procedures, and performing diagnostic ultrasound of the abdomen or thorax important for a new graduate.

When determining whether the specific internship experiences met the expectations of the participating new equine veterinarians, most respondents believed that their internships met their expectations "extremely well" or "very well," with the exception of understanding business management. These experiences included learning/career objectives, gaining valuable mentors, easing transition from student to practicing veterinarian, improving clinical skills, understanding business management and improving client-building skills.

Overall, if equine-specific respondents had the option of participating in an internship again, 75.3 percent would participate in the same internship, 15.1 percent would participate in a different internship, 1.8 percent said they would not participate in an internship, and 7.8 percent said they are not sure what they would do. Clearly, internships have made a positive difference in the careers of many.

Mutually Beneficial Internships

However, not all internships are a positive experience. New graduates expect to work hard, but in return they expect to have an opportunity to learn a plethora of skills under the guidance of experienced veterinary mentors. An internship should be a mutually beneficial relationship—the intern should receive a benefit of learning that equals his or her investment of time, money (in the form of lower salary) and effort. Using

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interns as low-paid technicians for night treatments and hospital admissions is a frequent complaint when poor-quality internships are discussed.

While an intern's on-call schedule is likely to be more intense than an associate's, as this is one of the ways that an intern receives "five years' worth of experience in one year," time off is necessary for mental and physical health.

Interns that are alone, instead of one of a pair or a group of interns, often fare less well, as they are not sharing the experience with peers. They frequently have a difficult time forming close friendships with the permanent team. Loneliness coupled with exhaustion is a potent brew that is toxic to emotional well-being.

If practices have only one intern, providing enough time off for that person to travel home at least quarterly for a weekend to recharge with family and friends is recommended. Even if several interns are at a practice, arranging on-call duties so that each has some regular nights and weekends without responsibilities is wise.

Setting expectations at the beginning of an internship will help make everything run more smoothly. The first week should be set aside for orientation: The intern should be introduced to the practice team and learn policies and procedures for laboratory, anesthesia, scheduling, invoicing, controlled substances, etc. A point person who will always be available to the intern should be designated. Expectations for dress, use of social media, cell phones, client communication, recordkeeping and care of the ambulatory vehicle should be covered. Giving each intern a copy of an intern manual is helpful. Training in safety (as mandated by OSHA) as well as documentation of controlled substances' use should also be accomplished in that first week.

Interns will feel more welcome if they are provided with practice logo shirts and jackets, and their arrival announced on the practice Facebook page with a photo and short biography. Some practices have a welcome breakfast for the entire team. Interns should always be addressed as "Dr." and be coached with how their initial communication with clients should go: "Hi, I'm Dr. Jones. I'll be doing the initial examination on Trigger."

"Check-ins" by the primary mentor should occur often during the first weeks, and more formal evaluations should occur every 90 days. These evaluations should be bi-directional. The interns can give feedback on what they would like to learn in the next 90 days (e.g., ultrasounding a stifle, castrating a colt in the field) as well as learning from the mentors where they are excelling

and where improvement is needed (e.g., great medical records but failing to make consistent eye contact and speaking confidently with clients).

Having the opportunity to practice hands-on skills repeatedly under mentorship is one of the wonderful aspects of an internship. After performing multiple regional limb perfusions, passing nasogastric tubes repeatedly, installing sub-palpebral lavage systems, splinting foals, taking many sets of radiographs, accessing synovial structures for diagnosis or treatment, etc., interns are ready to take on the world of equine practice with confidence. Things they might have never seen at veterinary school (wolf tooth removal, cellulitis, foot abscesses, choke, simple lacerations) are frequently seen on ambulatory calls. Clients expect proficiency with these common conditions—having a mentor's guidance eases the "firsts" that they see in the field.

Frequently the relationships formed with mentors and other interns in a good internship are long-lasting and shape the young doctor for a lifetime, as well as provide a network for support. Some practices create annual intern yearbooks, have farewell intern dinners and hold intern reunions at the AAEP Convention.

Take-Home Message

When practices approach internships with pride, as a production line that sends well-trained, confident, experienced young equine practitioners out into the world stamped with the practice brand, the quality of teaching and mutual benefit increases. When interns are simply an economically efficient part of a business model that maximizes profit, satisfaction falls for both sides.

Systems that rank internships by their success in keeping equine interns in equine practice would be helpful. Students must begin to seek internships in practices that will best position them for the career they want long-term rather than choosing one simply on the basis of name recognition or size.

Seeking externships at smaller practices with internship programs might offer better learning opportunities for general practice skills.

Practices with interns should consider offering weekly case rounds, journal club and radiology rounds for all doctors to attend. Having interns is a two-way interaction, as the newest techniques and medication uses at universities can be learned from new graduates. The objective must always be a mutually beneficial arrangement, where interns receive as much in mentoring, skill acquisition and experience as they give in time and effort.

Mentoring the future leaders of the equine veterinary profession can be one of the most rewarding aspects of practice. Be inspired by the incredible doctors you are helping shape! EM

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Sarcoids in the equine ear often respond best to benign neglect.

Pluck, Poke or Purge? Diagnosing Dermal Lesions

What's your go-to tool for diagnosing equine lumps and bumps?

