Business Solutions for Equine Practitioners
EquiManagement
January/February 2018

EPM Society Workshop

Infectious Disease Update

The Latest on Lameness

Respiratory Research

MEDIA PARTNER AAEP

Special Issue: Health & Research

FOR SOME HORSES, A LITTLE STARCH IS TOO MUCH

When a horse has severe metabolic issues, veterinarians recommend a diet containing less than 10% soluble carbohydrates. While these levels can be adjusted in feed, what about forage? Triple Crown's® new Safe Starch Forage eliminates the guesswork. We buy grass hays specifically for their low NSC content, then blend in a vitamin and mineral supplement that includes our nutritional EquiMix® Technology. This provides a total diet (hay and feed) with a soluble carbohydrate level below 10%, along with the optimum fiber length required for ideal gut fermentation. For more information or to find your nearest dealer, visit us online at **www.triplecrownfeed.com** or call **800-451-9916**.

Introducing **FastTrack™** The World's First Rehabilitative Orthotic For Equine Lameness

Consult your veterinarian and find out more at **www.horsepowertech.com**
or call +1 (844) 51-HORSE

Inside

Special Health/Research Issue

4 Publisher's Points: Welcome, 2018
By Kimberly S. Brown

6 New Vet Column: Getting Your Personal Team
By Zach Loppnow, DVM

8 Keeping Up
- Recognition of Equine Infectious Anemia
- Right Dorsal Displacement Surgery and Complications Post-Op
- Ophthalmology Research
- Mare Fertility and Uterine Inflammation
- Recovery from Multiple Procedures Under General Anesthesia
- Odontoclastic Tooth Resorption and Hypercementosis

By Nancy S. Loving, DVM

14 Business Brief: Should I Pay Off My Loan Early?
By Amy Grice, VMD, MBA

16 EPM Society Workshop
This report was written for equine veterinarians, students, techs and researchers who are interested in better understand ing the disease equine protozoal myeloencephalitis.
By Kimberly S. Brown

26 Infectious Disease Update
There is continuing advance-ment in the understanding, treatment and management of infectious diseases of horses.
By Nancy S. Loving, DVM

30 The Latest on Lameness
Lameness is one of the most commonly reported causes of equine loss of use.
By Nancy S. Loving, DVM

36 Respiratory Research
Research on herpes and strangles can help you better understand and manage these diseases.
By Emma N. Adam, BVetMed, DACVIM, DACVS, PhD

40 Advertising Index

Cover photo by Arnd Bronkhorst Photography

To detect pathology of the GI tract,

TEST YOUR EQUINE PATIENTS WITH THE ONE DIAGNOSTIC SCREEN THAT IS...

SIMPLE – Requires only a fresh fecal sample and clean water.

QUICK – Provides accurate results in minutes, right in the barn.

SENSITIVE – Detects pathology of the foregut, hindgut or both.

Recent research carried out by Professor Derek Knottenbelt and his team at the University of Glasgow vet school confirms "the very high prevalence of large colon and caecal diseases that are likely to be of clinical significance."*

This raises the value of a reliable diagnostic method for detecting pathologies of both the foregut and hindgut. The SUCCEED® Equine Fecal Blood Test™ provides a quick stall-side screen test for GI tract conditions, helps differentiate foregut from hindgut conditions, and supports earlier intervention and more targeted treatments.

Available only through veterinarians.

SUCCEED®
Equine Fecal Blood Test™

To keep your clients' horses healthy,

MAINTAIN OPTIMAL GI HEALTH WITH THE ONE DIGESTIVE PRODUCT THAT IS...

PATENTED – Validated with multiple patents in the U.S. and worldwide.

TESTED – Evaluated in various clinical trials.

SUPPORTED – Includes the industry's best colic reimbursement program.

Veterinarians seeking to maintain optimal GI health in their equine patients know SUCCEED® is backed with clinical trials and published research.

They also know that SUCCEED Veterinary Formula, sold only through veterinarians, supports their practice with the Healthy Gut Commitment veterinary colic reimbursement program. This provides up to $800 for medical colics and up to $15,000 for colic surgery.

Available only through veterinarians.

INCLUDES THE
SUCCEED® HEALTHY GUT COMMITMENT

SUCCEED®
Digestive Conditioning Program®
VETERINARY FORMULA

For research, technical data and more, register or log on to the SUCCEED Veterinary Center: www.succeed-vet.com

*"Perspectives on equine digestive health," by Helen Warren, PhD. Supplement to Equine Health magazine, May 2016.

SUCCEED® is a registered trademark, and Equine Fecal Blood Test™ is a trademark of Freedom Health LLC. © 2017. All Rights Reserved. U.S. Patent Nos. 7,629,180 and 8,168,446. Canadian Patent No. 2,601,368.

SUCCEED® and Digestive Conditioning Program® are registered trademarks of Freedom Health LLC. © 2017. All Rights Reserved. U.S. Patent Nos. 7,658,964; 7,824,706; 7,988,989 and 8,197,842. SUCCEED Veterinary Formula available in the U.S. only, not available for sale in the state of Texas.

PUBLISHER'S POINTS

By Kimberly S. Brown

Welcome, 2018!

I'm not sure what it is about starting a new year, but it gives everyone hope. We make resolutions for living better lives (and we actually mean them!). There's excitement that we have a clean slate in the personal and business aspects of our lives that allows us to do more, better. Then, unfortunately, reality sets in and we fall back into our ruts of daily survival.

For 2018, you should choose to break that habit of not breaking bad habits!

We have often told ourselves that we'll exercise, eat right, work fewer hours, focus on family and friends. What keeps you from doing that? Work is often the answer.

The demands of the veterinary profession are intense. Emergencies can happen any time. No two days are the same. Getting new clients is exciting but adds to the workload. Adding new services can mean better care for your patients but also means financial and sometimes mental stress in learning to be proficient in those technologies.

Everyone says "Work smarter, not harder!" What does that mean?

Smarter means having a plan, not just reacting to the world around you. Smarter means understanding your business so that you know what you are best at, what your clients value most about you, and how to avoid situations where you are putting excessive time and energy into low-return areas of your business.

Smarter also means holding yourself accountable for what you want to accomplish, whether that's making more money, learning new technologies and techniques, or finding more time for your family or yourself.

Sometimes having a friend who is not involved in your day-to-day activities can help keep you on track, and you can do the same in return for your friend.

Make a list of six things you want to accomplish this year. Add some timelines. Share that with your friend. Get your friend's list of six. Then set up a monthly lunch or call to check in. It's amazing how much more motivation you will have when someone you respect is helping you stay on track.

Sometimes it does take a village to help one person accomplish what he or she is capable of. Find that person, and be that person. Make 2018 the year you say "I did it!"

In This Special Issue

This special health and research issue of *EquiManagement* came about because veterinarians requested more information about the medical topics that their clients care about.

I encourage you to provide feedback on what you think of this issue, and whether this is something you would like to see continue annually. EM

EQUINE NETWORK

EquiManagement

Associate Publisher/Editor
Kimberly S. Brown
KBrown@aimmedia.com

Associate Publisher/ Advertising Sales
Michelle Adaway
madaway@aimmedia.com
859-619-8263

Advertising Sales
Tom Brazil
tbrazil@aimmedia.com
805-538-9986

Shelley Partridge
spartridge@aimmedia.com
859-327-7057

EQUINE NETWORK

Group Publisher
David Andrick

Senior Editor
Laurel Scott

Art Director
Adam Purvis

Group Production Director
Barbara Van Sickle

Production Manager
Diane Paolini

Prepress Specialist
Brad Burleson

Advertising Information Manager
Judy Howard

ACTIVE INTEREST MEDIA

President & CEO Andrew W. Clurman
Senior Vice President, CFO & Treasurer Michael Henry
Chief Innovation Officer Jonathan Dorn
Vice President of Audience Development Tom Masterson
Senior Vice President of Business Development & Equine Tom Winsor
Vice President, Equine Group David Andrick
Vice President, Controller Joseph Cohen
Vice President, Research Kristy Kaus
Vice President, Information Technology Nelson Saenz
AIM Board Chair Efrem Zimbalist III

Please Recycle This Magazine
Remove Inserts or Samples Before Recycling

Copyright 2018 Cruz Bay Publishing

"I recommend ColiCare for all of my patients,

and my own horses are enrolled, too!"

—Marsha Severt, DVM
Brown Creek Equine Hospital

ColiCare, the **#1 vet-recommended colic surgery reimbursement program**† puts you back at the center of the horse's wellness care and reimburses horse owners up to **$7,500** to help ease the financial burden of colic surgery.

ColiCare™

FROM SMARTPAK

SmartPak.com/ColiCare | 1-800-461-8898

†2016 Lebel Marketing Veterinary Market Survey

NEW VET COLUMN

By Zach Loppnow, DVM

Getting Your Personal Team

No one can know it all. No matter how smart, talented or creative we are, we simply can't know everything.

I have been finding this out as I trek through my internship year. I left school thinking I knew quite a bit, but there is nothing like the world of veterinary medicine to show me just how much more I have to learn. Each and every day, there are new breakthroughs, new advances in technology and new medications being developed. It is our job as veterinarians to stay abreast of this wave of new information so that we can augment its use to the betterment of our patients' lives.

That being said, there is still an entire world out there that we have to live in. A world that requires knowledge and expertise to navigate, lest we fall into traps and pitfalls of ignorance.

One of the biggest and most complicated webs in this world is the one of personal finance. Even if we manage to understand a good portion of it, there are rules and regulations that can change quickly. Whether by government oversight or simply as a result of a change in our personal lives, the waters of personal finance can often be murky.

Because of this, we have to surround ourselves with a team of people who can help get us to where we want to be. We wouldn't expect one of our clients to be able to pick up a scalpel and perform a complicated surgery. So we should not expect ourselves to understand every complexity or nuance in our finances.

That is not to say, however, that we should not spend time trying to understand what goes on with our personal finances. Much in the same way we educate our owners about their animals, we need to seek out education opportunities wherever possible for ourselves. Ultimately, though, it takes having a good set of people on your team to really find long-term success and stability.

One of the first people you should recruit to your "team," in my opinion, is a certified financial planner (CFP). We, as recent graduates and students, all likely have a massive elephant in our room called student debt. How are each of us going to pay off that debt? How can we make payments and still save for retirement? Will my debt burden affect my spouse? Should I try to pay it off as fast as possible, or take the income-based payoff plan? All of these questions and more are just a small part of what a good financial planner can answer for you. If you are looking for a CFP in your area, I recommend checking out the website letsmakeaplan.org, a resource run by the CFP Board of Standards to help people find nearby financial planners.

The second person I recommend adding to your team is a certified public accountant. While you might think "I can do my taxes on my own, thank you," accountants provide much more than just tax help. One of the biggest assets they can bring to your team is their ability to understand your personal financial goals and how your changing life might affect those goals. It's true that they can help you with your tax liability, but developing a personal relationship with a CPA can reap benefits far down the line, even into estate planning and retirement.

COURTESY ZACH LOPPNOW

A great place to start searching for this team member is aicpa.org. This directory of CPAs across the country can help you narrow down your search into different certifications that might apply to your personal situation.

Remember, through all of this, that the team of people around you can only help you with questions you know to ask. Having the best team in place still requires a personal investment to learn about your personal finances.

Learning even small parts can be enough to generate the questions your team needs to start you down the path to success. Whatever that path looks like, don't wait to start walking it. Get your team in place today, and start planning for tomorrow. EM

Zach Loppnow, DVM, is a 2017 graduate of the University of Minnesota College of Veterinary Medicine. He is working as an intern at Anoka Equine Veterinary Services in Minnesota. A graduate of the VBMA's Business Certificate Program, he continues to pursue his interest in practice management.

When compliance counts...

Prescribe UNIPRIM antibiotic powder, a convenient and cost-effective treatment.

UNIPRIM®

TMP/SDZ Powder for Horses

DESCRIPTION: UNIPRIM Powder contains 67 mg trimethoprim and 333 mg sulfadiazine per gram.

UNIPRIM Powder is a combination of trimethoprim and sulfadiazine in the ratio of 1 part to 5 parts by weight, which provides effective antibacterial activity against a wide range of bacterial infections in animals.

Trimethoprim is 2,4 diamino-5-(3, 4, 5-trimethoxybenzyl) pyrimidine.

ACTIONS: Microbiology: Trimethoprim blocks bacterial production of tetrahydrofolic acid from dihydrofolic acid by binding to and reversibly inhibiting the enzyme dihydrofolate reductase.

Sulfadiazine, in common with other sulfonamides, inhibits bacterial synthesis of dihydrofolic acid by competing with para-aminobenzoic acid.

Trimethoprim/sulfadiazine thus imposes a sequential double blockade on bacterial metabolism. This deprives bacteria of nucleic acids and proteins essential for survival and multiplication, and produces a high level of antibacterial activity which is usually bactericidal.

Although both sulfadiazine and trimethoprim are antifolate, neither affects the folate metabolism of animals. The reasons are: animals do not synthesize folic acid and cannot, therefore, be directly affected by sulfadiazine; and although animals must reduce their dietary folic acid to tetrahydrofolic acid, trimethoprim does not affect this reduction because its affinity for dihydrofolate reductase of mammals is significantly less than for the corresponding bacterial enzyme.

Trimethoprim/sulfadiazine is active against a wide spectrum of bacterial pathogens, both gram-negative and gram-positive. The following in vitro data are available, but their clinical significance is unknown. In general, species of the following genera are sensitive to trimethoprim/sulfadiazine:

Very Sensitive	**Sensitive**	**Moderately Sensitive**	**Not Sensitive**
Escherichia	*Staphylococcus*	*Moraxella*	*Mycobacterium*
Streptococcus	*Neisseria*	*Nocardia*	*Leptospira*
Proteus	*Klebsiella*	*Brucella*	*Pseudomonas*
Salmonella	*Fusiformis*		*Erysipelothrix*
Pasteurella	*Corynebacterium*		
Shigella	*Clostridium*		
Haemophilus	*Bordetella*		

INDICATIONS AND USAGE: Trimethoprim/sulfadiazine is indicated in horses where potent systemic antibacterial action against sensitive organisms is required. Trimethoprim/sulfadiazine is indicated where control of bacterial infections is required during treatment of:

Acute Strangles	Acute Urogenital Infections
Respiratory Tract Infections	Wound Infections and Abscesses

Trimethoprim/sulfadiazine is well tolerated by foals.

CONTRAINDICATIONS: Trimethoprim/sulfadiazine should not be used in horses showing marked liver parenchymal damage, blood dyscrasias, or in those with history of sulfonamide sensitivity.

ADVERSE REACTIONS: During clinical trials, one case of anorexia and one case of loose feces following treatment with the drug were reported.

Individual animal hypersensitivity may result in local or generalized reactions, sometimes fatal. Anaphylactoid reactions, although rare, may also occur. **Antidote:** Epinephrine.

Post Approval Experience: Horses have developed diarrhea during trimethoprim/sulfadiazine treatment, which could be fatal. If fecal consistency changes during trimethoprim/sulfadiazine therapy, discontinue treatment immediately and contact your veterinarian.

PRECAUTION: Water should be readily available to horses receiving sulfonamide therapy.

ANIMAL SAFETY: Toxicity is low. The acute toxicity (LD50) of trimethoprim/sulfadiazine is more than 5 g/kg orally in rats and mice. No significant changes were recorded in rats given doses of 600 mg/kg per day for 90 days.

Horses treated intravenously with trimethoprim/sulfadiazine 48% injection have tolerated up to five times the recommended daily dose for 7 days or on the recommended daily dose for 21 consecutive days without clinical effects or histopathological changes.

Lengthening of clotting time was seen in some of the horses on high or prolonged dosing in one of two trials. The effect, which may have been related to a resolving infection, was not seen in a second similar trial.

Slight to moderate reductions in hematopoietic activity following high, prolonged dosage in several species have been recorded. This is usually reversible by folinic acid (leucovorin) administration or by stopping the drug. During long-term treatment of horses, periodic platelet counts and white and red blood cell counts are advisable.

TERATOLOGY: The effect of trimethoprim/sulfadiazine on pregnancy has not been determined. Studies to date show there is no detrimental effect on stallion spermatogenesis with or following the recommended dose of trimethoprim/sulfadiazine.

