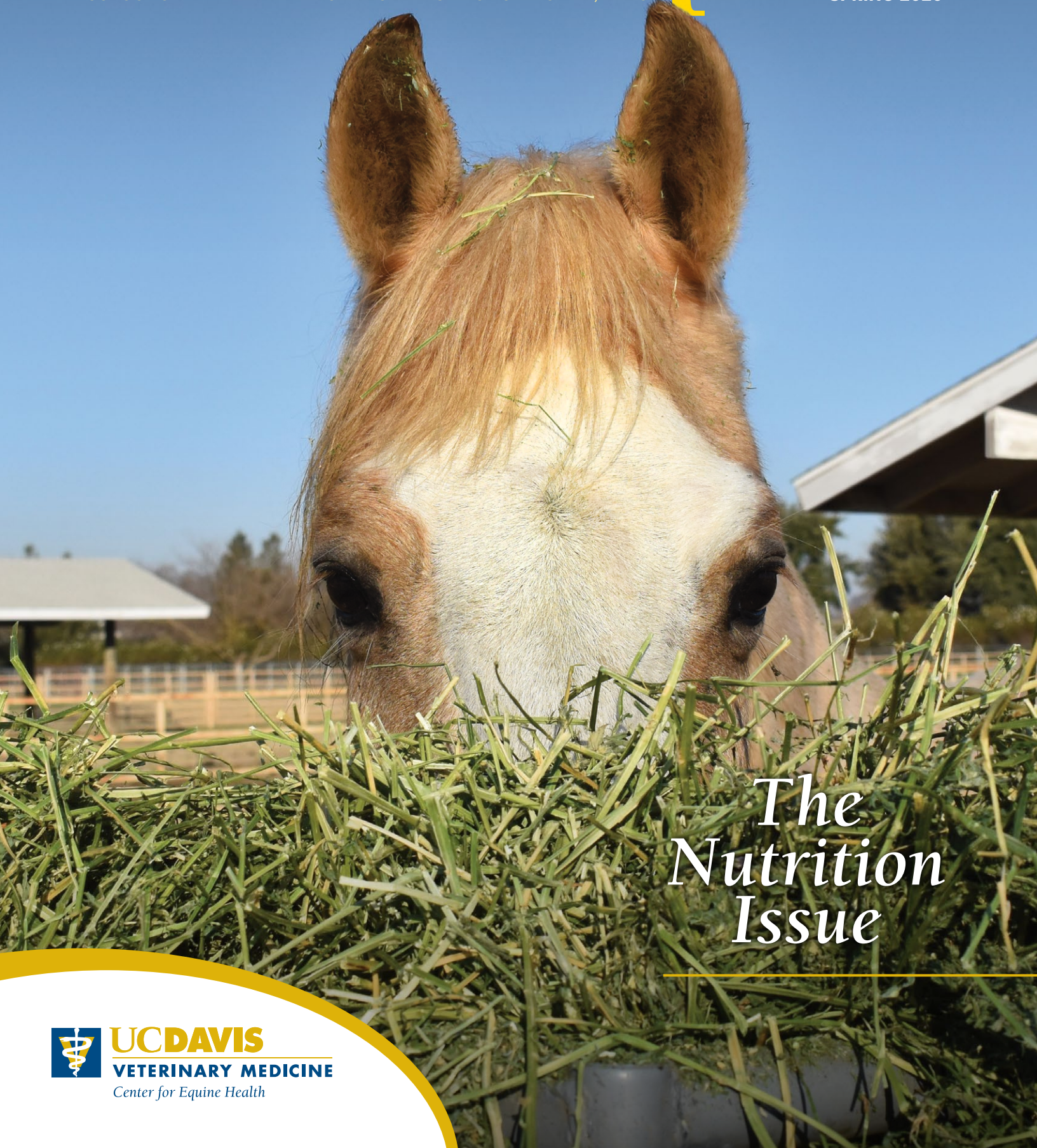


CENTER FOR EQUINE HEALTH

# HorseReport

SCHOOL OF VETERINARY MEDICINE • UNIVERSITY OF CALIFORNIA, DAVIS

SPRING 2020



*The  
Nutrition  
Issue*

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**UCDAVIS**

**VETERINARY MEDICINE**

Center for Equine Health



# DIRECTOR'S Message

Modern equine management approaches have largely removed horses from their natural routines of grazing and foraging for food over many hours. Grain and supplements are widely available, and equine diets are not always balanced, despite the best of intentions. In addition, horses are living longer, resulting in an ageing equine population that has its own unique dietary requirements.