By Stacey Oke, DVM, MSc

Horse owners pride themselves on their horses' beautiful bloom, taking hours to groom them and spending plenty of hard-earned money on shampoos, conditioners and supplements for skin and coat. When they find an abnormal bump, they don't typically waste time calling you out to take a peek.

While some dermal growths have a typical or classic presentation and are easy to diagnose (think equine viral papillomatosis in young horses), others require testing to determine the nature of the lump.

Equine dermatologists encourage testing all lumps and bumps, reminding vets that a lump is just a lump without a cytologic or histologic diagnosis.

"Without knowing what the lump is, effective treatments cannot be pursued, and you will not be able to give an accurate prognosis," said Julia E. Miller, DVM, DACVD, assistant clinical professor, Section of Dermatology, at Cornell University.

Faced with a long list of dermal masses capable of affecting horses, many with similar gross appearances, how do you know what test to perform?

Should you simply pluck some cells out of the lump via fine-needle aspiration (FNA), poke the lump taking a core or wedge biopsy, or simply purge the lump, taking it in its entirety and submitting the whole shebang to the local lab for diagnostics?

Pros and Cons of FNA Versus Biopsy

The benefits of FNA include its ease of use, the rapid turnaround of results, and economics (an FNA is typically less expensive than other types of testing). Further, horses don't usually need to be sedated to collect an FNA.

"Even though FNAs are quick and easy, I rarely recommend this diagnostic method," said Miller. "In general, equine skin tumors fail to exfoliate sufficiently, and samples submitted for evaluation frequently fail to be diagnostic."

Alan T. Loynachan, DVM, PhD, DACVP, an associate professor, Anatomic Veterinary Pathology, at the University of Kentucky, agreed with Miller's thoughts on the value of FNAs.

ARND BRONKHORST PHOTOGRAPHY

Fine-needle aspiration (FNA) is not always definitive in diagnosing equine skin tumors.

That said, two cases where an FNA might be useful in equine practice are squamous cell carcinoma (SCC) and eosinophilic granulomas. While an eosinophilic granuloma is fairly distinct on FNA, that is not always the case.

"If you do choose to perform an FNA, beware that a number of conditions such as equine mast cell tumors, mycotic dermatitis, habronemiasis, etc., can have very similar cellular makeups and may be misdiagnosed by FNA," Loynachan advised.

One study published in the *Canadian Veterinary Journal* (Zachar, et al. 2016) confirmed Miller's and Loynachan's opinions, stating, "The frequency of non-diagnostic results was significantly higher in equine submissions compared to those from dogs and cats."

Miller added, "Most horse tumors require either a biopsy or surgical excision for a definitive diagnosis."

Loynachan agreed, adding, "If the clinical circumstances allow for a biopsy, then that is the only method that I personally recommend. Biopsies are just diagnostically superior samples."

When submitting biopsies, Loynachan urged equine practitioners to try to send a large sample. "If on the submission form you describe a baseball-size mass, don't just submit a needle biopsy. The more tissue that is submitted, the better," he said.

Diagnosing Cutaneous Neoplasms

In some cases, equine tumors have a characteristic clinical presentation that narrows the list of differentials. When there is doubt or when owners wish to obtain a firm diagnosis, here are some suggestions for creating a diagnostic plan.

Papillomas

"These benign neoplasms are probably the third-most-common cutaneous growths seen in horses," said Miller. In young horses, viral papillomas typically occur on the muzzle—hence the colloquial name "grass warts." "These are the most common periocular, vulvar and penile tumor in *young* horses," said Miller.

Diagnostic plan: Leave these alone. Typical viral papillomas spontaneously regress in two to three months. A popular myth suggests that removing one or two might prompt early spontaneous regression. Studies do not support this hypothesis, further lending credence to benign neglect as a rational treatment plan.

By contrast, ear papillomas or "aural plaques" occurring in older horses on the concave aspect of the pinnae do not spontaneously regress. These occur commonly and bilaterally, starting as small 1-2 mm well-demarcated, raised, depigmented papules. These lesions grow, coalescing as hyperkeratotic plaques.

Like viral papillomas in young horses, many veterinarians rely on clinical presentation for diagnosing this condition.

"Aural plaques do not spontaneously regress, unfortunately, but they can wax and wane," said Miller. "I do *not* recommend any treatments for aural plaques because horses tend to become more head-shy when we mess with their ears, and there is no known effective treatment."

Sarcoids

For these locally invasive, frequently disfiguring, fibroblastic tumors, the diagnostic plan is rather simple: Let sleeping dogs lie!

These are by far the most common dermal neoplasia of horses and are notorious for responding poorly to manipulation. Biopsy or even incomplete surgical removal can stimulate the remaining sarcoid tissue to grow, or a quiescent sarcoid can be prodded into becoming an active, proliferative entity.

"I always encourage caution when sampling masses that might be sarcoids," advised Miller. "Benign neglect is an option for sarcoids that are not changing in character or bothering the horse. Biopsies (or any form of mechanical trauma) can aggravate the sarcoid and change its clinical behavior to become more locally aggressive."

The problem is that the differential diagnoses for the different variants of sarcoids are vast and varied. Some of those other tumors, unlike sarcoids, are either amenable to treatment or are even more aggressive than sarcoids. In such cases, knowing what kind of tumor we are dealing with will help with prognostication and counseling the owner.