DOSAGE AND ADMINISTRATION: The recommended dose is 3.75 g UNIPRIM Powder per 110 lbs (50 kg) body weight per day. Administer UNIPRIM Powder orally once a day in a small amount of palatable feed.
Dose Instructions: One 37.5 g packet is sufficient to treat 1100 lbs (500 kg) of body weight. For the 1125 g packets and 12 kg boxes, a level, loose-filled, 67 cc scoop contains 37.5 g, sufficient to treat 1100 lbs (500 kg) of body weight. For the 200 g, 400 g, and 1200g jars, and 2000 g pail, two level, loose-filled, 32 cc scoops contain 37.5 g, sufficient to treat 1100 lbs (500 kg) of body weight. Since product may settle, gentle agitation during scooping is recommended.

The usual course of treatment is a single, daily dose for 5 to 7 days.

Continue acute infection therapy for 2 or 3 days after clinical signs have subsided.

STORAGE: Store at or below 25°C (77°F)

HOW SUPPLIED: UNIPRIM Powder is available in **37.5 g** packets, **1125 g** packets, **200 g** jars, **400 g** jars, **1200 g** jars, **2000 g** pails and **12 kg** boxes. Apple Flavored UNIPRIM Powder is available in **37.5 g** packets, **1125 g** packets, **200 g** jars, **400 g** jars, **1200 g** jars and **2000 g** pails.

CAUTION: Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian.

ANADA # 200-033, Approved by FDA

NEOGEN®
800-621-8829 • 859-254-1221
inform@neogen.com • animalsafety.neogen.com L3775-0916
blog

By Nancy S. Loving, DVM

Recognition of Equine Infectious Anemia

While EIA is an uncommon occurrence, it is becoming somewhat more prevalent in racing Quarter Horses and bush-track racehorses.

At the 2017 North American Veterinary Conference, Erin Groover, DVM, DACVIM, presented a case study on a horse with EIA.

She reported that possible clinical signs that lend suspicion to an EIA infection include:

- hemolytic anemia
- icterus
- fever
- lethargy
- weight loss
- etechial hemorrhage
- distal limb edema
- pale mucous membranes
- inappetance

These clinical signs could be attributed to a variety of differential diagnoses: purpura hemorrhagica, autoimmune disorders, equine viral arteritis virus, neoplasia, liver disease or internal abscesses. Running a Coggins test or ELISA test on blood can quickly rule EIA in or out.

Right Dorsal Displacement Surgery and Post-Op Complications

At the 12th International Equine Research Symposium, a paper was presented comparing post-operative complications from right dorsal displacement of the colon (RDDC) with other colon lesions that are non-strangulating (NSAC). (Whyard, J.M. and Brounts, S.H. Post-Operative Complications And Survival In Horses With Right Dorsal Displacement Of The Ascending Colon Compared With Other Non-Strangulating Ascending Colon Lesions. *Equine Vet Educ* 2017, vol. 29, supp 8, p. 31.)

The study included 130 horses with the following summation that might be helpful for counseling clients as to whether or not to pursue colic surgery:

- 60% had RDDC and 54% had NSAC lesions.
- 37% of RDDC and 52% of NSAC patients developed at least one complication post-op.
- The complications in the RDDC group were more serious than those in the NSAC group.
- 93% of NSAC horses were discharged compared to only 77% of RDDC horses.
- RDDC horses had a greater incidence of a second surgery before discharge than the NSAC horses.
- Short-term survival was impacted by complications in the RDDC group.
- Long-term survival was equivocal for both groups.

Ophthalmology Research

Some eye diseases in horses might be genetically linked, as for example limbal squamous cell carcinoma in Haflingers. (Lassaline, M.; Cranford, T.L.; Latimer, C.A.; Bellone, R.R. "Limbal Squamous Cell Carcinoma in Haflinger Horses." Vet Ophthalmol, September 2015. 18(5):404-8.) Ultraviolet damage might be more extensive in Haflingers (and possibly other breeds) due to a genetic mutation that increases the risk for developing limbal squamous cell carcinoma (SCC). Not only do ultraviolet exposure and pigmentation characteristics serve as risk factors, but so does genetics. Besides Haflingers, ocular SCC commonly affects other breeds, including Appaloosas, Belgians, Percherons and Arabians.

To date, researchers at UC Davis School of Veterinary Medicine and the Veterinary Genetics Laboratory have determined that "a recessive mode of inheritance in Haflingers explains

Equine infectious anemia is becoming more prevalent in racing Quarter Horses, especially those at bush tracks.

The only dual ingredient injectable corticosteroid approved by the FDA for use in horses

The link between
RAPID ONSET and LONG-ACTING RELIEF
of pain & inflammation[1]

BetaVet® (betamethasone sodium phosphate & betamethasone acetate injectable suspension) is indicated for the control of pain and inflammation associated with osteoarthritis in horses. **Learn more at www.betavetequine.com or call 1-800-458-0163**.

Please see Brief Summary of Full Prescribing Information on the following page.

BetaVet®
betamethasone sodium phosphate & betamethasone acetate
INJECTABLE SUSPENSION

INDICATION: BetaVet® is indicated for the control of pain and inflammation associated with osteoarthritis in horses.

IMPORTANT SAFETY INFORMATION
For Intra-Articular (I.A.) Use in Horses.

CONTRAINDICATIONS: BetaVet® is contraindicated in horses with hypersensitivity to betamethasone. Intra-articular injection of corticosteroids for local effect is contraindicated in the presence of septic arthritis.

WARNINGS: Do not use in horses intended for human consumption. Clinical and experimental data have demonstrated that corticosteroids administered orally or parenterally to animals may induce the first stage of parturition when administered during the last trimester of pregnancy and may precipitate premature parturition followed by dystocia, fetal death, retained placenta, and metritis. Additionally, corticosteroids administered to dogs, rabbits and rodents during pregnancy have resulted in cleft palate in offspring and in other congenital anomalies including deformed forelegs, phocomelia and anasarca. Therefore, before use of corticosteroids in pregnant animals, the possible benefits to the pregnant animal should be weighed against potential hazards to its developing embryo or fetus. **Human Warnings:** Not for use in humans. For use in animals only. Keep this and all medications out of the reach of children. Consult a physician in the case of accidental human exposure.

PRECAUTIONS: Corticosteroids, including BetaVet®, administered intra-articularly are systemically absorbed. Do not use in horses with acute infections. Acute moderate to severe exacerbation of pain, further loss of joint motion, fever, or malaise within several days following intra-articular injection may indicate a septic process. Because of the anti-inflammatory action of corticosteroids, signs of infection in the treated joint may be masked. Due to the potential for exacerbation of clinical signs of laminitis, glucocorticoids should be used with caution in horses with a history of laminitis, or horses otherwise at a higher risk for laminitis. Use with caution in horses with chronic nephritis, equine pituitary pars intermedia dysfunction (PPID), and congestive heart failure. Concurrent use of other anti-inflammatory drugs, such as NSAIDs or other corticosteroids, should be approached with caution. Due to the potential for systemic exposure, concomitant use of NSAIDs and corticosteroids may increase the risk of gastrointestinal, renal, and other toxicity. Consider appropriate wash out times prior to administering additional NSAIDs or corticosteroids.

ADVERSE REACTIONS: Adverse reactions reported during a field study of 239 horses of various breeds which had been administered either BetaVet® (n=119) or a saline control (n=120) at five percent (5%) and above were: acute joint effusion and/or local injection site swelling (within 2 days of injection), 15% BetaVet® and 13% saline control; increased lameness (within the first 5 days), 6.7% BetaVet® and 8.3% saline control; loose stool, 5.9% BetaVet® and 8.3% saline control; increased heat in joint, 2.5% BetaVet® and 5% saline control; and depression, 5.9% BetaVet® and 1.6% saline control.

DOSAGE AND ADMINISTRATION: Shake well immediately before use. Use immediately after opening, then discard any remaining contents.

RX ONLY

References: 1. Trotter GW. Intra-articular corticosteroids. In: McIlwraith CW, Trotter GW, eds. *Joint Disease in the Horse*. Philadelphia: W.B. Saunders; 1996; 237–256.

© 2017 Luitpold Animal Health, division of Luitpold Pharmaceuticals, Inc. Luitpold Animal Health (logo) and the Horse Head design are trademarks and BetaVet® is a registered trademark of Luitpold Pharmaceuticals, Inc.
PP-BV-US-0010 7/2017

LUITPOLD ANIMAL HEALTH

BetaVet®

betamethasone sodium phosphate &
betamethasone acetate

INJECTABLE SUSPENSION

BRIEF SUMMARY OF PRESCRIBING INFORMATION

(Betamethasone Sodium Phosphate and Betamethasone Acetate Injectable Suspension) 6 mg betamethasone per mL
For Intra-Articular (I.A.) Use in Horses

CAUTION: Federal law restricts this drug to use by or on the order of a licensed veterinarian.

INDICATION: BetaVet® is indicated for the control of pain and inflammation associated with osteoarthritis in horses.

DOSAGE AND ADMINISTRATION: Shake well immediately before use.

CONTRAINDICATIONS: BetaVet® is contraindicated in horses with hypersensitivity to betamethasone. Intra-articular injection of corticosteroids for local effect is contraindicated in the presence of septic arthritis.

WARNINGS: Do not use in horses intended for human consumption. Clinical and experimental data have demonstrated that corticosteroids administered orally or parenterally to animals may induce the first stage of parturition when administered during the last trimester of pregnancy and may precipitate premature parturition followed by dystocia, fetal death, retained placenta, and metritis. Additionally, corticosteroids administered to dogs, rabbits and rodents during pregnancy have resulted in cleft palate in offspring. Corticosteroids administered to dogs during pregnancy have also resulted in other congenital anomalies including deformed forelegs, phocomelia and anasarca. Therefore, before use of corticosteroids in pregnant animals, the possible benefits to the pregnant animal should be weighed against potential hazards to its developing embryo or fetus. **Human Warnings:** Not for use in humans. For use in animals only. Keep this and all medications out of the reach of children. Consult a physician in the case of accidental human exposure.

PRECAUTIONS: Corticosteroids, including BetaVet®, administered intra-articularly are systemically absorbed. Do not use in horses with acute infections. Acute moderate to severe exacerbation of pain, further loss of joint motion, fever, or malaise within several days following intra-articular injection may indicate a septic process. Because of the anti-inflammatory action of corticosteroids, signs of infection in the treated joint may be masked. Appropriate examination of joint fluid is necessary to exclude a septic process. If a bacterial infection is present, appropriate antibacterial therapy should be instituted immediately. Additional doses of corticosteroids should not be administered until joint sepsis has been definitively ruled out. Due to the potential for exacerbation of clinical signs of laminitis, glucocorticoids should be used with caution in horses with a history of laminitis, or horses otherwise at a higher risk for laminitis. Use with caution in horses with chronic nephritis, equine pituitary pars intermedia dysfunction (PPID), and congestive heart failure. Concurrent use of other anti-inflammatory drugs, such as NSAIDs or other corticosteroids, should be approached with caution. Due to the potential for systemic exposure, concomitant use of NSAIDs and corticosteroids may increase the risk of gastrointestinal, renal, and other toxicity. Consider appropriate wash out times prior to administering additional NSAIDs or corticosteroids.

ADVERSE REACTIONS: Adverse reactions reported during a field study of 239 horses of various breeds which had been administered either BetaVet® (n=119) or a saline control (n=120) were: acute joint effusion and/or local injection site swelling (within 2 days of injection), 15% BetaVet® and 13% saline control; increased lameness (within the first 5 days), 6.7% BetaVet® and 8.3% saline control; loose stool, 5.9% BetaVet® and 8.3% saline control; increased heat in joint, 2.5% BetaVet® and 5% saline control; depression, 5.9% BetaVet® and 1.6% saline control; agitation/anxiety, 4.2% BetaVet® and 2.5% saline control; delayed swelling of treated joint (5 or more days after injection), 2.5% BetaVet® and 3.3% saline control; inappetance, 3.4% BetaVet® and 2.5% saline control; dry stool, 1.7% BetaVet® and 0% saline control; excessive sweating, 0.8% BetaVet® and 0% saline control; acute non-weight bearing lameness, 0.8% BetaVet®and 0% saline control; and laminitis, 0.8% BetaVet® and 0% saline control.

CLINICAL PHARMACOLOGY: Betamethasone is a potent glucocorticoid steroid with anti-inflammatory and immunosuppressive properties. Depending upon their physico-chemical properties, drugs administered intra-articularly may enter the general circulation because the synovial joint cavity is in direct equilibrium with the surrounding blood supply. After the intra-articular administration of 9 mg BetaVet® in horses, there were quantifiable concentrations of betamethasone (above 1.0 ng/mL) in the plasma.

EFFECTIVENESS: A negative control, randomized, masked field study provided data to evaluate the effectiveness of BetaVet® administered at 1.5 mL (9 mg betamethasone) once intra-articularly for the control of pain and inflammation associated with osteoarthritis in horses. Clinical success was defined as improvement in one lameness grade according to the AAEP lameness scoring system on Day 5 following treatment. The success rate for horses in the BetaVet® group was statistically significantly different (p=0.0061) than that in the saline group, with success rates of 75.73% and 52.52%, respectively (back-transformed from the logistic regression).

ANIMAL SAFETY: A 3-week target animal safety (TAS) study was conducted to evaluate the safety of BetaVet® in mature, healthy horses. Treatment groups included a control (isotonic saline at a volume equivalent to the 4x group); 1X (0.0225 mg betamethasone per pound bodyweight; BetaVet®); 2X (0.045 mg betamethasone per pound bodyweight; BetaVet®) and 4X (0.09 mg betamethasone per pound bodyweight; BetaVet®). Treatments were administered by intra-articular injection into the left middle carpal joint once every 5-days for 3 treatments. Injection site reactions were the most common observations in all treatment groups. Injection site reactions were observed within 1 hour of dosing and included swelling at the injection site, lameness/stiffness of the left front limb, and flexing the left front knee at rest. The injection site reactions ranged from slight swelling (in many horses on multiple days in all treatment groups) to excessive fluid with swelling, pain, and lameness (4x group only). Injection site reactions were observed most commonly on treatment days, and generally decreased in number and severity over subsequent days. The incidence of injection site reactions increased after the second and third injection (number of abnormalities noted on day 10 > day 5 > day 0). In the BetaVet® treated groups the number and severity of the injection site reactions were dose dependent. The 4X BetaVet® group had the highest overall incidence of and severity of injection site reactions, which included heat, swelling, pain, bleeding, and holding the limb up at rest. The control group and 4X group (which received similar injection volumes) had a similar incidence of injection site reactions; however, the severity of reactions was greater in the 4X group. Absolute neutrophils were statistically significantly higher in the BetaVet® treated groups as compared to the control group. Trends toward a decrease in lymphocytes and eosinophils, and an increase in monocytes were identified in the BetaVet® treated groups after the initial dose of BetaVet®. Individual animal values for white blood cells generally remained within the reference range. BetaVet® treated horses also had a trend toward increased blood glucose after the initial dose. Some individual animals showed mild increases in blood glucose above the reference range.

SHAKE WELL BEFORE USING

NADA 141-418, Approved by FDA

For customer care or to obtain product information visit www.betavetequine.com or call 1-800-458-0163.

To report an adverse event please contact Luitpold Animal Health at (800) 734-9236 or email pv@luitpold.com.

LUITPOLD
ANIMAL HEALTH

A Division of Luitpold Pharmaceuticals, Inc.
One Luitpold Drive | P.O. Box 9001 | Shirley, NY 11967

UC Davis has developed a DNA test for Haflingers to identify individuals with high risk of limbal and/or third eyelid squamous cell carcinoma.

some of the genetic components involved in the development of this cancer. They also discovered a DNA marker that identifies horses at higher risk to develop limbal and/or third eyelid SCC." UC Davis is currently offering a DNA test for Haflingers to identify individuals with high risk and to apply this information to breeding programs to help nullify the genetic mutation.

A corneal disease affliction of Friesian horses might also have a genetic link, which is being investigated by Lassaline and colleagues at UC Davis. Bilateral corneal stromal loss (BCSL) occurs in Friesian horses with corneal dystrophy. There is associated pain, vision loss and the potential to lose affected eyes. The disease tends to target male horses more often than females, and it also tends to be progressive until there is surgical intervention. Identification of a genetic link enables breeding programs to minimize passage of this defect to future generations.

Mare Fertility and Uterine Inflammation

Inflammation in a mare's uterus following breeding is not an unusual phenomenon and might, in fact, be part of a normal defense mechanism that clears introduced bacteria, debris and excess semen from the reproductive tract. Without a competent innate immune system, infection might settle in. Persistent endometritis can interfere with the establishment and retention of pregnancy.