It is in every equestrian's best interest to have a basic understanding of equine nutrition and be able to identify sources of essential vitamins and minerals in a horse's diet. Dietary deficiencies and excesses can both cause health issues and affect performance. This becomes even more important for the care and management of horses with disorders such as equine metabolic syndrome (EMS) and polysaccharide storage myopathy (PSSM).

In this issue of the *Horse Report*, we collaborated with Dr. Emily Berryhill, an assistant professor of equine internal medicine at the UC Davis School of Veterinary Medicine, and Summit Equine Nutrition's Dr. Clair Thunes, a UC Davis alumnus and equine nutritionist, to provide perspectives on important topics in equine nutrition. These include how to feed pregnant mares to prevent selenium deficiency in foals, a look into common endocrine disorders, and information on dietary management for horses with neuromuscular diseases. You can also test your knowledge of equine nutrition in our "10 Things You Might Not Know About Equine Nutrition" feature.

Equine nutrition is a broad subject and these topics are only the tip of the iceberg. We hope that this issue inspires you to learn more about properly balancing your horses' diets. Be sure to work with your veterinarian and/or equine nutritionist to formulate diets appropriate for your horses' needs to keep them feeling and performing their best!

Carrie J. Finno, DVM, Ph.D.  
CEH Director



## Thanks to our collaborators

The *Horse Report* is a collaborative effort and we are grateful to our colleagues for sharing their expertise to ensure the most up-to-date information.

### Dr. Emily Berryhill

Dr. Berryhill earned her DVM at UC Davis, where she also completed a large animal internal medicine residency. She is board certified by the American College of Veterinary Internal Medicine and is currently an assistant professor in the UC Davis School of Veterinary Medicine. Dr. Berryhill's research focuses on equine oncology and endocrinology.



### Dr. Clair Thunes

Dr. Thunes earned her MS in Animal Science and PhD in Nutrition at UC Davis. She owns and operates Summit Equine Nutrition where she works with a wide range of horses from many disciplines. She is a sought after speaker and published author on many topics related to equine nutrition.



# JOHN HARRIS receives Jerry W. Fielder Memorial Award

John C. Harris received the prestigious Jerry W. Fielder Memorial Award at the 47th Annual Cal Aggie Alumni Association (CAAA) Awards Gala. Themed “A Novel Night”, the event was held at the Peter J. Shields Library on February 7, 2020.

The 1965 UC Davis alumnus and owner of Harris Farms is well known as a successful Thoroughbred breeder and leading producer of agricultural products. His family has been in the California Thoroughbred business for more than 40 years and has produced Eclipse Award and Breeders’ Cup winners. He served on the California Horse Racing Board and was a director of the Thoroughbred Owners of California.



John Harris (center) with friends from the UC Davis School of Veterinary Medicine and Harris Farms. From left to right behind Mr. Harris: Dr. Carrie Finno, Dr. John Pascoe, Dr. Jeanne Bowers-Lepore, Jonny Hilvers, Dean Michael Lairmore.

A former UC Davis Foundation Board trustee and lifetime member of CAAA, Mr. Harris was honored for contributions that have helped UC Davis maintain its prominence in agriculture and animal health. He has served on the College of Agricultural and Environmental Sciences Dean’s Advisory Council and the Center for Equine Health’s Advisory Board. Faculty and students are welcome at his facilities for learning purposes and he has supported UC Davis equine teaching and research programs.