Type of Sarcoid	Differential	Management of Differential
Verrucous	- Papilloma - Squamous cell carcinoma (SCC)	- Benign neglect or topical treatments - Surgical removal or local chemotherapy
Fibroblastic	- SCC - Habronemiasis - Infectious granuloma	- See above - Systemic ivermectin - Systemic antimicrobials
Occult	- Dermatophytosis - Dermatophilosis, *Staphylococca l* folliculitis - Onchocerciasis	- Topical antimicrobials - Systemic antimicrobials - Systemic ivermectin
Nodular	- Melanocytic neoplasms - Mast cell tumor	- Surgical removal - Local chemotherapy
Granuloma	- Eosinophilic granuloma	- Intralesional steroids

For example, consider the differentials associated with sarcoids outlined in the accompanying table.

As we know, saracoids are difficult manage due to their unpredictable clinical course. On the plus side, sarcoids do not metastasize and have the potential to spontaneously regress. Other sarcoids, however, can become exceeding large and can therefore become life threatening simply due to their size and location.

"We find the phrase 'suspect sarcoid' frequently noted in the history," said Loynachan. "What we don't know is whether these veterinarians are knowingly sampling sarcoids or if they are anticipating a different diagnosis."

Miller advised that "if you would like to biopsy a lesion that might be a sarcoid, I recommend having a good plan in place for follow-up that likely involves removal and possible adjunctive therapies like intratumoral cisplatin injections."

Squamous Cell Carcinoma (SCC)

Squamous cell carcinomas occur commonly, serving as the second-most-commonly diagnosed neoplasm in horses. These tumors can sometimes present as verrucous or fibroblastic sarcoids as mentioned above; however, SCCs are malignant.

Many SCCs begin life as papillomas in the periocular or perigenital region; then they progress over time to more proliferative or ulcerative lesions. They can even sometimes be mistaken for proud flesh if they grow where the horse was previously traumatized. Further, necrosis and secondary infections can complicate the clinical picture.

As mentioned earlier, SCCs are one case in which an FNA might be useful. However, Loynachan added, "You are likely going to excise an SCC, so you would be saving time and money by taking an excisional biopsy on these suspected SCC cases."

Diagnostic Plan: Excisional Biopsy

The following might not be seen regularly, but you should be aware of them.

Eosinophilic Granulomas

Although not one of the most common dermal growths, eosinophilic granulomas occur commonly enough to be a concern to many horse owners, particularly because they tend to occur in the saddle region and therefore limit the horse's use. These granulomas present as raised, nonpainful, discrete nodules overlaid with normal hair. Granulomas can become quite large—over 10 cm in diameter—but most are 1-2 cm.

"The eosinophilic granuloma serves as a great example of where an FNA can be exceedingly helpful," said Miller. "An FNA can help differentiate eosinophilic granulomas from fungal granulomas, mast cell tumors or deep bacterial infections."

The diagnostic plan for eosinophilic granulomas are to use FNA.

Mast Cell Tumors (MCTs)

An uncommon tumor of the horse, mast cell tumors (MCTs) present as raised, firm, well-demarcated growths measuring anywhere from 0.5 cm to 20 cm in diameter. Like eosinophilic granulomas, MCTs might have normal overlying skin or they can be alopecic, hyperpigmented and even ulcerated. These tumors most commonly develop on the head, neck, trunk or limbs, including the nasal cavity, conjunctiva, sclera, nicitans and globe. These are also non-painful, like eosinophilic granulomas. But MCTs are unique in that they can occur in clusters of three.

FNA frequently yields an immediate tentative diagnosis. However, complete excision and submission of the mass is curative, and even incomplete excision tends to incite spontaneous regression of the remainder of the tumor.

The diagnostic plan for mast cell tumors is to use FNA first to confirm diagnosis, followed by excisional biopsy; or just go straight to excision.

Take-Home Message

In most cases, a biopsy will be the first tool to reach for when faced with dermal masses.

While a lump is indeed just a lump until it is analyzed, not all masses need to be disturbed.

As pointed out by our experts, the clinical presentation of certain masses—such as papillomas and sarcoids—might negate the need for biopsy. If you need a referral from a boarded veterinary dermatologist, check the websites at acvd.org. EM

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Veterinarians and farriers share a common goal of providing the best care to the horse.

Building Vet-Farrier Relationships

When veterinarians and farriers find common ground and develop good communication, the horses and clients they serve will benefit.

By Katie Navarra

World champion barrel racer Michael Duffie credits his successes to the relationship shared between his veterinarian, Jamie Carter of Southern Equine Service in South Carolina, and local farrier Syd Thurman. Together the pair has changed the angle of trim, shoe and pad based on his barrel horse's pastern angles.

"My horse is 17, and his performance has been better than ever," Duffie said. "And I owe it all to the changes the two of them have made for my horse in the last year."

Thurman added, "Dr. Carter called me and said, 'I think we need to raise the angles,' and we're having great success by working together."

Collaboration supports general soundness and success in the show pen. However, it's no secret that vet/farrier relationships can at times be strained. That discord is unproductive for the patient and the client. It's also well known that interactions between farriers are sometimes contentious.

Veterinarians and farriers share a common goal: to provide the best care possible for the individual horse. Technology makes communicating with one another on a case or meeting at a client's barn easier than ever. Yet many professionals on both sides struggle to work well together.