A review of the effect of inflammation on mare fertility examined the effect of breeding on a mare's innate immune response. (Christoffersen, M. and Troedsson, M.H.T. Inflammation and fertility in the mare. Reprod Dom Anim. 2017;52 (Suppl. 3):14–20.)

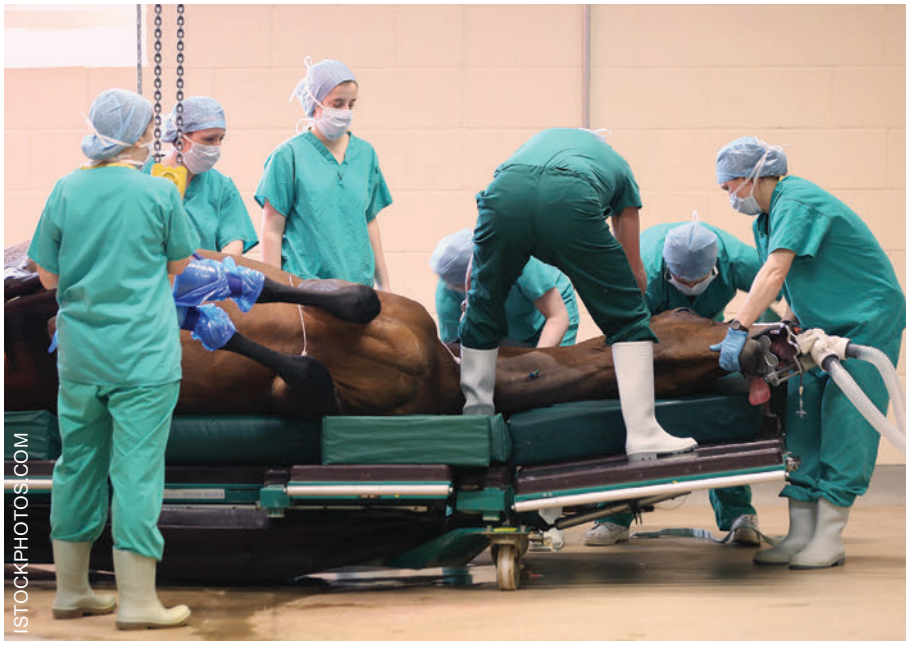
Antigenic stimulation, especially from semen, elicits a response of neutrophils (PMNs) being recruited and mobilized from the systemic circulation to the uterine lumen within 30 minutes. Their concentration peaks within four to six hours and lasts for up to 36 hours. Uterine contractions stimulated by prostaglandin response to PMN activation are important for helping to clear the uterus. Seminal plasma protects and provides nutrition for the spermatozoa as well as modulating post-breeding inflammation.

The most critical time for persistent endometritis to develop occurs six hours following breeding. Susceptible mares might have a diminished cytokine response in the three- to six-hour period following breeding as compared to mares that are resistant to bacterial infection.

Aging plays an important role as a risk factor for persistent endometritis. With this in mind, endometrial quality might be a predictive tool as to the health of the uterus and resistance to infection. Degenerative changes to the endometrium are associated with an increase susceptibility to infection.

Anatomical defects from structural changes and/or prior parturition events are additional predisposing factors. These include "poor vulvar conformation, an incompetent vestibule-vaginal sphincter, an increase in declination of the vulvar angle, and stretch of the broad ligaments to drop the uterus vertically in the abdomen." Such conformational and structural changes lead to fluid accumulation and retention, followed by bacterial colonization of the endometrium. Fluid accumulation of at least 2cm of fluid during estrus has also been associated with an increased risk of persistent endometritis.

The study concluded: "Interplay between an innate immune response, physical clearance and lymphatic drainage is required to ensure a sterile and non-inflamed uterine environment for survival of the early embryo when descending into the uterine lumen."



Researchers found that horses undergoing repeated anesthetic events had a "learned response" and recovered better, with improved balance.

Recovery from Multiple Procedures Under General Anesthesia

At times, a horse must undergo repeated surgeries under general anesthesia. Despite a low fatality rate associated with general anesthesia (less than 1%), 70% of fatalities during recovery from general anesthesia are caused by catastrophic fractures incurred during poor recovery. An innate flight-or-fight reflex encourages a horse to attempt to rise prematurely before coordination and strength are restored.

Using eight adult horses undergoing general anesthesia for multiple (six) MRI imaging events over 14 weeks, a study at Texas A&M University set out to evaluate the effects of multiple anesthetic episodes on recovery. (Platt, J.P.; Simon, B.T.; Coleman, M.; Martinez, E.A.; Lepiz, M.A.; Watts, A.E. The effects of multiple anesthetic episodes on equine recovery quality. *Equine Veterinary Journal*, Aug 2017, epub.) The horses were videotaped for observation of duration of recumbency, balance, coordination, knuckling, strength and time to full recovery.

It turns out that with an increasing number of anesthetic events, the horses recovered better, with improved balance and coordination and less knuckling over. There seems to be a learned response over each anesthetic recovery event. Neither acepromazine nor xylazine interfered with the horses' abilities to learn and become habituated to the anesthetic experience.

Odontoclastic Tooth Resorption and Hypercementosis

Dental evaluation and procedures are common in equine veterinary practice. Two often-overlooked conditions were reviewed and presented by Travis Henry, DVM, DAVDC, and Cleet Griffin, DVM, DABVP, at the 2017 North American Veterinary Conference. Since recognized a decade ago, tooth resorption and hypercementosis (EOTRH) are frequently identified. Equine practitioners will want to be aware of the presence of these syndromes.

Henry and Griffin describe tooth resorption (TR) as "an elaborate interaction between inflammatory cells, osteoclasts, periodontal tissues, alveolar bone and the hard dental tissues." This progressive condition is often painful. Hypercementosis is an enlargement of the reserve crown and root. When it occurs, it is usually concurrent with the resorptive process. This might be visually appreciated as "a bulging or gingival recession of the incisor mucosa that exposes the reserve crown (unerupted portion) of the teeth."

By the time the condition is clinically apparent, it has likely been going on for months or years. Draining tracts and parulis lesions (pustule on the mucosa) are seen in advanced stages of TR. The best way to diagnose early onset of these conditions is with dental radiographs of all quadrants of the incisors.

According to the presenters, the horse appears to be affected by two types of resorption processes:

- External inflammatory resorption—approximately 49% of horses and 17% of teeth. This is visualized radiographically by enlargement of the periodontal ligament space with loss of dental hard tissue and alveolar bone.
- External replacement resorption—approximately 77% of horses and 31% of teeth. This is visualized radiographically by loss of the periodontal ligament space and alveolar bone overtaking dental hard tissue.

Hypercementosis occurs in 21% of horses and 8% of teeth. It is visualized radiographically as enlargement of the dental hard tissue affecting the reserve crown and apex.

The recommendation is that all horses over age 15 should have incisor and canine teeth evaluated with radiographs to screen for EOTRH. Extraction is currently the treatment of choice in advanced cases. EM

EquiManagement Business Solutions for Equine Practitioners

ADVISORY BOARD

Andrew Clark, DVM, MBA
Interim Chief Executive Officer,
AVMA PLIT
DVMMBA.com

Amy Grice, VMD, MBA
President, Amy Grice VMD MBA LLC
AmyGrice.com

Robert Magnus, DVM, MBA
Managing Partner, Oculus Insights LLP
OculusInsights.net

Tracy A. Turner, DVM, MS, Dipl. ACVS, ACVSMR
Founder, Turner Equine Sports Medicine and Surgery
TurnerEquineSportsMed.com

American Association of Equine Veterinary Technicians and Assistants
AAEVT

MEDIA PARTNER AAEP

The AAEP does not endorse editorial or advertising content unless so acknowledged within the individual article or advertisement.

Welcome, 2018 Board Members

EquiManagement welcomes the following professionals, who have agreed to serve on the 2018 Advisory Board.

Andrew Clark, DVM, MBA, is the President of Andrew R. Clark, DVM, MBA, LLC. Clark provides business coaching, solutions, strategies and development for equine veterinary businesses in 12 states, two Canadian provinces, as well as clients in Europe.

Amy Grice, VMD, MBA, is president of Amy Grice VMD MBA LLC. She is an experienced veterinarian with strong business credentials. She advises veterinarians and practice owners on a wide variety of projects and challenges. Grice is an AAEP Board member and works with the AAEP's business and wellness groups.

Robert Magnus, DVM, MBA, is the managing partner of Oculus Insights LLP. Oculus is the global provider of veterinary business education and management consulting. Oculus provides targeted, actionable knowledge and materials to help transform businesses. Magnus was the founder of Wisconsin Equine Clinic and Hospital.

Tracy A. Turner, DVM, MS, Dipl. ACVS, ACVSMR, founded Turner Equine Sports Medicine and Surgery in 2016. The practice is dedicated to sports medicine, lameness and surgery. Prior to that he served on the faculty of the universities of Illinois, Florida and Minnesota. Turner consults for the USDA's Horse Protection group, the Fédération Équestre Internationale (FEI) and the United States Equestrian Federation. EM

Dream it. Design it. Build it.
Equine Veterinary Architects

ANIMAL ARTS
architecture animals people
800.332.4413 www.animalarts.com

BUSINESS BRIEF

By Amy L. Grice, VMD, MBA

Should I Pay My Loan Off Early?

Whether the debt you have is for your veterinary education, your car or a new digital radiography unit, you might wonder whether it is better to pay off your loan early or just keep making your monthly payments as scheduled. In order to make the best decision, you need to consider several factors: interest rate, cash flow, prepayment penalties and your financial values.

Paying off debt is rarely a bad idea. Because loans bear interest, it is best to pay them off as quickly as possible. Those debts carrying the highest interest should be paid down first. Credit card debt typically has a high interest rate, so paying credit cards in full each month is a smart financial move. Over time, the quicker you pay off interest-bearing debt, the more of your hard-earned income you get to keep.

In a business, loan principal payments are made from net earnings. While the interest that is paid is tax deductible, the principal is taxable. This is because when the loan proceeds are received by the company, they are not considered taxable income. Accelerating the payments on your business loan will increase the taxes that you owe that year, so you need to meet this obligation if you pay down debt ahead of schedule.

Determining the best approach with educational loans is complicated. With some of the Federal loan programs, you might lose certain benefits if you pay off the loan early. If your financial situation worsens while you are in repayment, some loan programs will lower your payment or forgive your loans after a period of years. For more information on repaying veterinary educational loans, visit AVMA.org and search for "scholarship loan repayment."

Minimizing the amount of interest you pay can be important, but having cash flow sufficient to accommodate unexpected expenses is crucial. Do you have an emergency savings fund with enough money to cover your expenses for three to six months?

Funneling some of your income into a retirement account is also essential. If you begin saving for retirement in your 20s or 30s, you will have years of gains that will make the effort much easier than that of those who neglect this aspect of their future until it is on the horizon. You will also want to be able to enjoy your life by having a modest amount of discretionary income.

In a veterinary practice, having sufficient cash flow to meet accounts payable and payroll is crucial, and that can be difficult with the seasonal nature of the equine industry. Utilizing excess cash to pay down debt in the busy months could leave you short in the lean months.

Most loans do not have a pre-payment penalty, but before deciding to pay down a debt, be sure that you will reduce your total interest payment if you pay off the principal early.

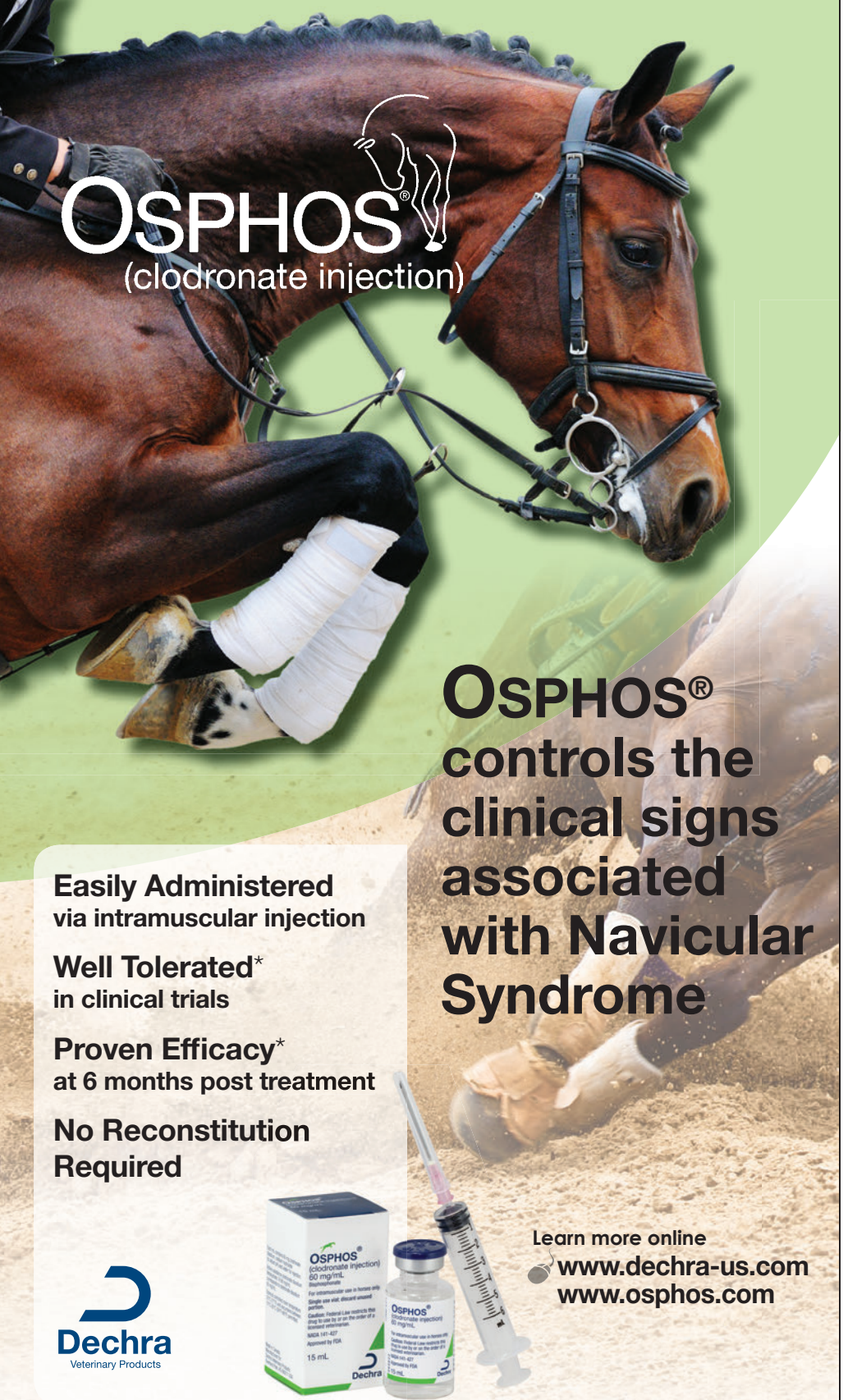
Not incurring debt or paying down debt as quickly as possible is a value that some people hold dear. Other people see debt as a tool to maximize their financial reach, and they will often take the longest possible term in order to minimize their monthly payments.

If the debt is used to earn profits higher than the interest rate on the note and the asset has an expected useful life longer than the loan term, this can be a good strategy. An example is the purchase of equipment to provide services that are highly profitable.

It's important to remember that finances are a very personal subject, and one's outlook on debt can affect peace of mind. When forming partnerships, it is important to have similar philosophies about debt.

If you find yourself with a little extra cash or you have inherited a large sum, you have a choice of how to use it: Save for retirement? Save for your child's education? Start an emergency fund? Go on a vacation? Get some new tires on your car? Make a charitable donation? Pay down debt? All of these uses of money have merit, and you need to balance your current needs against the millstone of debt around your neck.

Paying down debt promptly will improve your credit score, making you an attractive borrower for future credit needs. Once you eliminate a monthly payment, you suddenly have that cash available for other uses. EM



OSPHOS® controls the clinical signs associated with Navicular Syndrome

Easily Administered
via intramuscular injection

Well Tolerated*
in clinical trials

Proven Efficacy*
at 6 months post treatment

No Reconstitution Required

Dechra
Veterinary Products

Learn more online
www.dechra-us.com
www.osphos.com

As with all drugs, side effects may occur. In field studies, the most common side effects reported were signs of discomfort or nervousness, colic, and/or pawing. OSPHOS should not be used in pregnant or lactating mares, or mares intended for breeding. Use of OSPHOS in patients with conditions affecting renal function or mineral or electrolyte homeostasis is not recommended. Refer to the prescribing information for complete details or visit www.dechra-us.com or call 866.933.2472.