“We congratulate Mr. Harris on the Fielder award,” said Dr. Gregory Ferraro, CEH Director Emeritus. “Mr. Harris has been a major figure in California racing for decades and is a stalwart in Central Valley farming.”

## SELENIUM – An Essential Mineral

Selenium is an essential trace mineral with important antioxidant functions. Plants take up selenium through the soil and groundwater and are consumed by herbivores in their diets. The amount taken up by most plants varies by geographical area depending on soil conditions. Forage in many parts of the United States (particularly in the Northwest) is actually selenium deficient, which can lead to health issues, especially in foals.

[Severely affected foals](#) have breakdown of their muscles (“tying up”), leading to progressive weakness, organ damage, and sometimes death. Heart muscle can also be affected. Subacute cases demonstrate widespread profound muscle weakness, which may include difficulty swallowing, putting them at risk for developing pneumonia. In adult horses, deficiencies of both vitamin E and selenium can occur; however, it is important to assess these nutrients independently. Selenium deficiency in foals is easy to prevent through appropriate supplementation of the mare’s diet during pregnancy. Adult horses can also be easily supplemented.

The National Research Council (NRC) recommends a minimum of 1 mg (no more than 3 mg) of selenium daily for a 1,100-pound horse. Supplements that include high-selenium yeast are best absorbed by horses, and a variety of supplements are available that provide balanced trace minerals and vitamins.

It is good practice to know where your forage comes from (Is it from an area with soil known to be deficient in selenium?) and identify other sources of selenium in your horse’s diet (consult the labels for ration balancers and supplements) to make sure they are not under or over supplemented. Work with your veterinarian or equine nutritionist to adjust selenium levels, and discuss specific considerations for pregnant mares.





# Battling EMS and PPID – MISS GWEN'S ROAD TO RECOVERY

At 21 years young, Miss Gwen is every horse crazy girl's dream – a beautiful grey pony with a long forelock perfect for braiding. Gwen and her owner, Ainsely Davis, have a great time competing in shows, dressing up, and going on riding adventures. Today, Gwen is happy and healthy, but she and her family had to fight their way down a difficult road and find the right balance to manage not one, but two endocrine diseases, pituitary pars intermedia dysfunction (PPID) and equine metabolic syndrome (EMS).

The endocrine system is comprised of glands that produce hormones that then travel through the bloodstream to different tissues in the body. The hormones signal the tissues to perform various functions related to respiration, metabolism, development, growth, and more. These hormones are also part of feedback loops which tell the glands to increase or decrease hormone production depending on the body's needs at a given time. Endocrine diseases result in interruptions in these loops and often lead to disruptions in essential body functions. In humans, these interruptions can cause Type 1 and 2 diabetes, over and underactive thyroid (hyperthyroidism and hypothyroidism, respectively), Addison's disease, and more.





***“I prepared my daughter for what I thought was to come, us losing Gwen. I truly didn’t think she would ever come home again.”***

– Margaret, Ainsley’s mom

For Gwen, what first started out as mild foot soreness on gravel roads evolved into foot soreness in soft arena footing, prompting a visit with her veterinarian. She was diagnosed with PPID (also known as Cushing’s disease). This disease is associated with aging and affects hormones produced by the pituitary gland (see story “Separate but Connected” in this issue for more). Gwen started treatment, which included the medication pergolide and dietary management. Unfortunately, she became extremely foot sore to the point that she significantly shifted her weight onto her hindquarters. Her family decided to bring her to the UC Davis veterinary hospital.

In addition to PPID, UC Davis clinicians also diagnosed Gwen with another endocrine disease, EMS, which is associated with inappropriate blood insulin levels (see story “Separate but Connected” in this issue for more), similar to how type 2 diabetes in humans leads to insulin resistance. X-rays revealed laminitis (inflammation and damage of the tissue between the hoof and the underlying coffin bone) of both front feet due to these diseases.

“I prepared my daughter for what I thought was to come, us losing Gwen,” said Ainsley’s mom, Margaret. “I truly didn’t think she would ever come home again.”