"The minute we forget we're employees of the client is when we all get in trouble," said Mark Silverman, DVM, MS, of Sporthorse Veterinary Services in California. Silverman is both a veterinarian and farrier. "We both get hired to

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Without trust and a personal relationship, it's easy for a vet or farrier to second-guess the other's work.

work toward the benefit of patient and the client."

Every veterinarian knows at least one farrier who refuses to work with him or her. Silverman can easily recall one farrier in his area who simply refused to answer the phone, return voicemails or respond to emails. Fortunately, Silverman said, that is the exception rather than the rule. However, he has devoted time to cultivating relationships with farriers in the area.

"When I've given talks on certain topics that cover podiatry, I invite a farrier to speak with me," he said. "When they realize you're passionate about the topic, they get on your side."

For the past decade, Western Pennsylvania veterinarian Jim Zeliff, DVM, MBA, has focused on cultivating relationships with farriers at his Allegheny Equine Practice. He said the biggest key to success is establishing trust. To accomplish that, professionals must get to know one another.

"Get to know each other in another environment than in our usual interaction with the client," he said. "Working together is also not a bad marketing tool for the veterinarians because it demonstrates to clients that the two of you are comfortable working together, especially on lameness and laminitis cases."

From a business perspective, farriers can be a veterinarian's biggest advocate when developing a new client base. Horse owners often ask their trusted service providers—either farriers or veterinarians—for recommendations. It's human nature to recommend a professional with a personal connection.

Without trust and personal relationships, it's easy to second-guess one another's work. In the old days, a veterinarian would give a prescription based on a horse's lameness exam to a farrier. Because no conversation occurred, if the farrier was negative to the suggested treatment, he often chose to disregard it.

In the article that follows, Silverman and Zeliff share tactics they've used to develop partnerships with the farriers in their areas.

Common Courtesy

It's naturally easier to get along by showing courtesy. For example, if Silverman arrives at a barn where a farrier is working, he assesses the set-up. If the area is tight and the farrier is struggling to maneuver in the space, he gives him or her a few minutes to get situated. He also makes a point of always saying "hello."

"If you're carrying a syringe and they're carrying an anvil, let's be respectful of one another. Any time you show awareness that their job is hard is helpful, too," Silverman said. "If I see someone working on a horse doing a technique I've never seen before, I'll ask if I can watch. It's helpful to show an interest in learning."

With any relationship, there must be give and take. Veterinarians can extend all the courtesy and professionalism in the world, but if the farrier isn't willing to make an effort, there is only so much that can be done.

"On the bad side, I've gone out to a client's barn with a farrier, showed X-rays, described what worried me, and we come to an agreement about what to do only to find out that when I come back to check on the horse, the application is entirely different than what we talked about," he said. "Sometimes a

horse may have a crappy foot, and what I've recommended may not work. But the farriers I have a relationship with place a phone call and say, 'Hey, doc—this isn't going to work, and here's why. What if we try this?' "

From a business perspective, this type of workup and collaboration takes time. It might require an extra two or three hours to review X-rays, discuss pathology, evaluate the horse, put a shoe on, watch the horse go and make changes.

"The vet clinic or hospital-based farrier has to charge for that to accommodate for the time involved," Silverman said. "It's important that the client understands the changes involved in this sort of therapeutic shoeing approach."

Creating a Common Language

Both farriers and veterinarians are well-versed in the technical lingo specific to their areas of expertise. Sometimes the jargon creates trouble because each interprets the words to mean something else. Silverman uses the example of "shortening the toes." That could mean one of two things: shortening the toes from the ground up—making the hoof more upright—or shortening the toe from the front—adjusting the leverage associated with horizontal toe length.

"We have to approach things with language that is clear and concise," he said. "We need to talk about the purpose of the change so it becomes more clear."

One way to create a shared language and deepen relationships is through educational events that bring both professionals together. Up until COVID, Zeliff hosted monthly "Farrier Fridays" October through February.

At the event, a vet performs a lameness exam and explains the steps involved. The horses are blocked and radiographed. The veterinarian provides his or her findings, but does not indicate what should be done. One by one, each farrier shares an opinion for how he or she would trim and shoe the horse.

"This is not about veterinarians teaching farriers how to shoe. This is about getting together, getting to know one another and coming up with creative ideas," Zeliff said.

These interactive events that offer hands-on experiences tend to be popular with farriers. Clients who volunteer their horses are not charged for services or shoeing. But a lame horse that would make an excellent case study might not be in a position to wait for an upcoming farrier event, and it's hard to ask an owner to hold off on treatment even though the services are free.

Because of that, most of the cases that appear in Allegheny Equine's Farrier Fridays have an abscess, are laminitic or simply need corrective shoeing. Occasionally, a farrier who has a horse that isn't responding to some technique might ask whether the horse can be used for the event in order to receive input from others in the group.

AMY DRAGOO

Seeing a problem and treatment protocol eye to eye can be difficult without good communication.

"Ultimately, I have veto power because our practice is responsible for the horse, but we've never had that happen because there is a good collaborative effort from the group in determining what the horse needs," Zeliff said.

A number of vet practices have adopted similar events. Thurman has attended many of the clinics Carter has hosted at his practice. Bringing horses in and discussing how to change a horse's feet has created an common mindset between the professionals, said Thurman.

"That's helped a lot of people in this area have conversations and talk it through," he said. "At the end of the day, it's about what's best for the horse, and these events help remind us of that."