CAUTION: Federal law restricts this drug to use by or on the order of licensed veterinarian.

* Freedom of Information Summary, Original New Animal Drug Application, NADA 141-427, for OSPHOS. April 28, 2014.

Dechra Veterinary Products US and the Dechra D logo are registered trademarks of Dechra Pharmaceuticals PLC. © 2016 Dechra Ltd.

OSPHOS® (clodronate injection)

Bisphosphonate
For use in horses only.

Brief Summary (For Full Prescribing Information, see package insert)

CAUTION: Federal (USA) law restricts this drug to use by or on the order of a licensed veterinarian.

DESCRIPTION: Clodronate disodium is a non-amino, chloro-containing bisphosphonate. Chemically, clodronate disodium is (dichloromethylene) diphosphonic acid disodium salt and is manufactured from the tetrahydrate form.

INDICATION: For the control of clinical signs associated with navicular syndrome in horses.

CONTRAINDICATIONS: Horses with hypersensitivity to clodronate disodium should not receive OSPHOS.

WARNINGS: Do not use in horses intended for human consumption.

HUMAN WARNINGS: Not for human use. Keep this and all drugs out of the reach of children. Consult a physician in case of accidental human exposure.

PRECAUTIONS: As a class, bisphosphonates may be associated with gastrointestinal and renal toxicity. Sensitivity to drug associated adverse reactions varies with the individual patient. Renal and gastrointestinal adverse reactions may be associated with plasma concentrations of the drug. Bisphosphonates are excreted by the kidney; therefore, conditions causing renal impairment may increase plasma bisphosphonate concentrations resulting in an increased risk for adverse reactions. Concurrent administration of other potentially nephrotoxic drugs should be approached with caution and renal function should be monitored. Use of bisphosphonates in patients with conditions or diseases affecting renal function is not recommended. Administration of bisphosphonates has been associated with abdominal pain (colic), discomfort, and agitation in horses. Clinical signs usually occur shortly after drug administration and may be associated with alterations in intestinal motility. In horses treated with OSPHOS these clinical signs usually began within 2 hours of treatment. Horses should be monitored for at least 2 hours following administration of OSPHOS.

Bisphosphonates affect plasma concentrations of some minerals and electrolytes such as calcium, magnesium and potassium, immediately post-treatment, with effects lasting up to several hours. Caution should be used when administering bisphosphonates to horses with conditions affecting mineral or electrolyte homeostasis (e.g. hyperkalemic periodic paralysis, hypocalcemia, etc.).

The safe use of OSPHOS has not been evaluated in horses less than 4 years of age. The effect of bisphosphonates on the skeleton of growing horses has not been studied; however, bisphosphonates inhibit osteoclast activity which impacts bone turnover and may affect bone growth.

Bisphosphonates should not be used in pregnant or lactating mares, or mares intended for breeding. The safe use of OSPHOS has not been evaluated in breeding horses or pregnant or lactating mares. Bisphosphonates are incorporated into the bone matrix, from where they are gradually released over periods of months to years. The extent of bisphosphonate incorporation into adult bone, and hence, the amount available for release back into the systemic circulation, is directly related to the total dose and duration of bisphosphonate use. Bisphosphonates have been shown to cause fetal developmental abnormalities in laboratory animals. The uptake of bisphosphonates into fetal bone may be greater than into maternal bone creating a possible risk for skeletal or other abnormalities in the fetus. Many drugs, including bisphosphonates, may be excreted in milk and may be absorbed by nursing animals.

Increased bone fragility has been observed in animals treated with bisphosphonates at high doses or for long periods of time. Bisphosphonates inhibit bone resorption and decrease bone turnover which may lead to an inability to repair micro damage within the bone. In humans, atypical femur fractures have been reported in patients on long term bisphosphonate therapy; however, a causal relationship has not been established.

ADVERSE REACTIONS: The most common adverse reactions reported in the field study were clinical signs of discomfort or nervousness, colic and/or pawing. Other signs reported were lip licking, yawning, head shaking, injection site swelling, and hives/pruritus.

OSPHOS® (clodronate injection)

Dechra
Veterinary Products

Distributed by: Dechra Veterinary Products
7015 College Boulevard, Suite 525
Overland Park, KS 66211 866-933-2472

© 2016 Dechra Ltd. OSPHOS is a registered trademark of Dechra Ltd. All rights reserved.
NADA 141-427, Approved by FDA

A lot has been learned about the disease known today as EPM since it was first mentioned in literature in 1969.

EPM Society Workshop

This report was written for equine veterinarians, students, techs and researchers who are interested in better understanding the disease equine protozoal myeloencephalitis (EPM).

By Kimberly S. Brown

The future of equine disease research and collaboration was witnessed during the EPM Society's Workshop in October 2017. The first workshop was held in 2014 in Kentucky, where 45 attendees gathered with the goal to better understand EPM, share information, identify unresolved areas and promote collaborative research. A similar number gathered in Tahoe City, California, October 25-27, for an intensive 1½ days of presentations and discussion.

Another notable future that arrived was that more than half of the attendees were female, and there were infants and small children present and welcomed by the group. This is to be expected now that equine veterinarians have turned the gender curve to having nearly equal numbers of women and men practitioners. And it seems that equine research is on the same gender-equality

DUSTY PERIN

road, with 16 of the 22 presentations being given by women and all of the younger research presenters being female. That is promising for the future of equine protozoal research.

A lot has been learned since Dr. Jim Rooney and colleagues from New Bolton Center, the University of Pennsylvania and the University of Kentucky first described what is now known as EPM. It was first called "focal myelitis-encephalitis in horses" in an article published in *The Cornell Veterinarian* in 1969 (which can be found at https://babel.hathitrust.org/cgi/pt?id=uc1.b3779845;view=1up;seq=518).

While EPM is a disease that was recognized nearly 50 years ago—and a lot has been learned about the causes, treatments and preventions for the disease—the group agreed that there is still much to learn. And they stated that the future of that learning process must be collaborative to a large extent.

The 2014 EPM Workshop ended with the thought that considerable progress had been made in the areas of biology, the genome and life cycle of *Sarcocystis neurona*; the epidemiology and pathogenesis of EPM; the diagnosis of *S. neurona* and *N. hughesi* (which can cause EPM); and treatment.

It was also agreed in 2014 that the fields of needed research included:

- the effect of parasite genotype on pathogenesis;
- the horse as intermediate versus accidental host;
- the role of immune response in protection and disease;
- the contribution of co-morbidity (co-infection); and
- expanded fundamental knowledge on *N. hughesi*.

While some of these areas have been addressed by research, none has been definitively answered.

The updated EPM consensus statement released in 2016 is available to the public at http://onlinelibrary.wiley.com/doi/10.1111/jvim.13834/full.

The Future of EPM Research

Six topics for presentations and discussion at the 2017 Workshop were outlined: biology; genetics, immunology and vaccine; co-morbidity between Apicomplexan protozoa; laboratory diagnostics; future needs in the field of EPM; and treatment and prevention. The keynote talk was presented as a stand-alone on Friday morning.

One of the keynote speakers addressed an area that Nicola Pusterla, DrMedVeT, MedVet, of the University of California, Davis, College of Veterinary Medicine, said needed attention. This area is to look at "closely related pathogens and try to translate that to the pathogen we are dealing with."

How do the parasites that cause equine protozoal myeloencephalitis evade a horse's competent immune response?

Jereon Saeij, PhD, Associate Professor and Researcher Pathology, Microbiology and Immunology, University of California, Davis, has been studying *Toxoplasma gondii* for the last 15 years. Saeij is new to the field of *Sarcocystis* and EPM research, and he said there is still a lot to be discovered about the parasites that cause EPM. He brought up some very interesting questions and observations about EPM during his presentation: "What if—a comparative approach to the Apicomplexan protozoal organisms."

The other keynote speaker was Patricia Conrad, DVM, PhD, Professor and Researcher Pathology, Microbiology and Immunology, at the University of California, Davis. Conrad was awarded the 2017 AVMA Lifetime in Excellence Research Award. She been working on protozoal parasites for 37 years.

One of the points that Conrad raised is whether horses are really aberrant hosts in the *S. neurona* life cycle. It has been proven that *N. hughesi* can recrudesce from the latent bradyzoite state and proliferate again, and that there can be vertical transmission from a dam to a fetus. Could the same be true of *S. neurona*? Most research suggests this does not occur routinely.

Saeij asked the audience to ponder why some animals get sick after infection with a particular parasite strain while others do not. He posed that some individuals are more susceptible than others, and some strains of a given parasite are more virulent than others.

"Differences in disease outcome are caused by the complex interaction between host genotypes and parasite genotypes with environmental variation, which can include co-infection," said Saeij. "Parasites have figured out how to manipulate a host to stay with it the rest of the host's life. But how do they evade a competent immune response?"

Saeij said that Apicomplexan parasites are a leading cause of human and livestock diseases worldwide. "There are hundreds of *Sarcocystis* species, most have two-host life cycle (carnivore and herbivore), and some have one host. *S. neurona*, unlike most *Sarcocystis* species, can have multiple intermediate hosts."

He noted that *Sarcocystis* parasites need to keep their host alive, as only the chronic encysted form is infectious—so it can't complete its life cycle if the host dies too soon after infection.

"Parasites secrete proteins to control the immune response to form lifelong infections," noted Saeij. "If this is a multi-host parasite, how is *Sarcocystis* able to evade immune responses in different species?

"Nothing is known about how *S. neurona* modulates the host cells it infects," he added.

Dr. Frank Andrews of Louisiana State University reported on a study on the proportional morbidity rate of EPM.

Saeij said there is a lot of "basic" knowledge that is missing in the study of *S. neurona*. "Mice are not a good model to study pathogenesis of *S. neurona*," he noted. "*S. neurona* is missing ROP18 and ROP5, which are effectors secreted by *Toxoplasma* to inhibit host IFN-gamma-induced, immunity-related GTPases (IRGs) that are involved in killing the parasite, and therefore likely extremely susceptible to IFN-gamma mediated killing. So only IFN-gamma knockout mice can be infected by *S. neurona*."

His emphasis was that this is not a "natural" state of the parasite's life cycle and thus didn't provide information on how *S. neurona* was interacting with a natural host.

"Horses, cats, opossums, skunks and humans do not have TLR11, which is the main innate immune receptor in mice that recognizes *Toxoplasma* and other apicomplexan parasites, and they do not have IRGs," he noted. Therefore, these species must have other ways of recognizing and destroying parasites such as *S. neurona*.

"Nothing is known about how *S. neurona* modulates the host cells it infects," he concluded.

It should also be noted that the natural life cycle of *N. hughesi* is not known.

There is no good animal model to test for differences in virulence for *S. neurona* strains, noted Saeij. "If we knew what virulent *S. neurona* strains were, and which ones were avirulent, we could cross them in possums and test virulence of the F1 progeny," he said.

He said an alternative solution was to improve serodiagnostics so that different strains of *S. neurona* could be distinguished and association studies between *S. neurona* strains and EPM could be performed.

"*S. calchasi* is closely related to *S. neurona* and causes pigeon protozoal encephalitis," said Saeij. "Is this a possible model for *S. neurona*?"

When Saeij said he did not feel that mice were a good animal model for *S. neurona* research, it caused a bit of debate about using mice among the researchers.

"We gave TLR11 knockout mice *S. neurona* and didn't hurt them," said Saeij. "Mice can kill *S. neurona* through IRGs. And the way mice deal with *Sarcocystis* is different from the way the horse and opossum deal with *Sarcocystis*, as these species do not have IRGs."

Antoinette Marsh, JD, MS, PhD, Associate Professor, Service Head of Veterinary Medical Center Diagnostic Parasitology, Department of Veterinary Preventive Medicine, The Ohio State University, acknowledged that raccoons are difficult to work with in the lab in response to another audience member's question on lab animal models. She said her lab has looked at ferrets.

Marsh also discussed the point that

MARQUIS® (15% w/w ponazuril) Antiprotozoal Oral Paste, a Merial product

Some diagnoses you have to face head-on.

Equine Protozoal Myeloencephalitis (EPM) is an expert in deception and your clients may at first confuse it with other issues, such as lameness. Only stopping the parasite responsible can stop EPM from causing further damage to the horse's brain and CNS. Time matters. The sooner EPM is detected and diagnosed, the better the chance for recovery.

That's why you need a tube of MARQUIS on every truck to initiate treatment immediately. MARQUIS is a powerful anti-protozoal.

Only MARQUIS offers a 3X loading dose protocol that allows it to reach steady state in 24 to 48 hours.*,[1]

*Clinical relevance has not been determined.

The signs can be subtle.
The treatment should be aggressive.

Marquis®
(15% w/w ponazuril)

Clients can save on their next purchase.
MAX.merial.com

[1]MARQUIS Freedom of Information Summary and Supplement and product label.

IMPORTANT SAFETY INFORMATION: *The safe use of MARQUIS in horses used for breeding purposes, during pregnancy, or in lactating mares, has not been evaluated. In animal safety studies, loose feces, sporadic inappetence, lost weight, and moderate edema in the uterine epithelium were observed.*

Boehringer Ingelheim

Merial is now part of Boehringer Ingelheim.
®MARQUIS is a registered trademark of Merial.
©2017 Merial, Inc., Duluth, GA. All rights reserved. EQUIOMQ1506-B (04/16)

MARQUIS®

(15% w/w ponazuril)

Antiprotozoal Oral Paste

Caution: Federal (U.S.A.) law restricts this drug to use by or on the order of a licensed veterinarian.

For The Treatment Of Equine Protozoal Myeloencephalitis (EPM) In Horses For Oral Use Only

BRIEF SUMMARY
Before using MARQUIS, please consult the product insert, a summary of which follows:

INDICATIONS
MARQUIS (ponazuril) is indicated for the treatment of equine protozoal myeloencephalitis (EPM) caused by *Sarcocystis neurona*.

WARNINGS
For use in animals only. Not for use in horses intended for food. Not for human use. Keep out of reach of children.

PRECAUTIONS
Prior to treatment, a complete neurologic exam should be completed by a veterinarian. In most instances, ataxia due to EPM is asymmetrical and affects the hind limbs. Clinicians should recognize that clearance of the parasite by ponazuril may not completely resolve the clinical signs attributed to the natural progression of the disease.

The prognosis for animals treated for EPM may be dependent upon the severity of disease and the duration of the infection prior to treatment. The safe use of MARQUIS (ponazuril) in horses used for breeding purposes, during pregnancy, or in lactating mares, has not been evaluated. The safety of MARQUIS (ponazuril) with concomitant therapies in horses has not been evaluated.

ADVERSE REACTIONS
In the field study, eight animals were noted to have unusual daily observations. Two horses exhibited blisters on the nose and mouth, three animals showed skin reactions for up to 18 days, one animal had loose stools, one had a mild colic on one day and one animal had a seizure while on medication. The association of these reactions to treatment was not established.

ANIMAL SAFETY SUMMARY
MARQUIS (ponazuril) was administered to 24 adult horses (12 males and 12 females) in a target animal safety study. Three groups of 8 horses each received 0, 10 or 30 mg/kg (water as control, 2X and 6X for a 5 mg/kg [2.27 mg/lb] dose). Horses were dosed after feeding. One half of each group was treated for 28 days and the other half for 56 days followed by necropsy upon termination of treatment. There were several instances of loose feces in all animals in the study irrespective of treatment, sporadic inappetence and one horse at 10 mg/kg (2X) lost weight while on test. Loose feces were treatment related. Histopathological findings included moderate edema in the uterine epithelium of three of the four females in the 6X group (two treated for 28 days and one for 56 days).

For customer care or to obtain product information, including a Material Safety Data Sheet, call 1-888-637-4251 Option 2, then press 1.

®MARQUIS is a registered trademark of Merial.

©2016 Merial, Inc., Duluth, GA.
All rights reserved.

MERIAL
A SANOFI COMPANY

there are at least two horse strains of *S. neurona* that produce small cysts rather than large cysts. "We don't have good markers to know if they are metrocytes or bradyozoites," she said.

Saeij noted that with toxoplasmosis, when a strain is always passed through mice vs. always passed *in vitro*, and when these strains are then used to infect a host, the host can react differently in terms of virulence. "*In vitro*, the strains often become more virulent," he said. "So how a strain has been treated in the laboratory can influence phenotypes."