Fortunately, Gwen responded well to medication and therapeutic approaches.

“Gwen is a very special pony, and her owners took recommendations to manage her metabolic syndrome and laminitis to heart,” said Dr. Emily Berryhill, assistant professor of Medicine and Epidemiology at the UC Davis School of Veterinary Medicine and a clinician with the UC Davis veterinary hospital’s [Equine Internal Medicine Service](#).

The first steps to managing Gwen’s conditions were to test batches of hay and read labels on grains in order to find an appropriate feed with low non-structural carbohydrate (sugar) content. Gwen was placed on a supplement to increase her metabolism and help her lose weight quickly since her feet were too sore for exercise. Medications helped decrease the amount of sugar absorbed from her



intestines and kidneys and reduce the pain associated with her fluctuating laminitis flare-ups. Her referring veterinarians monitored her insulin concentrations often to gauge her response to the different therapies. Gwen also had frequent and consistent visits with [Shane Westman, the UC Davis veterinary hospital’s farrier](#), who tried a variety of different therapeutic shoes to provide mechanical support for Gwen’s fragile feet and improve her comfort.

The process of finding the right balance of medications, dietary management, and farrier care was vital to Gwen’s recovery, but it did not happen overnight.

“Gwen became a favorite patient to all at the veterinary hospital, as it took months and many visits to find the combination of medications to control Gwen’s metabolic disease and for Gwen’s feet to stabilize,” said Berryhill. “Gwen and her owners were troopers through it all, and we are so glad she is a happy and comfortable pony again.”

Gwen’s owners recognize that the combination of a strict, low sugar, low carbohydrate feed, medications, and farrier care saved her life. They are happy to report that “today Gwen is totally sound, bright eyed, and the beautiful, sweet pony we have always loved.”

# SEPARATE BUT CONNECTED – Endocrine Diseases EMS, PPID, and Laminitis

**E**quine metabolic syndrome (EMS), pituitary pars intermedia dysfunction (PPID) and laminitis are associated with disruptions in the equine endocrine system. They are discrete conditions, but can occur at the same time in an individual animal. Treatment for all three involves diet and exercise management.

## Equine Metabolic Syndrome

Equine metabolic syndrome is associated with inappropriate blood insulin levels (insulin dysregulation), increased fat deposition, and a reduced ability to lose weight. When affected horses consume meals high in specific carbohydrates, their bodies produce higher than normal levels of insulin and are slow to return to baseline values.

This disorder often affects horses bred to survive in harsh climates, including ponies, Arabians and mustangs. These breeds utilize glucose very efficiently to ensure adequate energy reserves when food is scarce. When these “thrifty” horses have access to an abundance of carbohydrates and do not get as much exercise as they would in their ancestral habitats, they consume too many calories. One of the most serious consequences of EMS is laminitis.

Treatment for EMS is with dietary management in the form of non-structural carbohydrate restriction, calorie restriction, and a reduction or elimination of pasture access. It may also include increased exercise depending on physical condition and soundness.