The Whole Picture

Silverman said he has more disagreements with himself than any client or farrier. Working as both veterinarian and farrier, he has internal debates about changes based on images and videos without actually seeing and handling the hoof. A farrier receiving recommendations based on a remote consult might recognize that the specific hoof in question might have trouble handling the desired changes.

"When talking with farriers, I tend to focus on goals rather than specific shoes," Silverman said. "I ask them what options they are most comfortable with to help us get to the endpoint with the horse."

Face-to-face interactions also increase the level of respect among colleagues. Bad-mouthing other professionals can be rampant in some areas, especially when neither party knows the other. Putting a face with a name and getting to know someone personally decreases the likelihood of saying something negative. Establishing trust gives both parties the confidence that they'll have support when they need it most.

Take-Home Message

When veterinarians and farriers can find common ground, develop good communication and foster mutual respect, the horses and clients they serve will benefit. Investing time in building a professional rapport with farriers in your area can serve you and your practice when you need help with a hoof issue. EM



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Having the right space at your facility for each job means a safer environment for horses and humans.

Veterinary Best Building Practices

This article provides basic standards for building the various areas in your veterinary facility.

By Heather Lewis, AIA, NCARB

Equine veterinarians have always been quick to learn the best, most efficient and safest ways to operate their practices. Knowledge comes quickly in this demanding profession. When it comes to applying hard-earned lessons to the task of designing a hospital, equine veterinarians instinctively understand which solutions will work best for their teams.

Despite their practical knowledge, most equine veterinarians lack access to structured information about hospital design. The AAEP does provide excellent guidelines, but facility information is limited compared to what is available to companion animal veterinarians. Even the AAHA accreditation standards, which contain many facility standards, are tailored for small animal medicine.

The equine veterinary profession would benefit from a list of hospital design and construction best practices. This article begins this task by compiling common principles of design, as well as modified ideas from the AAHA accreditation standards for small animal medicine.

Safety

The cornerstone of a good equine hospital or clinic is that it is as safe as possible for horses and humans. With that in mind, here are some areas you should address.

Separate horses and vehicles. When laying out a site, create separate traffic patterns for horses and vehicles. For example, if vehicular traffic is a loop, equine traffic should move back and forth within the loop as much as is practical. Where vehicle patterns and equine traffic patterns cross, create good sight lines and designate a clear crossing zone.

Prevent traffic flow through rooms. Avoid designing traffic patterns that require people, horses or equipment to travel through one room to access an-

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COURTESY ANIMAL ARTS

Designing your facility for good vehicle, human and horse traffic patters can reduce congestion areas and spread of disease.

other. When traffic flows around a room rather than through it, staff and horses suffer fewer distractions and sanitation is easier.

Size the rooms large enough. Each room in a hospital or clinic should safely accommodate horses and equipment.

- The smallest clear room size for examining a horse is 16 feet by 16 feet. A space this size must be clear of obstructions.
- The lowest safe ceiling height is 12 feet. This is the lowest that any light fixture, fan or other equipment should hang.
- Ceiling heights for surgery hoist beams must be higher than 12 feet. The bottom of beam is 14 feet to 15 feet to prevent horses' heads from dragging on the floor when they are transported.
- Aisles should be no less than 10 feet wide, and 12 feet is preferred. A width of 14 feet is better for busy barns where horses pass each other.

Keep equipment stored out of the way. Horses should not be at risk of crashing into equipment such as carts, hoses, etc., when being treated or examined. Equipment storage closets and alcoves minimize these risks.

Design with durable materials. Horses are powerful animals. Most building materials are not made for containing them safely. Use materials such as wood that will give gently when kicked, or alternatively, use materials such as reinforced concrete block that are strong enough to withstand abuse from a horse. Do not use materials that will shatter or break into shards. Induction stalls are grouted solid or built from poured-in-place concrete due to the extreme forces of a horse leaning or falling against the walls.

Prevention and isolation of disease. It is a veterinary practice's responsibility to prevent transmission of diseases within the facility.

Evaluate disease risks. Referral hospitals have more disease risks than smaller haul-in clinics due to the number of patients seen and the larger geographic area from which patients arrive. Practices that serve equine event and training areas that draw horses from across state lines have the greatest disease risks. While all hospitals need strict protocols for evaluating incoming horses and for isolating a sick horse, hospitals with greater risks should provide more separation between types of patients and should follow all AAEP Biosecurity Guidelines.

Design to minimize all modes of disease transmission. Use these guidelines to help you minimize disease spread.

- **Fomite transmission.** Fomite transmission is the most likely mode of disease transmission in any facility. Provide hand-washing stations in each medical space. Tools and equipment should not be shared between hospitalized ICU patients or between any patients in isolation.
- **Fecal/oral contamination.** For risky areas where hospitalized patients are housed, the facility should be designed to be hose cleaned. If a facility is hose cleaned, then it must be designed with non-porous, sealed, cleanable finishes. Medical treatment areas should also be hose cleaned and should be finished accordingly. Avoid dragging hoses from space to space; hose reels should be placed in each medical area.
- **Aerosol transmission.** Follow the AAEP Biosecurity Guidelines for each probable infectious disease. Provide a physical separation of the isolation facility by at least 30 feet. We recommend 60 feet if the site will allow for a greater distance.
- **Vector transmission.** Rigorously prevent harboring rodents and other pests in the facility. Keep the facilities tidy and all feed stored neatly.
- **Isolate patients showing signs of disease.** Any horses that show clinical signs of disease, as defined by the AAEP, should be isolated in a separate facility.