That raised discussion on where isolates used in research had been cultured, where they have traveled, and how they have been handled.

Conrad noted that some "isolates" could be a combination of different strains, or they could have had a metabolic change in the laboratory setting.

Dan Howe, PhD, a professor at the University of Kentucky's Gluck Equine Research Center, said the idea of metrocytes (transition stage between merozoite and bradyzoite) being able to recrudesce is intriguing. "How long do metrocytes hang around?" he asked colleagues in the audience.

Marsh's response seemed to sum up what the audience members thought: "I don't know."

Conrad asked whether the audience members thought strain differences among *Sarcocystis* species should be considered by researchers when the question is raised as to why so many horses are infected and only a small proportion get disease.

Several in the audience agreed that a "hotspot" of disease would occur if there was a more virulent strain in an area.

Conrad noted that opossums can be infected with different *Sarcocystis* strains. "Opossums appear to be different from cats in shedding," she said. "Maybe opossums are persistent shedders, not one-time shedders. But what are they contaminating the environment with? You can't even say 'keep possums off or out of feed,' because once opossums poop and it rains or snows, it washes in. The oocysts are in soil and wash into water supplies. They last a long time."

Pusterla asked the audience how hard it is to genotype *Sarcocystis*. Conrad said that if the right laboratories had access to the parasites, it would be easy.

Resources for Veterinarians and Students

Pusterla said, "We're all experts in our fields, but we are a small group. Each of us can make a contribution in our fields. Our colleagues are faced with the challenges out in the field. Our goal and responsibility is to come up with tools to address EPM."

Among the topics where researchers felt they could help veterinarians in the field were helping to create guidelines for case assessment and for conducting a comprehensive neurologic exam.

"We think most vets know how to do a neurologic exam," said Pusterla. "Sometimes there is no reason to suspect EPM."

Pusterla added, "I'm not seeing people doing CSF taps." Perhaps, he said, we need to show them techniques that are easier and safer when they have to sedate and test these horses.

There was discussion by Michel Levy, DVM, from the University of Calgary, about creating case simulations for veterinary students. Many in the audience thought that when the information was pulled together for these case simulations, they should also be made available to practicing veterinarians.

Levy has been working with a woman in Montreal who retired from creating training for astronauts. He wants to put together virtual computer cases from history to pathology. The cases will also have different client types, from the "spend anything" to "I can't afford to test, only treat" types.

Levy wants to create a consortium of

Presenters at the EPM Society meeting included, from left, Drs. Siobhan Ellison, Steve Reed, Rodney Belgrave, Akinyi Nyaoke and Amy Johnson.

professionals to provide and look at cases for this online education. Included in the education would be different ways to do a spinal tap.

Monica Aleman, MZV, PhD, DACVIM-Internal Medicine Large Animal Internal Medicine, DACVIM-Neurology Veterinary Neurology and Neurosurgery, University of California, Davis, noted that it was important that these cases be accessible to veterinarians. "You need specialized training in neurology to see some of these things," she explained. "I took special training, and it really opened my eyes."

Pusterla recommended that when this online education was created, there should be a consultation portal to make it easy for veterinarians to connect with experts in the field of protozoal parasites.

The discussion turned from online education to the need for a repository of samples that researchers could use.

"We don't have a repository of what we need," said Pusterla. "Can we come up with group agreement for a 'wish list' of samples and who keeps track of them? What kind of financial support can we get to provide this?" He explained that it would be like OIE centers for equine influenza.

The audience members agreed that researchers needed "gold standard" cases for reference. "Absolutely," said Pusterla. "We would have to have a questionnaire to have specific information and samples."

Conrad said that the repository would need to identify the pathologists who are interested in protozoa and let them work out some of the logistics, such as how samples are shared and who pays for the personnel and facilities needed.

"We would need restrictions as to client information and the ability to use samples for other purposes," she noted. "And we would need a collaborative team that includes pathologists."

Pusterla reminded the audience that something of this nature would need to start with the clinicians. "We need a well-documented case that makes it to pathology," he noted. "We need a good history, and they need to be terminal cases that then go to pathology. Perhaps we start with referral hospitals."

Sharon Witonsky, DVM, PhD, DACVIM, Associate Professor Equine Field Service, Department of Large Animal Clinical Sciences, Virginia-Maryland College of Veterinary Medicine, said the group would need to get people together to determine key questions of case definition and have everyone possible collecting samples. "When it takes 2.5 hours to sample a brain and spinal cord, we need to share for collaborative purposes and authorship," she said.

Levy added that the reference information should include some difficult or different cases as differential diagnoses.

David Wilson, BVMS, MS, Professor Emeritus Medicine & Epidemiology, University of California, Davis, College of Veterinary Medicine, said the group would also need "gold standard" negative cases. That elicited discussion as to whether those negative cases should be from areas without *S. neurona* (Europe, for example) or should be negative horses from areas where EPM is known to occur.

Conrad added, "We need to use animals that underwent all the same diagnostics and pathologic sampling. We need to come to consensus on that."

Following are short synopses of several of the presentations at the 2017 EPM Society Workshop.

Size Matters

Marsh and colleagues recently completed a study where they found small sarcocysts that probably were missed in previous studies. "Our results also highlight the importance of immunohistochemistry staining for detecting the small sarcocysts that can be missed due to their size and lack of associated inflammation," she reported.

During the question-and-answer session, an audience member noted that a Michigan paper stated that horses are capable of having cysts in the tongue.

Seroprevalence of *S. neurona* and *N. hughesi* Among Healthy U.S. Horses

Kaitlyn James, PhD, a research assistant in the College of Veterinary Medicine at the University of California, Davis, did a study to describe the general seroprevalence of *S. neurona* and *N. hughesi*. She also looked at the potential risk factors (geographic region, breed, use, gender and age) of the horses involved in the study.

A total of 5,250 samples from 18 states was collected with risk factor information. The overall prevalence of *S. neurona* was 78%, while the overall prevalence of *N. hughesi* was 34%. Thirty-one percent were seropositive for both parasites, and 18% were seronegative to both.

S. fayeri Infection Associated with Neuromuscular Disease in Horses

Two years ago, Aleman and colleagues published an article about equine infections with *Sarcocystis* species. She referenced a Japanese study showing that humans who consumed raw horse meat had a *S. fayeri*-induced toxicity that caused intestinal sarcocystosis.

Aleman and colleagues found that *S. fayeri* infection was common in young, mature equids with neuromuscular disease. "Our study did not establish causality, but a possible association (8.9% of cases) with neuromuscular disease; the assumption of *S. fayeri* sarcocysts in muscle being an incidental finding in every case might be inaccurate. Further studies are needed to determine the role of *S. fayeri* infection in the development of neuromuscular disease in horses."

Questions from the audience centered around which parasite is actually causing disease when both *S. neurona* and *S. fayeri* are a co-infection in the same horse.

One audience member said it might be possible that when *S. fayeri* releases toxin, it might cause neurologic disease, compared to *S. fayeri* that doesn't release toxin.

Proportional Morbidity Rate of EPM in North America

Frank Andrews, DVM, DACVIM, of the Louisiana State University Veterinary Teaching Hospital, had a two-fold reason for this study. The first reason was to assess temporal changes in the proportion of cases reported to vet teaching hospitals in North America. The second was to assess the perception of veterinary practitioners regarding the incidence (cases seen) of EPM.

This was a retrospective study 1990-2015 of case records from Veterinary Teaching Hospitals in North America and a survey sent to veterinarians via several major veterinary Listservs in 2016.

Andrews reported on the proportional morbidity rate (PMR), which is the number of cases of a specific diagnosis divided by the total number of cases of all diagnoses in that same population. He noted that a PMR is an indicator of incidence in veterinary teaching hospitals, but not of actual incidence in the whole horse population at large.

The spike in cases seen from 1995 to 1999 was probably due to the introduction of the Western blot test to diagnose EPM, after which more cases were recognized. With this exception, the PMR from veterinary teaching hospitals (1990-2008) showed little change and was approximately 0.80 (8 EPM cases/1,000 cases presented).

"However, for the past seven years (2009-2015) of the study, the number of EPM cases presented to veterinary teaching hospitals has significantly decreased," noted Andrews. This might indicate that more practitioners are diagnosing and treating horses with EPM in their practices and not sending them to veterinary teaching hospitals, because veterinarians' perceptions, during that time, showed that a majority thought the number of cases was staying the same or increasing.

"It appears that Standardbreds, Tennessee Walking Horses, Thoroughbreds, warmbloods, stallions and horses 3-7 years of age and 11-15 years of age are more likely to be diagnosed with EPM," noted Andrews.

He said it is important for horse owners to consult with their veterinarians so that other causes of neurologic disease can be ruled out. However, with improved diagnostics and three available treatment options, practitioners are likely treating more EPM cases in the field and referring fewer cases to veterinary teaching hospitals.


ISTOCKPHOTOS.COM

Once opossums defecate and it rains or snows and washes in, the oocysts are in soil, get in water supplies and remain for a long time.

Vaccination Development

While there was a lot of discussion about this topic, the consensus was that there is no viable vaccine at this time that has been proven to protect horses from the causative parasite. More research is needed.

Co-Morbidity Between Apicomplexan Protozoa

Martin Furr, DVM, PhD, DACVIM, is the head of the Department of Physiological Sciences at Oklahoma State Uni-

versity's Center for Veterinary Health Sciences. He and Conrad co-authored a presentation on co-morbidity between apicomplexan protozoa, with Furr making the presentation.

Furr said that survival and growth of infectious protozoa in immunocompetent hosts meant that the parasites had "outrun" the host response by fast replication or mutation. It also meant that they impair development of expression of immunity in the host (immune evasion or restriction).

"The result is a 'non-sterilizing' immunity, which reduces parasite burden and limits pathological damage without wiping out the invader," stated Furr.

Protozoan co-infections (polyparasitism) is common in humans, noted Furr, who said that might be the norm rather than the exception with protozoa. He said there are known co-infections in cats. In a 2014 study from Pusterla, where he looked for co-infections with *S. neurona* and *N. hughesi* in 3,123 EPM suspect horses, the researchers found that 71% of the horses were negative to both parasites; 26.8% were positive only for *S. neurona*; 1.2% were positive for *N. hughesi* only; and 0.8% were positive for both parasites.

The questions raised by the researchers included:

- Does *Sarcocystis* infection caused immunosuppression, allowing secondary infections with other organisms?
- To what degree does this immunosuppression limit treatment efficacy?
- Are other parasitic, bacterial or viral co-morbidities influencing EPM susceptibility?
- Do infections with various strains of *S. neurona* or *N. hughesi* influence disease susceptibility or clearance of organisms?

Laboratory Diagnostics

The overview of laboratory diagnostics for EPM was presented by Jennifer Morrow, PhD, of Equine Diagnostic Solutions, and Amy Johnson, DVM, Assistant Professor of Large Animal Medicine and Neurology, University of Pennsylvania, New Bolton Center.

The 2016 ACVIM Consensus Statement noted that there are three recommendations for the diagnosis of EPM:

1. a neurologic exam to confirm clinical signs;
2. the exclusion of other potential diseases; and
3. immunodiagnostic testing of serum and CSF to confirm intrathecal antibody production.

Johnson and Morrow presented tables of comparisons that were modified from the 2016 ACVIM consensus statement that looked at

- commercially available immunologic tests for antibodies against *S. neurona*;
- commercially available immunologic tests for antibodies against *N. hughesi*; and
- test comparisons focusing on EPM caused by *S. neurona*.

Their summary was that serum tests are less accurate, and that the SAG2, 4/3 ratio was the most accurate compared to Western blot, SAG1 and IFAT.

Other presentations in the laboratory section included c-reactive protein and serum amyloid A (SAA) as a biomarker for EPM diagnosis; comparison of specific antibody index and Goldmann-Witmer coefficient to evaluate intrathecal immunoglobulin G production in EPM; phosphorylated neurofilament H as a potential diagnostic marker for neurological disorders in horses; and performance assessment of different diagnostic assays to identify EPM-affected horses in a clinical setting.

Relevance and Future Needs in the Field of EPM

Pusterla gave an overview of this section. For the clinician, he said there is a need for a reliably validated and potentially improved diagnostic for EPM, as well as ways to support a diagnosis without performing a CSF tap.

He said that the industry wants additional effective drugs. He noted that case definition and quantitative serodiagnostics could potentially improve the efficacy of approved drugs. To do this, he said there is a need to establish a cost-effective and reliable animal model.

Pusterla said that in the area of prevention, the industry would like a vaccine that is proven with post-licensing studies as well as better understanding of relapse/recurrence rates.

Standing Cervical Spinal Tap

Many practitioners in the field are not comfortable doing a spinal tip for EPM testing.

Pilar Camacho-Luna, an equine medicine resident at Louisiana State University School of Veterinary Medicine, working with Andrews and another colleague, described an alternative to standing lumbosacral CSF tap for EPM diagnosis.

Traditionally, the approach for a CSF tap in horses is either alanto-occipital or lumbo-sacral. The cervical approach offered less blood contamination than samples taken from the lumbo-sacral space, and Camacho-Luna said that the location was less difficult to access. The procedure was done using ultrasound-guided needle insertion.

She reminded the audience that there is always a risk associated with anesthetizing a horse that is already neurologic.

Treatment and Prevention

The final segment of the EPM Workshop started with an overview presented by Steve Reed, DVM, DACVIM, of Rood and Riddle Equine Hospital, and Rob MacKay, BVSc, PhD, DACVIM, a professor at University of Florida College of Veterinary Medicine.

The presenters noted that there have been several drugs used to treat

SHANK'S VETERINARY EQUIPMENT INC.

Lifting Large Animals Since 1957
www.shanksvet.com

EPM in the last 40 years. Currently there are FDA-approved therapies that include Marquis (ponazuril), Protazil (diclazuril), sulfa/pyrimethamine and a combination treatment. They noted there also are unofficial/off-label/illegal EPM treatments that include toltrazuril (Baycox) and compounded drugs.

Some immunostimulants are being used in horses with EPM. Other prevention methods include reduction of risk factors (such as stress and transportation), reduction of exposure to or contamination by opossums, and prophylactic treatment.

Reed noted that there is "promiscuous" use of EPM drugs in racehorses.

Howe reported that bumped kinase inhibitors (BKIs) might be good candidates for treatment of EPM. Pusterla discussed a positive initial study of twice-weekly diclazuril administration rather than daily administration to reduce infection rates.

There also was a long discussion about "relapses" of EPM with no clear-cut answers.

One interesting presentation was on a paper by Heather Fritz, DVM, PhD, of UC Davis diagnostic lab, and colleagues from Davis and Washington State University, entitled: "Novel high-throughput screen of drug compound library identifies inhibitors of SN growth."

Her group developed, validated, then implemented the use of novel high-throughput screen to test 725 FDA-approved chemical compounds from the National Institutes of Health clinical collections library.

"Our screen identified 18 novel compounds with confirmed inhibitory activity against *S. neurona* growth," she reported. "Many of the inhibitory compounds identified have well-defined mechanisms of action, making them useful tools to study parasite biology in addition to being potential therapeutic agents."