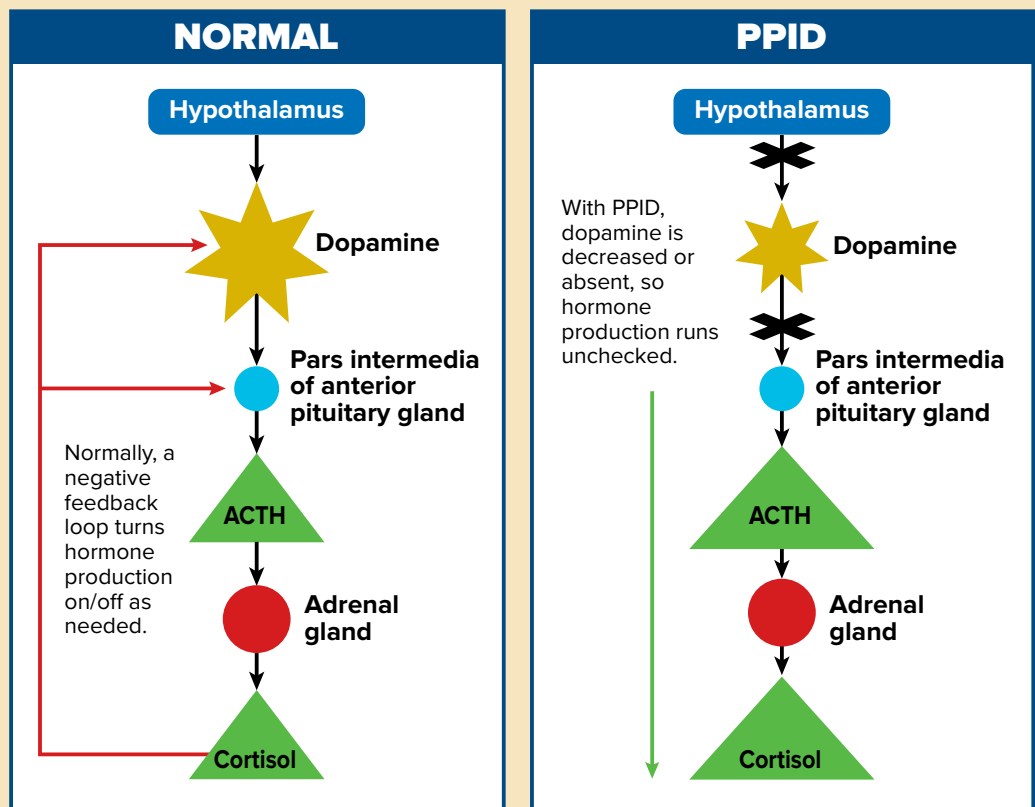
Many horses respond well to management through diet and exercise. Horses that are “easy-keepers” or have persistently high insulin levels may require medical treatments. Although treatment can reduce clinical signs, there is no “cure” for EMS. Long-term care requires diligence along with support and guidance from a veterinarian.

## Pituitary Pars Intermedia Dysfunction (PPID)

Pituitary pars intermedia dysfunction, also known as Cushing’s Disease, causes progressive degeneration of neurons in the brain as horses age, resulting in production of high levels of hormones such as adrenocorticotropic hormone (ACTH) and cortisol. Clinical signs include a long, curly hair



Increased fat deposition on the neck of a horse with EMS.



**Left:** The normal hormone production pathway. **Right:** Reduced or absent dopamine production affects the production of other hormones in horses affected with PPID.



**PPID causes progressive degeneration of neurons in the brain as horses age. Clinical signs include a long, curly hair coat, delayed shedding, loss of muscle, and laminitis.**

coat, delayed shedding, loss of muscle, and laminitis. Horses with PPID can be susceptible to infections and abscesses, have decreased wound healing, and have higher parasite burdens.

To date, aging is the only significant risk factor for PPID and cases typically occur in horses older than 15 years of age. Approximately 30% of horses with PPID also show signs of insulin dysregulation, the hallmark of EMS. Knowledge of insulin status is important for assessing laminitis risk and informing dietary management.

There is no cure for PPID. Treatment is intended to reduce clinical signs and must be continued for the life of the animal. The only medication licensed for the treatment of PPID in horses is pergolide mesylate (Prascend®). Some horses respond to a low level of medication, while others need a much higher level. Earlier diagnosis may result in a better quality of life, particularly if negative consequences like infections and laminitis can be avoided.

Management also involves a veterinarian-approved diet and exercise program. Horses with PPID should receive good preventative veterinary care to ensure they are healthy due to a decrease in their immune responses. This includes a regular deworming and vaccination protocol, routine dental examination, and periodic blood work.

## Laminitis

Laminitis is damage and inflammation of the tissue between the hoof and the underlying coffin bone (distal phalanx, P3). This tissue, the laminae (also called lamellae), is actually folded layers of tissue, contacting the surface of the bone on one side and the inside of the hoof wall on the other, connecting the two. Depending on how severely these attachments are weakened, the outcome can range from mild foot soreness to separation of the coffin bone and hoof (founder). The front hooves, which bear the majority of the horse's weight, are most commonly affected, but it can also occur in the hind hooves.