Separate non-infectious patients. Patients of different types should be housed in separate areas.

- **Separate outpatients and inpatients.** Outpatient stalls often face to the exterior of the building.
- **Design to prevent nose-to-nose**

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contact between horses. Design stall panels to prevent side-to-side contact between horses. Design inpatient stall fronts to keep horses' heads in their stalls.

- **Hospitalized patients need dedicated housing.** ICU is often placed inside the conditioned/ventilated hospital facility and away from other patients. It needs to be placed in an area where it is readily accessible to nursing staff and where it has its own support areas, such as storage, janitorial and hand washing.
- **Mare/foal stalls need to be visible.** Mare and foal stalls should be visible and easily accessible. They also should have their own support areas.

Inventory Management. Well-run equine veterinary practices have effective infrastructure for inventory management and control.

- **Create an enclosed pharmacy.** The pharmacy/central stocking area for the practice should be in a room that locks.
- **Follow all laws for scheduled drugs.** Keep all scheduled drugs under double lock and follow all laws and regulations.
- **Develop an inventory management system.**
  - Utilize a software system for managing inventory.
  - Track the supplies stocked in ambulatory trucks to avoid problems of missing or unaccounted for inventory.

Planning for equipment. Equine veterinary hospitals have specialized equipment needs.

- **Laboratory planning is an equipment coordination exercise.** To plan a laboratory, inventory all items of equipment and ensure there is adequate power/data and counter space for each, as well as free space for sitting, writing and preparing samples.
  - Separate microscope seating areas from counters where centrifuges are placed.
- **Plan carefully for radiological safety.**
  - Radiological safety is regulated at the state and federal level. Ensure that a radiation physicist is involved in the planning of any room containing X-ray, CT, fluoroscopy or rooms containing radioisotopes, such as nuclear scintigraphy.
  - Design the walls per the physicist's report to shield radiation from other areas.
  - Follow all manufacturer's requirements for room layout and construction materials.
  - Handle isotopes properly in contained rooms. Dispose of them per regulations.
  - Provide "hot" stalls to contain

radioactive biological waste from horses. These should be directly connected to scintigraphy areas to reduce the risk of spreading radioisotopes throughout the building.

- **Larger equipment items need direct involvement from manufacturers.**
  - Overhead X-ray, scintigraphy, CT, MRI, pools of all types and specialized rehabilitation equipment require direct and careful involvement of the equipment manufacturer.
  - The manufacturer should guide placement and room layout.
  - The manufacturer should provide power, HVAC and shielding requirements.
  - The manufacturer should advise about unexpected interactions between different modalities.

Surgery standards. Surgery is risky for horses because they are difficult to move, difficult to place in recumbent positions for long periods, and recovery is difficult.

- **Design an aseptic environment for surgery.**
  - Separate dirty procedures from clean surgery.
  - All surgery rooms must be finished with non-porous materials and must be able to be heavily cleaned with water. This is very different from small animal surgery areas, where hose cleaning is discouraged.
  - Pay special attention to the joint between the floor and wall. The floor materials should "cove" up the wall several inches to facilitate cleaning.
  - Surgery rooms require positive, laminar air flow to ensure no air flows back into the surgery room from other spaces.
  - Use MERV 13 filters in surgery. In practices with heavy orthopedic caseloads, consider utilizing HEPA filtration in the surgery room.
- **Surgery rooms are limited use.** Prep, scrub and any other functions must be placed outside of the surgery room.
- **Limit traffic flow.** Traffic should never pass through surgery.
- **Limit stored items.** Keep the floors clear in surgery so that the room can be sanitized. It is useful to have equipment storage rooms for this purpose. Do not place cabinets in surgery rooms unless they are above the floor.
- **Plan for specific surgery recovery protocols.** The design should be built around the specific surgery recovery method that the practice wants to utilize.
  - Unassisted recovery stalls should be no larger than 12 by 12 feet.
  - Assisted recovery stalls need to be larger, and the type of assistance and placement of assistants need to be accommodated in the design. For example, the space for a catwalk should be planned in advance so there is room for it in the floor plan.

Take-Home Message

The above list of best veterinary building practices is a place to begin if you are building or adding onto your facility.

If you are planning to renovate or expand your current facility, practice owners can review this list and build upon it with the help of outside experts. Ensure the list you have is shared with your architect and construction professionals early in the planning process.

Finally, take advantage of the knowledge already embodied in the best referral and university facilities around the country. While they might be built at a larger scale than anything relevant to your practice, they were designed with care and with the great wealth of practical knowledge for which equine veterinarians are known. EM

ISTOCK/GROOMEE

Insist that owners teach horses basic ground manners and that owners have basic horse-handling skills.

Training Owners To Keep You Safe

As equine veterinarians, we can minimize the risk of injury from horses by educating and training clients to handle horses in ways that keep us safe.

By Colleen Best, DVM, PhD, BSCH

Equine veterinarians have dangerous jobs; there's no way around that fact. At the best of times, horses are unpredictable, and we're often dealing with them at the worst of times, whether due to pain, stress, disease, injury or something else.