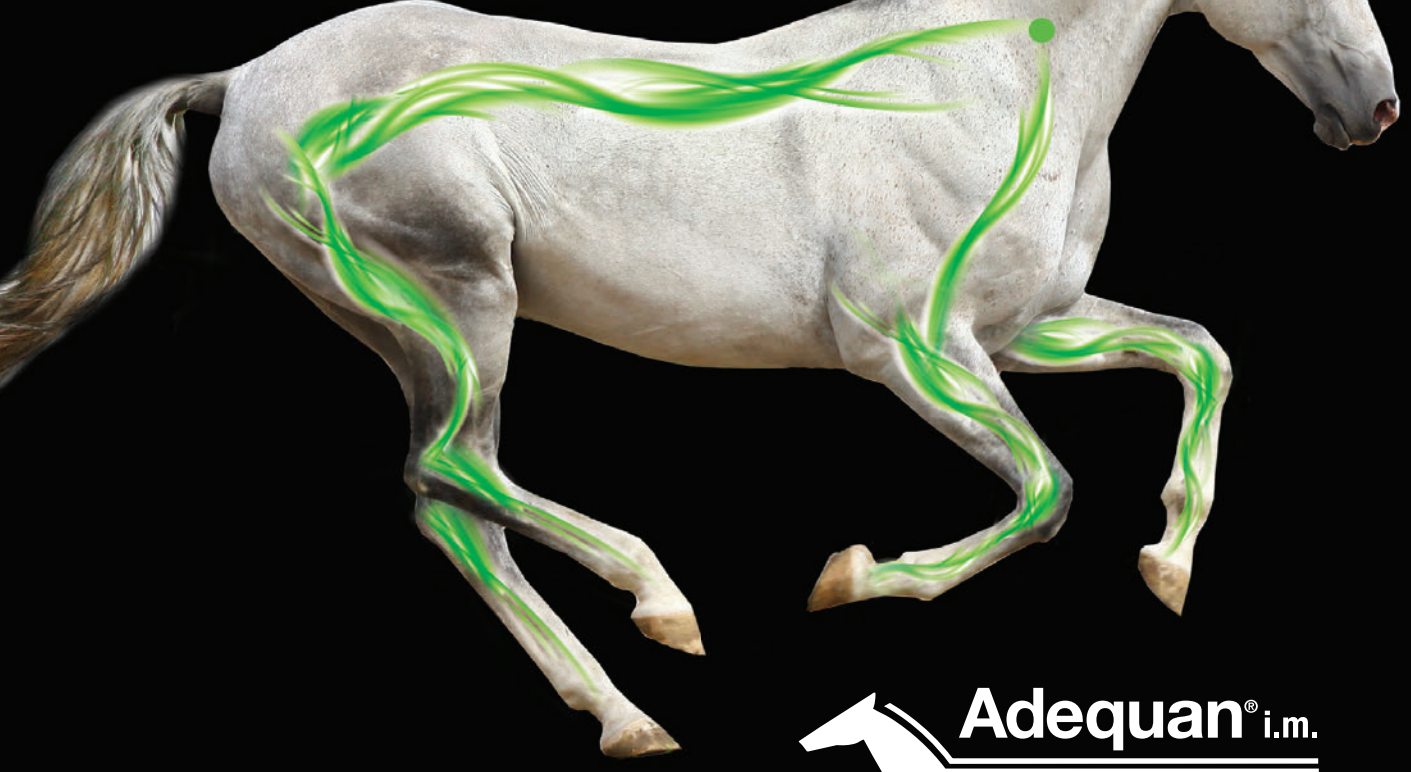
They found that 15 of the 18 compounds had activity against one or more related apicomplexans.

"Interestingly, nearly half of the inhibitory compounds were reported to have activity against dopamine receptors," she reported. "These studies demonstrate the use of a robust new tool for discovering new chemotherapeutic agents for EPM and potentially provide new reagents to elucidate biologic pathways required for successful *S. neurona* infection."

Take-Home Message

The 2017 EPM Society Workshop might have been small in size, but the information should give hope to clinicians and horse owners that solving the problem of EPM is moving forward at a rapid rate. There is still much to learn, but with cooperation and a little more time, this disease can be mastered. EM

Looking for QUALITY BANDAGES for your Practice?
STERIROLL®
Sterile leg bandage in several lengths
REDIROLL™
Nonsterile leg bandage in several lengths
COMBIROLL®
Bulk cotton combine roll preferred by veterinarians, 10-yard rolls
All products available in 8", 12", 14" and 16" widths
Endorsed by leading equine veterinarians and used by hospitals, clinics and schools of veterinary medicine across the U.S.
MADE IN THE USA
THE FRANKLIN-WILLIAMS COMPANY
Lexington, Kentucky • 800 556-5517 • 859 259-0515
www.franklinwilliams.com



Adequan® i.m.
polysulfated glycosaminoglycan

There is NO GENERIC ADEQUAN®

The **ONLY** FDA approved equine PSGAG for the intramuscular treatment of non-infectious degenerative joint disease (DJD) of the carpal and hock joints proven to:

- DIMINISH the destructive processes of degenerative joint disease
- REVERSE the processes which result in the loss of cartilage components
- IMPROVE overall joint function and associated lameness

Available for order! For more information about equine joint health and treatment with Adequan® i.m., please visit **www.adequan.com**.

INDICATIONS

For the intramuscular treatment of non-infectious degenerative and/or traumatic joint dysfunction and associated lameness of the carpal and hock joints in horses.

IMPORTANT SAFETY INFORMATION

There are no known contraindications to the use of intramuscular Adequan® i.m. brand Polysulfated Glycosaminoglycan in horses. Studies have not been conducted to establish safety in breeding horses. **WARNING:** Do not use in horses intended for human consumption. Not for use in humans. Keep this and all medications out of the reach of children. **CAUTION:** Federal law restricts this drug to use by or on the order of a licensed veterinarian.

Please see Full Prescribing Information at www.adequan.com.

Adequan® and the Horse Head design are registered trademarks of Luitpold Pharmaceuticals, Inc.
© Luitpold Animal Health, division of Luitpold Pharmaceuticals, Inc. 2016. AHD227 Iss. 4/2016

LUITPOLD ANIMAL HEALTH

Infectious Disease Update

There is continuing advancement in the understanding, treatment and management of infectious diseases of horses.

By Nancy S. Loving, DVM

Strangles can cause physical problems for horses and financial problems for horse owners, stables and those holding equine events.

ARND BRONKHORST PHOTOGRAPHY

Diseases that are spread from animal to animal or through vectors continue to cause problems in the equine industry. The Equine Disease Communication Center (equinediseasecc.org) can help veterinarians stay abreast of contagious and infectious diseases in the area, as well as trends across the country. This allows you to keep your clients aware and your patients protected.

In this article, we will look at some of the prominent topics in the area of infectious diseases.

Potential New Antibiotic

There is an increasing concern about the declining availability of reliable antibi-

otics due to overuse-induced drug resistance in all species. This makes finding a new, effective antibiotic particularly noteworthy for the medical community.

An incidental discovery centers on clay deposits in British Columbia near Kisameet Glacial Bay, which is land populated by native Heiltsuks. This native Canadian tribe has been using the clay for medicinal purposes for many generations.

In testing the clay for cosmetic use, it was found that the mineral expresses marked antibacterial qualities, specifically against multidrug-resistant bacteria referred to as ESKAPE bacteria: *Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa* and various *Enterobacter* species. This group is notorious for causing many resistant nosocomial infections.

A study (www.ncbi.nlm.nih.gov/pmc/articles/PMC4742703/3) evaluated use of an aqueous suspension of sterilized clay dust on bacteria obtained from hospitals and a wastewater treatment plant. The clay solution was added to plates of these incubated bacteria. Within 24 hours, bacterial concentrations fell below detectable limits for all ESKAPE species except *E. Faecium*, which was killed within 48 hours. Interestingly, control bacteria receiving only a water solution declined in numbers but did not die off completely.

The study concluded: "The pipeline of novel antimicrobials in the pharmaceutical industry is essentially empty. Thus, there is a great need to seek new sources for the treatment of recalcitrant infectious diseases. This material is worthy of further clinical investigation."

Coronavirus in Adult Horses

Although human coronavirus takes the form of severe acute respiratory syndrome (SARS), it is emerging as a significant GI infectious disease in adult horses across the United States. Clinical signs include diarrhea, colic, fever and suppression of white blood cells within two to four days of onset. It is not unusual for horses infected with Coronavirus to have parasitic co-infections, including with *Cryptosporidium*.

While it can develop any time of the year, infection with coronavirus tends to occur more in winter. High loads of virus are shed in the feces and the nasal mucosa for up to two weeks. In general, two out of three horses develop fever, unwillingness to eat and GI dysfunction. On occasion, a horse might demonstrate neurologic signs attributable to excess blood ammonia levels.

Equine Proliferative Enteropathy (EPE)

An emerging infectious disease in foals less than a year of age is caused by *Lawsonia intracellularis.* About half of infected foals are afflicted with diarrhea, but all those infected demonstrated weight loss and anemia due to low albumin.

Ultrasound is informative when it shows thickened walls of the small intestines; however, confirmation of disease also relies on serology and fecal PCR testing.

In foals, passively acquired antibodies do not protect against *Lawsonia intracellularis*. (*Equine Vet J.* 2015 Nov;47(6):655-61. The effect of passively acquired antibodies on *Lawsonia intracellularis* infection and immunity in the horse. Page, A.E.; Stills, H.F. Jr.; Horohov, D.W.) A vaccine developed for swine can be given per rectum to help protect foals in endemic areas.

Equine Herpesvirus Type 5 (EHV-5)

A relatively lesser-known herpesvirus is EHV-5, which is related to the human Epstein-Barr virus (human herpesvirus type 4). Although historically thought to be of little consequence to horses, in fact, it can cause a serious syndrome: equine multinodular pulmonary fibrosis (EMNPF).

Besides suffering from poor performance, an affected horse might appear to have a case of "heaves," but is also febrile. Bloodwork shows lymphopenia and increased fibrinogen levels. Radiographs are demonstrative for pulmonary fibrosis. Uveitis is also sometimes present with EHV-5.

It is interesting to note that there has been an association of multi-centric lymphoma with EHV-5 infections. A study (Identification of Equine Herpesvirus 5 in Horses with Lymphoma, ACVIM 2011, Vander Werf, Davis, Janardhan, Bawa, Bolin, and Almes) reveals an increased frequency of EHV-5 (gamma herpesvirus) in horses diagnosed with lymphoma compared with healthy control horses. When treated with an antiviral medication such as acyclovir, lymphoma lesions disappeared. (Vander Werf and Davis, Disease Remission in a Horse with EHV-5-Associated Lymphoma. *J Vet Intern Med* 2013, 27: 387–389.)

Streptococcus equi subsp. *equi*

While not much new has developed about strangles (*S. equi*), there remains confusion as to its pathogenicity in the environment. It survives in the environment for only about one to three days, but it could be longer under specialized conditions, such as being shrouded in mucus. (Weese, S.J., et al. Survival of *Streptococcus equi* on surfaces in an outdoor environment. Can Vet J 2009 Sep; 50(9):968-970.)

While rain, temperature or contact surface (wood, metal, rubber) makes little difference to survival or persistence of the organism, sunlight does. It can kill *S. equi* within 24 hours. That implies that quarantine of an area consistently exposed to sunlight need not be prolonged for weeks. The study does caution: "These results should not be extrapolated to areas free of sunlight, such as in a barn, in shady outdoor areas, or within soil or grass."

The main reservoir for the organism is the horse, as it is harbored in the guttural pouch for extended periods in clinically affected or recovering horses.

Leptospirosis

Although not a new disease, leptospirosis recently has been high on the radar for equine practitioners.

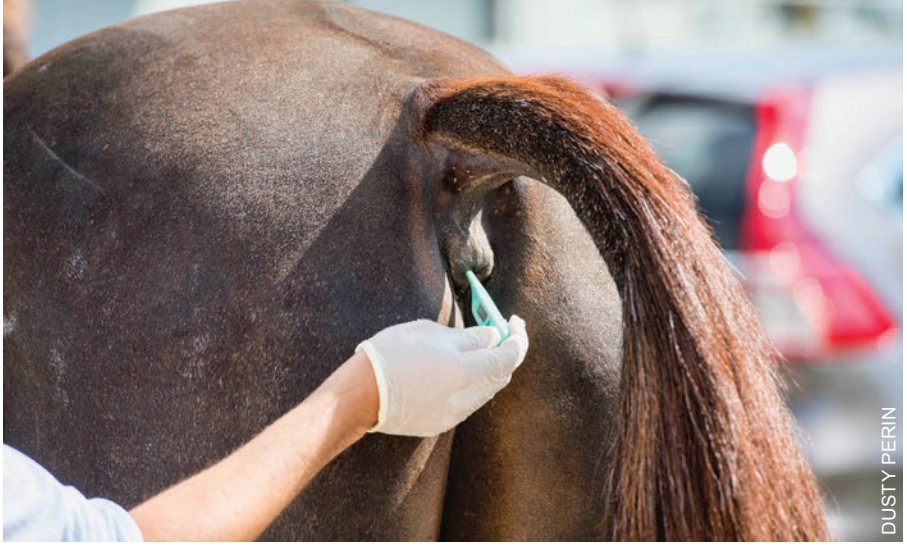
This spirochete bacterium persists in the environment through reservoir hosts of domestic and wild animals. These animals don't necessarily demonstrate illness related to infection, but they shed the organisms in their urine, thereby spreading it widely through the environment. Chronic infection of kidney tissue causes bacterial shedding for long periods.

Leptospirosis is also a public health risk as a zoonotic disease for people, such as veterinarians and barn personnel who come into contact with animal urine or contaminated water or soil.

The horse is an incidental host. Exposure to *Leptospira* is relatively common; however, infection rates are low. High stocking density of horses and certain environmental factors increase the risk of exposure. Several different serovars (bacterial variations) tend to create disease in horses, but *Leptospira pomona* is responsible for the bulk of equine disease in the United States.

During the acute phase of infection, a horse sheds large quantities of pathogen into urine, milk or the tissues of an aborted fetus or placenta. Leptospirosis organisms survive for weeks in warm, moist environments and slow-moving water. High precipitation rates and/or flooding create favorable conditions for exposure and infection.

A USDA-licensed vaccine against *Leptospira pomona* is available for use in pregnant mares: Lepto Eq Innovator (Zoetis). In studies leading to USDA approval, vaccination with Lepto Eq Innovator entirely reduced urinary shedding from *L. pomona*, which is the primary serovar responsible for cases affecting the equine reproductive tract and eyes. While Zoetis noted that no certainty exists for this vaccine to protect against abortion, equine recurrent uveitis or acute renal failure, it can reduce the potential risk.


DUSTY PERIN

Monitoring horses and using proper biosecurity can go a long way toward reducing spread of contagious diseases.

Equine Infectious Anemia

Historically considered a disease transmitted primarily by biting insects, specifically horse flies and deer flies, equine infectious anemia (EIA) is now on the rise due to iatrogenic causes.

Infection can be transmitted through contaminated blood or blood products (often unlicensed), through shared needles, through blood-contaminated multi-use vials and through intravenous tubing.

Other sources of infection come from blood contamination of the hands, dental or tattoo equipment, and any instrument inappropriately cleaned and disinfected that then contacts another horse.

Prior to 2013, EIA cases of iatrogenic transmission were not recognized as contributing significantly to the number of cases. In 2013, about 25% of annual EIAV infections were caused by iatrogenic transmission. However, in 2014 alone, 54% of EIAV positives were traced back to an iatrogenic origin, which could have likely been prevented.

The most significantly affected population of horses appears to be racing Quarter Horses and unsanctioned bush track racehorses. Education of this group of horse owners is paramount to minimizing EIA risk.

As well, piroplasmosis, another blood-borne disease usually transmitted by ticks, is on the rise for all the same reasons as EIA and in the same population of horses.

Lyme Disease and Vaccine

Lyme disease caused by *Borrelia burgdorferi* is becoming a more prevalent problem in endemic areas of the country, such as the Northeast, the Middle Atlantic States, Wisconsin and Minnesota. Transmitted by ticks, it is difficult to manage, especially for horses living outside, where insect vectors are abundant.

To date, there is no vaccine marketed for horses against Lyme disease. The only possible protection is to use a dog vaccine. A recent study evaluated the use of three different canine Lyme disease vaccines on horses. (Guarino, C., et al. Vaccination of horses with Lyme vaccines for dogs induces short-lasting antibody responses. *Vaccine* Jul 24;35(33):4140-4147.)

To understand this study, you must know that the tick carrying *Borrelia* expresses outer surface proteins (Ospc) at various times. Ospc A is expressed within the tick's gut; Ospc C is maintained during early infection; and Ospc F is evident with chronic infection.

A Lyme Multiplex assay (Cornell Uni-

versity) is able to identify all three outer surface proteins to differentiate whether a horse has been exposed and for how long. Antibodies to Ospc A represent a vaccination response, whereas antibodies to Ospc C denote acute infection (within three weeks; these antibodies decline by four to five months post-infection) and Oscpc F antibodies denote chronic infection after five to eight weeks.

The three vaccines used in the study were:

- killed bacterin with Ospc C antigen
- bacterin with OspcC and OspcA antigens—given at one of two doses (1 ml or 2 ml)
- recombinant OspcA antigen vaccine given in two doses

Results were inconsistent, but in general:

- All three of the vaccine products induced OspcA antibodies for a brief period, lasting less than 16 weeks.
- OspcA responses were equivocal, whether the vaccine was given IM or subcutaneously.
- The antibody response for the bacterin inducing both OspcC and OspcA declined rapidly irrespective of dose quantity (1ml versus 2 ml).
- The two-dose recombinant vaccine was able to elicit an immune response for up to 20 weeks, particularly if the horse was previously vaccinated and/or subject to environmental exposure.