Long, curly hair coat characteristic of PPID.

Laminitis can be the outcome of excessive grain intake, access to pasture high in sugars, compensatory weight bearing due to injury of the opposite limb (supporting-limb laminitis), ingestion of toxic plants, and excessive work on hard surfaces (road founder). Laminitis often occurs due to diseases such as EMS or PPID (endocrinopathic laminitis), sepsis or systemic inflammatory response syndrome (sepsis-related laminitis).

Laminitis is irreversible and once clinical signs are observed, the damage is already underway. At this point, it is important to minimize further progression. Treatment largely involves pain management and supportive care. Successful management is dependent upon good relationships between owners, veterinarians, and farriers. Early identification is ideal for recovery. Call your veterinarian immediately if you suspect that your horse is developing laminitis.



X-ray of the hoof of a horse with laminitis showing displacement of the coffin bone.

# Using **DIET** to Manage **NEUROMUSCULAR DISORDERS**

*The clinical signs displayed by horses with neuromuscular disorders are not necessarily unique to the described conditions. Without an accurate diagnosis, a horse could be treated for the wrong condition.*



◀ Abnormal stance in a horse affected with EMND. All four legs are close together and the head is lowered due to severe weakness.

**E**quine nutritionist Dr. Clair Thunes and Dr. Carrie Finno, CEH director and expert in equine neuromuscular diseases, share dietary recommendations for horses with neuromuscular diseases.

## **Equine Motor Neuron Disease**

**What it is** – [Equine Motor Neuron Disease \(EMND\)](#) is a degenerative condition that affects nerve cells (neurons). Neurons transmit impulses to muscle fibers that make them contract, resulting in movement. The neurons of horses with EMND are damaged which causes them to send incorrect signals. Affected horses may display muscle wasting, weight loss, muscle twitching, and sweating.

**What causes it** – Dietary vitamin E deficiency over 18 to 21 months can lead to clinical signs. However, not all horses with prolonged vitamin E deficiencies develop the disease.

**How diet can help** – Ensuring that horses receive adequate vitamin E reduces the risk of developing EMND. For affected horses, treatment involves changing the vitamin E level in the diet. The natural source of vitamin E for horses is fresh green grass. Horses that do not have adequate access to pasture may require supplementation. The only biologically active form of vitamin E is  $\alpha$ -tocopherol. The natural form, d- $\alpha$ -tocopherol, is more bioavailable, more readily absorbed, and has greater antioxidant activity than the synthetic form, dl- $\alpha$ -tocopherol (also called all-rac- $\alpha$ -tocopherol). It is not recommended to use the synthetic product at any dosage as it is ineffective at raising blood vitamin E levels.

Determine baseline vitamin E levels through bloodwork before starting a supplementation program, as it may be necessary to fine-tune the dose. For horses that do not have adequate



access to fresh green grass, recommendations are made based on baseline blood vitamin E levels and  $\alpha$ -tocopherol formulation (i.e. natural liquid product or natural powder/pellet product). Perform follow-up bloodwork to determine if the dose needs to be adjusted.

## Equine Neuroaxonal Dystrophy and Equine Degenerative Myeloencephalopathy

**What it is** – [Equine neuroaxonal dystrophy \(eNAD\)](#) and [equine degenerative myeloencephalopathy \(EDM\)](#) result from abnormalities of certain neurons. Research suggests that eNAD is the underlying basis for EDM. Clinical signs may begin with performance issues at a young age and progress to incoordination, abnormal circling, and a horse not knowing where to place its feet.

**What causes it** – Cases in closely related horses suggest a genetic basis for eNAD/EDM, but a causative mutation has not been identified. [Vitamin E deficiency](#) during specific developmental stages can lead to clinical signs.