A 2018 article in *Equine Veterinary Education*[1] reported that among survey respondents, equine veterinarians were injured about every four years, and 33% of those injuries necessitated a hospital visit. The results suggest that over a 30-year career, equine veterinarians would sustain between seven and eight injuries.[1]

In order for us to work effectively, we need our bodies to be safe while we're working, and we need to be "serviceably sound" with respect to the physical demands of practice.

It's also important to consider the mental strain that accompanies working with dangerous horses or unsafe environments of all descriptions and causes. When our brains sense we are under threat, many of our higher brain functions (e.g., executive functioning, logical reasoning, problem solving) are

diminished. This is because our own fight, flight or freeze response is activated in the hope that one of those will neutralize the threat.

Given the importance of optimizing our safety, the question then becomes: "How do we do that?"

The aforementioned study asked that question of respondents, and the top two suggestions were better handling (28% of respondents) and "owner education about risks and use of sedatives" (25% of respondents).[1] Both of these necessitate us prioritizing safety on a daily basis.

There are many aspects that factor into our overall safety when we're working with horses, with our own horse-handling skills being the most important. The skill of the handler comes in a close second, despite often being tremendously variable.

As the veterinarian and ranking professional during appointments, the responsibility falls on our shoulders to make safety a top priority. There is often an unspoken assumption that we are all expert horse handlers, and while this might be true for many, it's not true for all. It's important to continue learning new techniques and strategies whenever possible. This can be done through traditional continuing education offerings, by interacting with horses outside of veterinary settings (e.g., riding, horse sport), and by working with a trainer who can provide instruction in "horsepersonship" skills.

Unfortunately, no matter how skilled we are, it's very difficult to perform the myriad of different procedures we are called upon to do while simultaneously restraining the horse. It can be well worth the associated costs to travel with a skilled assistant or technician in whom you have confidence. However, there will be times when this is not possible. To this end, we must consider how we can engage clients as partners in their horses' care and our safety. The best ways that I know how to do this are through client communication and education.

Horse Handling Expectations

Before we address how to work with clients, first we need to ensure we know what we want and expect from them with respect to horse handling during appointments.

We all have expectations of our horse handlers; however, the tricky part about most expectations is that they are often unconscious or subconscious, only becoming apparent when they are not met. So we have to take some time to ask ourselves what qualities, skills and capabilities we want our horse handlers to have.

Ultimately, what we want and need is competent, focused handlers who are committed to placing our safety as their

Veterinarians all have run into horses that despite the best efforts of the client and trainers, are unwilling and dangerous veterinary patients.

ISTOCK/IRINA ORLOVA

first priority. Exactly what that looks like is up to each of us to determine for ourselves.

I have a couple of additional must-haves. They include horses and humans having equipment appropriate for the task (e.g., halter, lead shank, close-toed shoes, etc.) and limited distractions (e.g., phones away, dogs away, children safe). There must also be a safe location in which to work (e.g., clear from hazards, enough space so there is an escape route).

Your must-haves might be different. Therefore, we each need to devote time and focus to determining exactly what we want and need from our horse handlers so that we stay as safe as possible.

Also, it's important to consider that clients are likely to have expectations about how we handle horses. Their background and experience is likely to influence the types of restraint and handling with which they are comfortable. As such, it is incumbent upon us to take the time to discuss this with them to ensure all parties are on the same page. This will help prevent conflict and set everyone up for a safe and successful interaction.

Equine Ground Manners

Another consideration: the expectations we have of our patients—specifically their ground manners. We've all run into some horses that, despite the best efforts of the client (and trainers), are unwilling and dangerous veterinary patients.

However, in many more situations, poor ground manners are tolerated without consideration that those bad manners might limit the horse's ability to receive high-quality veterinary care or cause safety concerns for the veterinarian.

Using nonjudgmental and open communication can help to ensure these types of conversations lead to positive outcomes.

Most clients are invested in the health, performance and longevity of their horses. These are all compromised when the horse is a danger to those whose job it is to keep him healthy! This type of conversation might also prime the client to be more accepting of charges related to amount of sedation or extended examination times due to an uncooperative patient.

We can also direct them to resources such as the video series "How not to break your vet," put together by the British Equine Veterinary Association.[2] These videos help owners work with their horses so they are more willing patients, with an added bonus of improving the horse-handling skills of the owner.

We cannot be responsible for every horse's behavior, so giving owners "homework" on which they can work can highlight the importance of their role in each individual horse's care.

Educating Clients

Once we have a handle on what we want from our clients and their horses, we can look to communicating and educating our clients.

Given the high stakes associated with handling, it's essential that we communicate clearly and check the client's understanding as we go. This might mean opening the appointment with a conversation that includes the types of procedures planned and the restraint and handling the horse will need.

Taking the time to get the client on your side will save time and facilitate success. During the appointment, it's important to remember clients are not necessarily well-versed in veterinary procedures so are unlikely to be able to predict our moves or anticipate any reactions the horse might have. It is our responsibility to share information and updates with the handler as we are working. This will help keep their focus on the horse. It will reinforce their value as a key member of the team. The bonus side effect is that it will build value in the eyes of the clients because they will

be more aware of the different types of things we are evaluating and examining.

There can also be a lot of "hurry up and wait" during appointments when we are drawing up drugs, setting up the radiograph machine and so on. It can be valuable to consider the attention span of the horse—and handler— in those situations.