The study concluded: "Commercial Lyme vaccines for dogs induce only transient antibody responses in horses, which can also be of low magnitude. Protection from infection with *B. burgdorferi* should not be automatically assumed after vaccinating horses with Lyme vaccines for dogs."

Take-Home Message

The world of infectious diseases in horses is ever-changing, with new discoveries being made and new understanding of how these diseases occur and can be managed or prevented. EM

Tildren® (tiludronate disodium) restores bone balance. Its track record for treating navicular syndrome and providing lasting relief from osteolytic pain is unmatched:

- **Over a dozen published clinical studies supporting its safety and efficacy**
- **13 years of usage**
- **More than 250,000 doses sold**

To learn more about Tildren®, visit www.bimedaequine.com.
To order, contact your preferred distributor or call 1-888-524-6332.

Supporting your dedication to equine care.

Do not use in horses with impaired renal function or with a history of renal disease. NSAIDs should not be used concurrently with Tildren®. Concurrent use of NSAIDs with Tildren® may increase the risk of renal toxicity and acute renal failure. The safe use of Tildren® has not been evaluated in horses less than 4 years of age, in pregnant or lactating mares, or in breeding horses.

Tildren® is a registered trademark of Cross Vetpharm Group. All rights reserved.
*CAUTION: Federal law restricts this drug to use by or on the order of a licensed veterinarian.

All ages of horses are susceptible to lameness issues.

The Latest on Lameness

Lameness is one of the most commonly reported causes of equine loss of use.

By Nancy S. Loving, DVM

Horses perform in a variety of athletic endeavors that depend on different skill sets, but one thing they have in common is the development of lameness issues.

Equine veterinary medicine often leads the way in managing degenerative arthritis, using strategies now being employed for human patients. What new developments have been in the works for lameness issues in horses?

Gene Therapy Using AAVIRAP

Clinicians and researchers at the Orthopaedic Research Center at Colorado State University have investigated methods to reduce inflammation over a long period using gene vectors, specifically adenoassociated viral vectors (AAV) with the DNA sequence that encodes for interleukin receptor antagonist protein (IRAP). The objective is to maximize protein production in a joint to assist cartilage and bone repair, which have "extended healing times," while not inducing further inflammation within the joint.

ISTOCKPHOTOS.COM

Supports prevention and treatment of colic, diarrhea, gastric/colonic ulcers, and hindgut imbalances.

Neigh-Lox®
ADVANCED

- Maintains normal stomach pH, reducing risk of gastric ulcers
- Supports a healthy hindgut so microbial imbalances and colonic ulcers are less likely to occur
- Sustains growth and activity of beneficial bacteria
- Supports reduced inflammation and the healing of damaged tissue

Recommended for horses of all ages that are:

- At risk for developing colonic and/or gastric ulcers due to lifestyle, disposition or past history
- Consuming high-grain diets and therefore susceptible to grain overload and hindgut acidosis
- Convalescing after surgery
- Recovering from illness or injury
- Suffering from episodes of diarrhea
- Undergoing antibiotic therapy

Available through all major veterinary suppliers.

For more information, call KPP:
800-772-1988

Developed by:

Kentucky Performance Products LLC

KPPusa.com

EquiMGT 2018-01

IRAP works its anti-arthritic effects by blocking or antagonizing interleukin-1, a cytokine present in degenerative arthritic joints. A recent study injected AAVIRAP into the middle carpal and metacarpal-phalangeal joints of two horses, which resulted in good success in elevating IRAP levels for at least four months. The injections did not elicit any toxic effects, swelling or pain in the injected joints. The goal of providing longer-term IRAP anti-inflammatory activity was achieved in this trial, and the horses' progress continues to be monitored.

Muscle Studies

Myofibrillar myopathy (MFM) is undergoing research at the Michigan State University's Equine Neuromuscular Diagnostic Laboratory by Stephanie Valberg, DVM, PhD, DACVIM, ACVSMR, and colleagues. This newly identified syndrome involves the disruption of the orderly alignment of myofibril contractile proteins.

The test to confirm MFM relies on staining desmin in a muscle biopsy rather than on genetic testing. According to reports from the Neuromuscular Diagnostic Laboratory, "Normally desmin is found at one specific repeating place in the myofibril, the Z-disc, and it acts to hold myofibrils in proper alignment across the muscle cell. In horses with MFM, sections of a muscle cell start to produce abnormal amounts and shapes of desmin, likely as a reaction to instability in the contractile proteins."

Glycogen might pool in the breaks between myofibrils, thereby eliciting a false positive diagnosis of Type 2 equine polysaccharide storage myopathy (PSSM2). Instead, Valberg and colleagues note that MFM is a separate pathology of muscle. MFM might be incorrectly diagnosed if a biopsy is taken from a horse with actively regenerating muscle tissue following an injury.

Warmblood horses: Researchers have identified that myofibrillar myopathy, or MFM, occurs in some warmblood horses. (Valberg, S.J., et al. Clinical and histopathological features of myofibrillar myopathy in warmblood horses. *Equine Vet J* 2017 May 22.) Muscle disease can significantly interfere with a horse's athletic function. Some warmblood horses by ages 8-10 might begin to experience exercise intolerance, reluctance to go forward, stiffness, and hind limb lameness that is not readily localized through diagnostic procedures.

Data was obtained through muscle biopsies of 10 horses that experienced myopathy signs. Cellular evaluation and staining revealed "desmin-positive aggregates in myofibres of the founding dam and in horses from two subsequent generations." The study concluded that MFM is a potentially heritable form of exertional myopathy.

Arabian horses: Intermittent episodes of exertional myopathy are not uncommon findings in Arabian horses, especially those engaged in endurance pursuits. Muscle biopsies were obtained in 14 Arabian controls, 13 Arabian horses with complaints of myopathy and 25 samples evaluated from Arabians previously classified as having Type 2 polysaccharide storage myopathy (PSSM), recurrent exertional rhabdomyolysis (RER) or no pathology. (Valberg, S.J., et al. Suspected myofibrillar myopathy in Arabian horses with a history of exertional rhabdomyolysis. *Equine Vet J* 2016 Sept:48(5):548-556.) Rather than identifying a storage myopathy, the study discovered that these horses were experiencing myofibrillar myopathy.

Management of MFM: While the predominant breeds associated with MFM are Arabians and warmbloods to date, cases have been identified in a few Thoroughbreds, Quarter Horses and Paso Finos. Nutritional changes to providing low-starch, low-sugar diets might be helpful. Fat can be included if necessary to maintain body condition. Whey protein can be helpful to add bulk to muscle, especially when fed 45 minutes prior to exercise. However, diet alone cannot cure this syndrome.

Valberg's group recommended avoiding rest and instead implementing a steady program of incremental and consistent training, along with pasture turnout. These horses do best with a good warm-up period that stretches the topline and core abdominal muscles via a long-and-low frame for five to 15 minutes before more intensive work is requested.

Early Exercise in Young Foals

Horse owners often perceive that young foals should be protected from too much exercise. By keeping foals in confinement, they might be doing the young horses a great disservice.

Wayne McIlwraith, BVSc, MS, PhD, DSc, FRCVS, DACVS, DECVS, DACVSMR, of Colorado State University (CSU), has pioneered many advances in the field of equine orthopedics. He collaborated with Chris Kawcak, DVM, PhD, DACVS, also of CSU, and Elwyn Firth, BVSc, MS, PhD, DACVS, DSc, of the University of Auckland, in a recent investigation into the effects of early exercise on the metacarpal-phalangeal joint. (Kawcak, C.E.; McIwraith, C.W.; Firth, E. Effects of early exercise on metacarpophalangeal joints in horses. *Am Vet J Res* 2010;71:405-411.)

Six pasture-reared horses preconditioned with exercise from 3 weeks old to 18 months of age were compared to six similar-aged horses that were provided with only daily pasture turnout. Significant differences were identified.

"Horses that were exercised since near birth had fewer gross lesions in the joints, greater bone fraction in the dorsolateral aspect of the condyle, and higher bone formation rate compared to non-exercised horses," noted the research. "However, there was less articular cartilage matrix staining in

A HOME FOR EVERY HORSE

Fed by

WEATHERBEETA

Dedicated to enriching the lives of unwanted horses.

Organizations and supporters like WeatherBeeta help change not only the lives of the horses saved, but the life of the person who adopted their next partner. I adopted my horse Freddo Joel from Second Chance Thoroughbred Rescue; we hope to bring to light the benefits of adopting and rescuing a horse.

- ADOPTER ASHLEY ROSENDALE

FIND OUT HOW TO

Heart the Cause Today

WWW.AHOMEFOREVERYHORSE.COM

A Home For Every Horse is brought to you by the Equine Network and sponsored by:

FEED GREATNESS™ · ELECTRO BRAID FENCE · WEATHERBEETA · TSC TRACTOR SUPPLY CO · MERCK Animal Health

the dorsal aspect of the condyles in exercised horses."

Young horses exercised at an early age appear to benefit from the protective effects of exercise on the fetlock joints; however, reasons for reduced cartilage matrix staining deserve further investigation.

A similar study had previously reviewed the effects of early exercise on mid-carpal joints and found no deleterious effects. (Kim, W.; Kawcak, C.E.; McIlwraith, C.W.; Firth, E.C.; McArdle, B.; Broom, N.D. Influence of early conditioning exercise on the development of articular surface abnormalities in cartilage matrix swelling behavior in the equine middle carpal joint. *Am J Vet Res* 2009;70:589-598.) "Investigators have concluded that early conditioning is a positive influence on articular cartilage and is safe to use."

Injection of the Navicular Bursa in a Lateral Approach

Treatment of podotrochlear disease is a common procedure for equine practitioners. A newer technique enables access to navicular bursa injections without penetration of the deep digital flexor tendon.

A lateral approach to the navicular bursa using ultrasound guidance was performed on bilateral forelimbs of 62 cadaver horses and 26 live horses. (Nottrott, K.; De Guio, C.; Khairoun, A.; Schramme, M. An ultrasound-guided, tendon-sparing, lateral approach to injection of the navicular bursa. *Equine Vet Journal* 2017 Jan 27.) Radio-contrast agent was injected with the foot placed in a flexed position on a navicular block.

In 91% (104/114) of the limbs injected, contrast agent was identified in the navicular bursa. Contrast was deposited in only the navicular bursa and no other structures in 78% of the limbs injected. In those cases where material did not get injected into the navicular bursa, failure was attributed to poor ultrasound quality, leading to injection of the coffin joint, tissue around the bursa and, in one horse, the deep digital flexor tendon.

One caveat of this study is that the injections performed were done on non-diseased navicular bursae. It is undetermined how well this technique will work with cases of clinical disease of the podotrochlear apparatus, especially in regard to injection of diagnostic anesthesia and therapeutic agents.

Comparison of Stem Cell Aspirates From the Ilium or Sternum

Regenerative therapies are instrumental in returning horses to athletic usefulness. Much research has been directed toward the use of stem cells and, in particular, bone marrow aspirates of bone mesenchymal cells.

A study at the Colorado State University's Equine Orthopedic Research Center compared quality of aspirates in seven horses aged 2-5 years. While no differences in cell numbers or growth rate were identified between either stem cell sources—ilium versus sternum—what was of significance is that in both sites, the first five milliliters of aspirate "yielded the highest concentration of stem cells."

Take-Home Message

One of the attributes horse owners seek in a veterinarian is a willingness to keep up with medical knowledge. *EquiManagement* strives to alert equine veterinarians to research updates through the Keeping Up segment in each magazine, through additional medical and research articles on EquiManagement.com, and through links to articles from referred journals on *EquiManagement*'s Facebook page. EM

American Association of Equine Practitioners

Wonder When They'll Call Again?

Discuss the importance of annual wellness exams with your clients.

Some horse owners only call a veterinarian when a medical emergency occurs. Help your clients understand that even healthy horses need regular exams.

Promote the value of wellness examinations with downloadable AAEP resources at

aaep.org/dashboard/clienteducation

AAEP®

Testing is needed to determine the cause of a horse's respiratory illness.

ARND BRONKHORST PHOTOGRAPHY

Respiratory Research

Research on herpes and strangles can help you better understand and manage these diseases.

By Emma N. Adam, BVetMed, DACVIM, DACVS, PhD

Herpes is a household name. It is common knowledge that once you have a cold sore, the *Herpes simplex* virus can recrudesce throughout your life to cause further bothersome and infectious sores.

The ability of viruses of the herpes family to "hide in plain sight" in the body is one of their more remarkable host adaptations. With host adaptation, parasites co-evolve with their natural host species to create a balance between virulence and transmissibility.

The more notorious members of the equine herpesvirus family are those that cause outbreaks of severe respiratory disease and neurological disease—equine herpesvirus type 1 (EHV-1) and equine herpesvirus type 4 (EHV-4). These viruses can be virulent in the host and are highly transmissible in respiratory secretions from infected horses.

Thankfully, vaccination, ever-more-sophisticated testing methods and increased industry awareness have helped to curb outbreaks.

Equine herpesvirus type 2 (EHV-2) and equine herpesvirus type 5 (EHV-5) are highly host adapted, as well as ubiquitous, and until recently were considered benign after the initial infection and related mild respiratory disease.[1]

However, continued diligent research and more sophisticated testing methods have challenged that dogma. Equine herpesvirus type 5 has come under intense scrutiny regarding its relationship to mature horses suffering from a disease now recognized as equine multinodular pulmonary fibrosis or EMPF.[2]

Recently, one of Koch's postulates (criteria to establish causative relationships between agent and disease) has been fulfilled, whereby horses experimentally infected with EHV-5 developed lung fibrosis.[3] Since that time, it has been hypothesized that interactions between the host, the strain(s) of EHV-5 harbored and possibly co-infections with EHV-2 strains play a role in the ultimate development of EMPF as a clinical entity.[4-6]

However, although progress has been made, because both EHV-2 and EHV-5 are found in healthy equids worldwide, a diagnostic challenge is afoot.

EMPF is not a commonly diagnosed disease. Horses diagnosed tend to be mature (average age 14 years) with no gender predilection. EMPF can manifest with signs similar to several different lung diseases, including primary bacterial infection or as an infection secondary to underlying inflammatory airway disease (IAD).

Clinical signs include a combination of weight loss, decreased appetite, low grade fever, cough, increased respiratory rate and effort, and exercise intolerance with varying degrees of respiratory distress.

Usual diagnostic techniques are of little help. Auscultation of the thorax and blood work will do little to help with diagnosis. Ultrasonography of horses with EMPF will generate images of either a diffuse nodular pattern or larger demarcated areas of hyperechoic tissue, consistent with fibrosis. However, this is not pathognomonic for EMPF.

Herpesvirus vaccination, more sophisticated testing methods and increased industry awareness have helped curb outbreaks.

The "gold standards" for diagnosing EMPF are a lung biopsy and lung radiographs.[7] While radiographs carry little risk to the horse, having the equipment to perform good thoracic radiographic studies has typically been the domain of large practices and veterinary schools. Lung biopsy carries a real and undesirable risk of hemorrhage even in the most experienced hands, making it an uninviting diagnostic tool. Tracheal wash or broncho-alveolar lavage (BAL) can be a challenge in a horse with respiratory distress, and as such, the horse that presents with low-grade fever and respiratory distress might be treated for IAD and/or bacterial pneumonia. Only when the horse does not respond to therapy might we pursue more diagnostic tests.

Recent work has shown that performing quantitative PCR (qPCR) for EHV-5 on BAL fluid or *paired* whole blood and nasal secretions can be supportive of a clinical diagnosis of EMPF.[7] However, at this point, quality thoracic radiographs or a lung biopsy can be more readily justified to confirm a diagnosis of EMPF.