**How diet can help** – Since newborn foals get vitamin E in the colostrum, pregnant mares must receive adequate vitamin E during the last trimester. Foals born to mares that previously produced affected foals should be supplemented around weaning. Baseline vitamin E levels are essential to determine if the supplementation plan is working. The timing of supplementation is important; once a foal starts to display signs of eNAD/EDM, the disease is irreversible.

◀ Horse with eNAD displaying neuromuscular signs.



## Polysaccharide Storage Myopathy Type 1

**What it is** – [Polysaccharide storage myopathy type 1 \(PSSM1\)](#) results in an abnormal accumulation of glycogen, the form of sugar stored in muscle. This can cause episodes of muscle stiffness and pain after exercise, also known as “tying up” or exertional rhabdomyolysis. Affected horses may be reluctant to move and may display sweating, lameness, and muscle tremors.

**What causes it** – A genetic mutation in the glycogen synthase 1 (GYS1) gene causes PSSM1. Since it is an autosomal dominant trait, only one copy of the mutation is needed for a horse to be affected. However, environmental factors, namely diet and exercise, play important roles in the onset of clinical signs.

**How diet can help** – Dietary nonstructural carbohydrate (NSC) intake in affected horses should be limited to less than 12% of the diet to keep blood insulin levels low and reduce glycogen storage in muscle. Horses must exercise daily to maximize the muscles’ ability to burn glycogen. Affected horses are often easy keepers and management through a low-NSC grass hay and a good-quality ration balancer is usually sufficient. If additional calories are needed, a low-NSC and/or high fat feed source should be incorporated.

## Polysaccharide Storage Myopathy Type 2

**What it is** – Polysaccharide storage myopathy type 2 (PSSM2) also results in abnormal glycogen storage in muscle, but horses do not have the GYS1 mutation. Clinical signs are the same as PSSM1.

**What causes it** – The cause of PSSM2 remains unknown; there may actually be multiple causes. There is currently no scientifically validated diagnostic test for PSSM2.

**How diet can help** – Affected horses can improve with the correct diet and exercise regimen. Since small management changes can have a big impact, fine-tuning the diet over time may be necessary. Ensuring an adequate source of quality protein in the diet appears to be important.

Drs. Finno and Thunes caution against adopting dietary changes without a confirmed veterinary diagnosis. The clinical signs displayed by horses with neuromuscular disorders are not necessarily unique to the described conditions. For example, clinical signs seen under saddle in PSSM2-affected horses are similar to those seen in horses with gastric ulcers. Without an accurate diagnosis, a horse could be treated for the wrong condition.

Horse owners should work closely with their veterinarian to achieve an accurate diagnosis to enact management changes for the best outcome. Seeking the expertise of a qualified equine nutritionist may also be needed.



# 10 THINGS

## You Might Not Know About Equine Nutrition



*Equine nutrition is complex and it is easy to become overwhelmed when choosing what to feed your horse. We collaborated with Dr. Clair Thunes of Summit Equine Nutrition to share ten things you might not know about equine nutrition.*



**1 Feed by weight, not volume.** It is tempting to feed by flakes or scoops, but feedstuffs have different densities and weights. A flake of alfalfa does not weigh the same as a flake of grass hay, and a scoop of sweet feed does not weigh the same as one of oats. Weigh the concentrate initially and mark the scoop for consistency. Weigh a flake from the bale and adjust as needed. Repeat anytime you change feed.



**2 There are pros and cons to alfalfa.** Love it or hate it, alfalfa is highly palatable, a good protein source, and easily digestible. It is higher in calories than other forages, so it may not be a good choice for easy keepers. Protein and calcium levels can also be excessive. High alfalfa diets are linked to [gastric stones \(enteroliths\)](#), which can cause colic. When fed, alfalfa should be 25 to 30% of the daily forage, and no more than 50%.



**3 Balance forage diets with a ration balancer.** Ration balancers provide amino acids, vitamins, and minerals that may be deficient in forage. These nutrients are supplied without added calories in the form of fat, starch or sugar, which is important for horses that need diets low in non-structural carbohydrates (NSCs). Research has also shown that fortification of trace minerals may prevent developmental orthopedic disorders in young horses.