If it's appropriate, send the owner to put the horse away, or give the owner a break and put the horse on crossties (or tie him safely). Knowing when he or she can have a break is a helpful way of not taxing an owner too heavily.

In situations where the horse is in distress, it's important to share predictions about the horse's possible behavior and response to procedures. For example, if the horse is violently colicking, then we might need to give the owner instructions on how to handle the situation if the horse goes down when we go to the truck.

One practical way to prioritize safety in appointments is instituting a checklist system. Create a checklist that you run through on your own or with the handler at the outset of the appointment. Checklists have been used in a number of industries (e.g., airline, human healthcare) to support high performance and reduce risk. Having a checklist might seem unnecessary or over the top, but it ensures that everyone is aware of the inherent risks; it also increases focus on the task.

Your checklist might be as simple as:

- People wearing appropriate gear
- Horse wearing appropriate gear
- Appropriate physical environment (open space, level ground, no hazards)
- Distractions minimized (phones away)
- Person in charge identified
- Plan for procedure/handling reviewed

Take-Home Message

At the end of the day, despite our best efforts, things can go wrong, and we might get hurt. As equine veterinarians dealing with large, flight-prone animals, we live with that risk daily.

However, we can minimize that risk by educating and training our clients to handle horses in ways that keep us safe.

The potential benefits of partnering with the client to support your safety well outweigh any risks. Prioritizing safety makes sense and is part of ensuring a long, satisfying career. EM

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By Nancy S. Loving, DVM

ISTOCK/SOMOGYVARI

The microbiome and intestinal integrity can affect horse behavior and training.

Effects of the Microbiome

Researchers stated that the microbiome might be a metabolic organ with significant effects on equine behavior.

By Nancy S. Loving, DVM

The intestines play a significant role in equine health, not just for digestion and absorption of nutrients, but for the effects on the immune system and brain function.

Studies have examined the role of intestinal microbiota—with its staggering 109 microorganisms per gram of ingesta—in equine physical and mental health and metabolism. While diet appears to have a great effect on microbial variation in the intestinal tract, a recent study looked at the role of exercise and its effects on the microbiome [Mach, N.; Ruet, A.; Clark, A. *et al.* Priming for welfare: gut microbiota is associated with equitation conditions and behavior in horse athletes. *Sci Rep* 10, 8311 (2020). https://doi.org/10.1038/s41598-020-65444-9].

Training has elements of physical and mental stress. The authors of the study previously ascertained that sporthorse breed type has no influence on the microbiome. In this study, the researchers evaluated the effect of environment—equitation, diet, housing, season—and host factors—age, sex, body condition, reproductive status, parasite, protozoal and fungal loads, pH, hematology and behavior—on fecal microbiota.

The study was conducted on 185 healthy sporthorses with similar husbandry and care, although they were trained in different disciplines—dres-

sage, eventing, jumping and vaulting. Fecal microbiota was examined at the start of the study and monitored through eight months of the study. All received the same diet and were individually housed.

Over the eight-month period, bacterial communities in healthy horses were found to experience considerable microbial drift. Many of the changes seen were associated with equitation factors such as discipline, possibly due to the physical and mental stress associated with training, competition and transport.

The researchers noted that "intestinal communities of individuals bred for dressage and jumping were more similar to one another than communities from individuals bred for eventing."

Those horses in dressage and jumping experienced higher levels of stress due to intense training schedules, travel and competition, with little time for recovery—all of which leads to emotional and physical stress.

The authors suggested that "a multiple-stressor environment characterized by high physical exertion, suboptimal energy intake, muscle damage and inflammation adversely affects intestinal barrier integrity and alters intestinal microbiota composition and metabolism."

A comparison was made with conditions experienced by military personnel—extended periods of physical exertion, psychological stress, sleep deprivation and environmental extremes.

Mean corpuscular hemoglobin and erythrocyte-to-leucocyte ratio, representative of the capacity for blood oxygen uptake, were associated with microbial communities far more than other host factors of age, sex and breed. The authors explained this by saying: "High physical exertion and performance were accompanied by hyperthermia, ischemia and hypoperfusion in the intestinal tract, which could have caused intestinal barrier disruption, followed by blood entry in the lumen and alteration of the oxygen gradient."

Similarly, findings of gut microbiota changes were associated with mental distress (hypervigilance) and oral stereotypies, which reflect a horse's attempt to cope with the stress of his environment. The microbiome might be a metabolic organ with significant effects on equine behavior, stated the authors.

The study identified specific bacterial taxa, or their metabolites, as linked to behavior that reflects deterioration in welfare concerns.

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Another finding suggested that butyrate and hydrogen sulfide-producing bacteria confer the host with an adaptive response to reverse or counteract potential negative effects of oral stereotypies.

Aggressiveness might be linked to two lactate-producing bacteria that could lead to acidosis, although fecal pH did not represent this. More studies are necessary to make this association.

Evidence indicated that aggressiveness might be correlated to bedding type. High-fiber intake and variability of organisms ingested in non-soluble polysaccharides when bedded on straw can favorably impact the microbiota. Straw bedding also encourages horses to lie down and spend more time engaged in feeding in comparison to horses bedded on shavings or wood pellets.

Take-Home Message

The gut microbiota has the potential to influence the central nervous system and the gut-brain axis through nervous, endocrine and immune-signaling mechanisms. Athletic activity in training, competition and travel have impacts on intestinal integrity that ultimately can affect behavior. EM

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