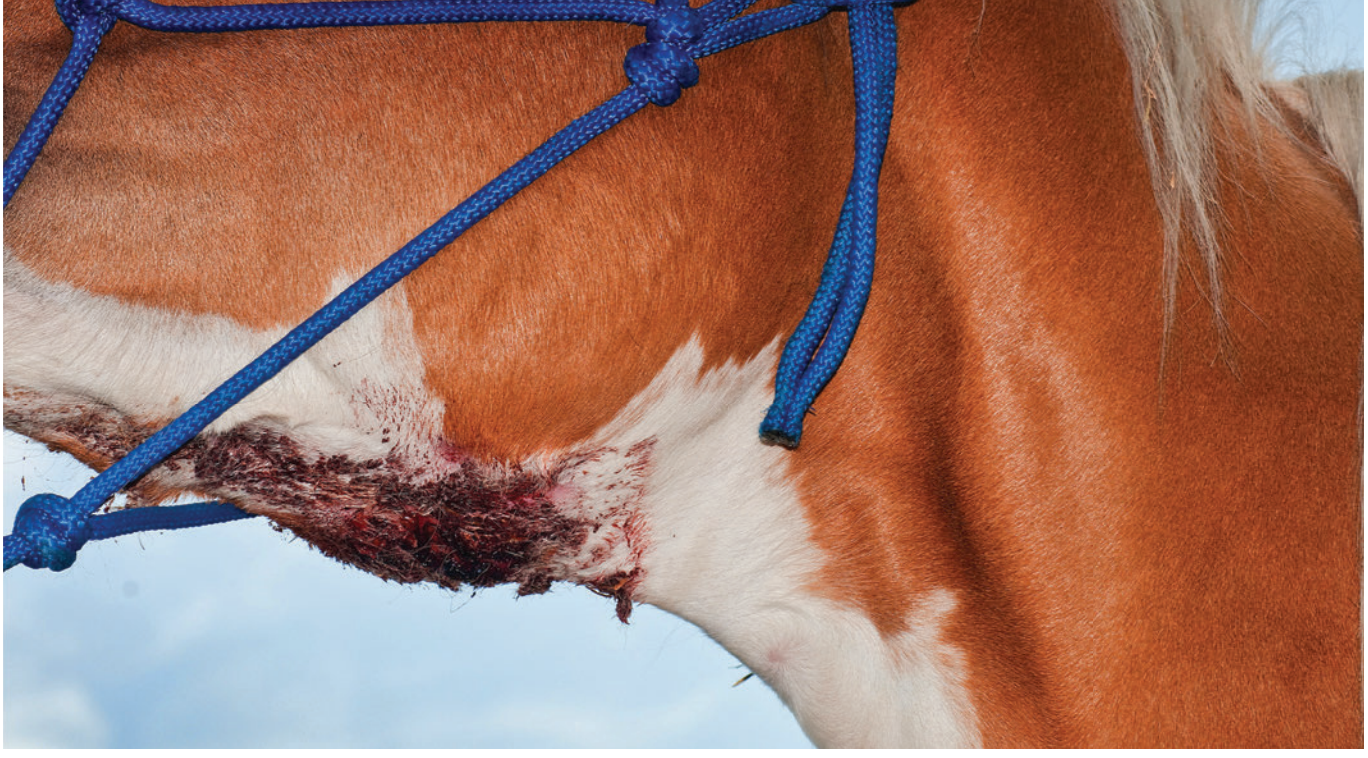
Current literature on EMPF makes for sober reading, as many horses were diagnosed on the necropsy floor or did not respond to therapy. However, the recent publication of a case diagnosed with EMPF treated with the antiviral drug valacyclovir suggests that when caught early, this disease might be curable.[8] Consequently, adjusting our diagnostic testing algorithm for horses with respiratory disease to include testing for EHV-5 on appropriate samples might be our best chance for EMPF to truly become a curable disease.

Strangles

Strangles is the most-diagnosed infectious disease in horses worldwide.[9] Brief mentions in ancient literature allude to the disease; Ruffus in 1251 was the first to record the clinical signs of the disease, noting pyrexia followed by abscessation of lymph nodes of the head and neck. Such easily recognized clinical signs beg the question as to why strangles continues to be a scourge of horses globally today. The answer to this question might be the biological complexity and complicated practicality of eradication.

Strangles is a highly infectious and contagious disease caused by the bacterium *Streptococcus equi* subspecies *equi (S. equi)*, so named for its ability to cause swelling of the lymph nodes of the head and neck that can occlude the upper respiratory tract. *S. equi* is the consummately host-adapted equid pathogen.[10] Genomic sequencing from outbreaks around the globe has changed the previously held notion of a stable genome and added further knowledge regarding the elegance of this organism's host adaptation.[11,12]

Following infection with *S. equi* from contaminated water, or contact with infected material or equipment, the bacteria cross the oral and nasal mucus membranes to infect the regional lymph nodes.[13] Presence of the bacteria on mucus membranes can be minimal in as little as three hours after inoculation—a



Strangles is the most-diagnosed equine infectious disease world-wide. Up to 10% of horses become carriers.

feature that can lead to false negative results when testing these surfaces.[14]

Once in the lymph nodes, the bacteria are resistant to phagocytosis, causing abscessation and eventual rupture.[15]

Up to 10% of infected horses develop carrier status, with bacteria being harbored in the guttural pouch. Despite this colonization, these horses appear to be healthy.[10] Carriers are key to the global success of this organism, as they can intermittently shed the organism.

Another key survival tool investigators are beginning to unravel through genomic sequencing is the ability of *S. equi* to survive in two contrasting environments: the guttural pouch and the lymph node. Gene loss and gene gain have been found through genome sequencing and might be relevant to diagnostic testing, as well as to the host's immune response.

For example, differences in the unique *S. equi* gene, *SeM*, have been identified in strains harboured in guttural pouch samples vs. lymph node sample.[12,16]

Further complicating diagnostic testing is the enormous overlap between the genome sequences of *S. equi* and the ubiquitous *Streptococcus equi* subspecies *zooepidemicus (S. zooepidemicus)*, which share a massive 97% of their DNA identity.[11]

Bacterial culture used to be the gold standard for diagnostic testing

ARND BRONKHORST PHOTOGRAPHY

our expertise is
your strength

Workers' Compensation • Business Property & Liability • Employment Practices Liability • Umbrella Liability • Commercial Auto • Flood • Data Breach • Professional Liability • Veterinary License Defense • Professional Extension (Animal Bailee) • Embryo & Semen Storage Coverage • Safety & Risk Management Resources • Personal Auto • Homeowners • Renters • Personal Excess (Umbrella) Liability

Protect your livelihood with all the right coverage through AVMA PLIT. We are the most trusted source of professional, business and personal coverage for every stage of your career.

800-228-7548 • **avmaplit.com**

AVMA | PLIT®
Protecting you through it all

for *S. equi*. However, with the need to wait 48 hours for growth and the up to 56% false negative detection rate, this technique has been surpassed by DNA-based techniques. New genomic data have led to more sensitive, specific and rapid methods of detection by PCR using the traditional *SeM*, as well as gene targets such as *seeI, eqbE* 17 and SEQ2190.[11]

Although the biological complexity of the disease is fascinating, what are the practical implications?

In clinical practice, the questions include what to test and when. Aspirates from swollen lymph nodes are an obvious choice, but when faced with new horses entering the herd, patience, tenacity and the dedication of some financial resources are required. These practical considerations are often overlooked or underfinanced and can lead to industry outbreaks of devastating magnitude.

Compliance for quarantine and the testing of new horses entering a facility is the stuff of nightmares. The confusion as to what samples to procure and the challenge of maintaining dedicated staff or providing appropriate barrier clothing should not be underestimated.

Absolute consensus does not exist as to which samples are the best to submit for testing. However, most believe the current gold standard to be a one-time guttural pouch wash for laboratory PCR testing.[18,19] Importantly, this sample must include wash fluid from both left and right guttural pouches, and the endoscope must be appropriately cleaned between horses. The cumbersome nature of this test might make the technique of three nasopharyngeal washes performed at weekly intervals sound like an acceptable alternative.

However, *be warned*: The longer period of sampling and the possibility of a false negative test result with the nasopharyngeal technique easily make the nuisance factor and expense of guttural pouch endoscopy well worth the effort.

In conclusion, while there are some new methods for diagnosing *S. equi* infection, the basic tenants of diligent quarantine practices, biosecurity measures and appropriate screening sample testing remain the bedrock of controlling the miserable and costly disease we call strangles.

Take-Home Message

Ongoing research on "old" diseases and agents, such as strangles and herpesviruses, can help veterinarians better understand the health problems that can be caused in horses and how those problems can be avoided. That understanding can also help you educate your clients on better management of their horses to prevent problems with diseases such as herpes and strangles. EM

References

1. Hartley, C.A.; Dynon, K.J.; Mekuria, Z.H.; El-Hage, C.M.; Holloway, S.A.; Gilkerson, J.R. Equine gammaherpesviruses: Perfect parasites? *Veterinary Microbiology* 2013;167: 86–92.

2. Williams, K.J.; Maes, R.; Del Piero, F.; Lim Wise, A.; Bolin, D.C.; Caswell, J.; Jackson, C.; Robinson, C.N.E.; Derksen, F.; Scott, M.A.; Uhal, B.D.; Li, X.; Youssef, S.A.; Bolin, S.R. Equine Multinodular Pulmonary Fibrosis: A Newly Recognized Herpesvirus-Associated Fibrotic Lung Disease. *Veterinary Pathology* 2007;44:849–862.

3. Williams, K.J.; Robinson, N.E.; Lim, A.; Brandenberger, C.; Maes, R., et al. Experimental Induction of Pulmonary Fibrosis in Horses with the Gammaherpesvirus Equine Herpesvirus 5. *PLoS ONE* 2013;8(10): e77754. Doi:10.1371/journal.pone.0077754.

Your Padding & Safety Flooring Specialists

Custom Wall Padding

Superior Flooring Options for Barns, Exam, Surgery, and Recovery Rooms

Pavesafe • Trac-Roll • Vet-Trac

Dandy Products, Inc.

3314 State Route 131, Goshen, OH 45122

888-883-8386 513-625-3000 Fax: 513-625-2600

www.dandyproducts.net

4. Hue, E.S.; Fortier, G.D.; Fortier, C.I.; Leon, A.M.; Richard, E.A.; Legrand, L.J.; Pronost, S.L . Detection and quantitation of equid gammaherpesviruses (EHV-2, EHV-5) in nasal swabs using an accredited standardized quantitative PCR method. *Journal of Virology Methods* 2014;198:18-25. doi: 10.1016/j.jviromet.2013.12.008. Epub 2013 Dec 24.

5. Back, H.; Ullman, K.; Treiberg Berndtsson, L.; Riihimäkib, M.; Penell, J.;, Ståhld, K.; Valarchera, J-F; Pringle, J. Viral load of equine herpesviruses 2 and 5 in nasal swabs of actively racing Standardbred trotters: Temporal relationship of shedding to clinical findings and poor performance. *Veterinary Microbiology* 2015;179: 142–148.

6. Back, H.; Ullman, K.; Leijon, M.; Soderlund, R.; Penell, J.; Stahl, K.; Pringle, J.; Valarcher, J-F. Genetic variation and dynamics of infections of equid herpesvirus 5 in individual horses. *Journal of General Virology*. 2016;97: 169–178 DOI 10.1099/jgv.0.000332.

7. Pusterla, N.; Magdesian, K.G.; Mapes, S.M.; Zavodovskaya, R.; Kass, P.H. Assessment of quantitative polymerase chain reaction for equine herpesvirus-5 in blood, nasal secretions and bronchoalveolar lavage fluid for the laboratory diagnosis of equine multinodular pulmonary fibrosis. *Equine Veterinary Journal* 2017;49: 34–38. DOI: 10.1111/evj.12545.

8. Schwarz, B.; Schwendenwein, I.; van den Hoven, R. Successful outcome in a case of equine multinodular pulmonary fibrosis (EMPF) treated with valacyclovir. *Equine Veterinary Education* 2013; 25 (8): 389-392 doi: 10.1111/j.2042-3292.2012.00425.

9. Timoney, J.F. Strangles. *Veterinary Clinics of North America; Equine Practice* 1993;9, 365–374.

10. Waller, A.S. New perspectives for the diagnosis, control, treatment and prevention of strangles in horses. *Veterinary Clinics of North America; Equine Practice*. 2014;30:591-607.

11. Holden, M.T.G.; Heather, Z.; Paillot, R.; Steward, K.F.; Webb, K.; Ainslie, F., et al. (2009) Genomic Evidence for the Evolution of *Streptococcus equi*: Host Restriction, Increased Virulence and Genetic Exchange with Human Pathogens. *PLoS Pathog* 2009;5(3): e1000346. https://doi.org/10.1371/journal.ppat.1000346.

12. Harris, S.R.; Robinson, C.; Steward, K.F., et al. Genome specialization and decay of the strangles pathogen, *Streptococcus equi*, is driven by persistent infection. *Genome Research* 2015;25:1360-71.

13. Weese, J.S.; Jarlot, C.; Morley, P.S. Survival of *Streptococcus equi* on surfaces in an outdoor environment. *Can Vet J*. 2009;50:968-970.

14. Timoney, J.F.; Kumar, P. Early pathogenesis of equine *Streptococcus equi* infection (strangles) *Equine Veterinary Journal*. 2008;40:637-642.

15. Timoney, J.F.; Suther, P.; Velineni, S.; Artiushin, C. The antiphagocytic activity of SeM of *Streptococcus equi* requires capsule. *Journal of Equine Science*. 2014;25:53-56.

16. Kelly, C.; Bugg, M.; Robinson, C., et al. Sequence variation of the SeM gene of *Streptococcus equi* allows discrimination of the source of strangles outbreaks. *Journal of Clinical Microbiology*. 2006;44:480-486.

17. Heather, Z.; Holden, M.T.; Steward, K.F., et al. A novel streptococcal integrative conjugative element involved in iron acquisition. *Mol Microbiol* 2008;70:1274-92.

18. Newton, J.R.; Verheyen, K.; Talbot, N.C., et al. Control of strangles outbreaks by isolation of guttural pouch carriers identified using PCR and culture of *Streptococcus equi*. *Equine Veterinary Journal*. 2000;32:515-526.

19. Boyle, A.G.; Rankin, S.C.; Duffe, L., et al. *S. equi* detection PCR assay for equine nasopharyngeal and guttural pouch wash samples. *Journal of Veterinary Internal Medicine*. 2016;30:276-281.

Ad Index

AAEP....35
A Home For Every Horse....33
Animal Arts....13
AVMA PLIT....38
Bimeda....29
Boehringer Ingelheim....19, 20
Dandy....39
Dechra....15
Doc's Products....inside back cover
Equine Diagnostic Solutions....34
Franklin Williams....24
Freedom Health....3
Horsepower Technologies....1
Kentucky Performance Products....31
Luitpold....9, 10
Luitpold....25
Neogen....7
Platinum Performance....back cover
Shank's....24
SmartPak....5
Triple Crown....inside front cover

POWER PACKED PELLETS

Revolutionary
2-in-1 supplement
supports the **bone and joint**
health of horses in all stages of life.

Hyaluronic Acid
lubricates joints, providing cushion and protection against friction

Silicon
critical nutrient for prevention and treatment

Micro-sized precursors to chondroitin and glucosamine
to repair, rebuild, and maintain cartilage

11 Amino Acids
essential for growth and repair

A breakthrough formula that **maintains**, **protects** and **restores** **bone and joints**.Pharmaceutical quality ingredients encourage new cartilage growth, lubrication of joints and relief from inflammation for better mobility.

Cost Effective: As low as 99¢ a day.

OCD™ OPTIMAL CARTILAGE DEVELOPMENT PELLETS

CELEBRATING 10 YEARS ANNIVERSARY

Doc's™ Products, Inc.

www.DocsProductsInc.com | 866-392-2363

Dr. Douglas R. Beebe • Lexington, KY

Introducing

Platinum Performance® GI

Equine Wellness & Performance Formula + Digestive Care

THE HEALTH OF THE EQUINE GUT is correlated to gastrointestinal (GI) function, metabolism, immunity and more. This is why we have been hard at work researching, formulating, testing and conducting trials with **Platinum Performance® GI**. This gastrointestinal-focused approach to **total horse health** supports wellness and is recommended for horses in training or competition as well as senior horses. Platinum Performance® GI can help maintain health while traveling, during antibiotic or NSAID therapy and for horses that have digestive health concerns or difficulty maintaining weight.

OVERALL WELLNESS

This veterinary-developed formula provides omega-3 fatty acids, antioxidants, vitamins and trace minerals, along with Bio-Sponge®, prebiotics, probiotics and glutamine for GI support.

DIGESTION

Prebiotics nourish the "good" bacteria in the gut and support the digestion of fiber, while probiotics are important for absorption of nutrients.

IMMUNITY

An estimated 70-80% of the immune system resides in the gut. Nourishing the beneficial bacteria can help support a healthy gut barrier and microflora balance.

PLATINUM PERFORMANCE®

Good Nutrition is Good Medicine™

PlatinumPerformance.com | 866-553-2400

100% SATISFACTION GUARANTEED

SINCE 1996

© 2017 PLATINUM PERFORMANCE, INC.