**4 Feed according to the label or add a ration balancer.** When horses are fed below the recommended amount of grain for their type as listed on the label, the amount of vitamins and trace minerals in the diet will likely be insufficient. This can result in deficiencies that need to be corrected by a ration balancer.



**5 Environmental factors affect the nutritional content of forage.** Where forage is grown, variations in rainfall, mineral content of soil, the growth stage at harvest, the amount of leaves versus stems and how it is stored influence the nutritional content. Sugar levels in pasture grasses



vary by season, maturity, and time of day. Have forage tested and work with a veterinarian and/or nutritionist to analyze the results.



**6**

**Horses without regular access to fresh green grass should have their vitamin E levels tested.** Vitamin E, an antioxidant that protects against cell damage, boosts immune system response, and prevents debilitating neuromuscular diseases, is abundant for horses with access to lush green pastures. Not all horses exhibit clinical signs of [vitamin E deficiency](#), but unless horses are on green pasture for at least 6 months/year, they require supplementation. Test your horse's blood vitamin E levels and discuss the results with your veterinarian before adding vitamin E supplements.

**7**

**Horses can have mineral deficiencies despite access to a salt block.** Voluntary sodium intake from salt blocks varies between horses, potentially falling short of maintenance requirements. To ensure that your horse's sodium needs are met, give 1 tablespoon of loose salt per 500 pounds of body weight in feed, along with access to a salt block. Although mineral blocks may contain trace minerals such as zinc and copper, they are probably not consumed at significant levels. A ration balancer should be added to ensure trace mineral needs are met.

**8**

**Supplements are largely unregulated.** The U.S. Food and Drug Administration categorizes most animal feed ingredients as "generally recognized as safe". As long as no unsubstantiated claims are made about curing or treating disease, safety and efficacy testing is not required. Many supplement companies employ good manufacturing practices, but it is up to the consumer to verify that this is occurring. Importantly, ingredients found in supplements can potentially alter pharmacologic effects of medications. Additionally, exercise caution when combining supplements as unknown mineral concentrations can potentially exceed recommended dietary mineral intake levels.

**9**

**Horses with endocrine disorders require veterinary input on feed as grain and pasture can lead to laminitis.** Studies have established connections between obesity, insulin resistance, [EMS](#) and cases of [laminitis](#). The best way to prevent laminitis in horses with endocrine disorders is with diet and exercise. Limit NSCs, including fructose, glucose, lactose, sucrose, and starch, in the diet, especially in horses that are unable to exercise due to their condition. Grains and grasses are often high in NSCs, which can lead to laminitis in at-risk horses. Work closely with a veterinarian or equine nutritionist to ensure proper dietary management of diagnosed horses.



**10**

**If a horse is offered water with electrolytes, also provide fresh water.** Horses lose electrolytes (chloride, potassium, and sodium) when their bodies sweat to cool down. This can cause an electrolyte imbalance and affect muscle function. Electrolyte supplements can support recovery after prolonged or strenuous exercise. However, horses must consume water to gain the maximum benefit from supplemented electrolytes and avoid dehydration. Ensure that your horse has access to plain, fresh water to encourage appropriate water intake.



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## Rosie Pony

Rosie Pony is a valued member of the CEH teaching herd. At 25 years young, her current role is to teach horse handling to veterinary students. Rosie Pony is a textbook example of a horse with EMS, as evidenced by her “cresty” neck and fat deposits on her tail head. Fortunately, once diagnosed, Rosie Pony responded very well to dietary management. She is maintained on a low-NSC diet and is closely monitored to prevent complications associated with EMS. Horses like Rosie Pony present unique opportunities for veterinary students and residents to learn about this endocrine disease. Please consider giving to the CEH Teaching Herd Fund, which supports the daily and specialized care of horses like Rosie Pony. To make a gift, visit [give.ucdavis.edu/VCEH](http://give.ucdavis.edu/VCEH) or contact our Advancement team at 530-752-7024 for more information.

