

# Respiratory Health

*Airway inflammation can have a major impact on performance*

The athletic prowess of a horse is dependent on inborn talent and excellent function of the musculo-skeletal system. However, this system's performance, especially in high-speed events, is affected by a horse's ability to fuel the muscles with oxygen. And this is dependent on the capacity of air that is bellowed through the lungs.

The equine athlete must be sound in body and sound in wind. Training and fitness develop strength and stamina, and emphasis is placed on these strategies in preparing an athlete for the intended task. Yet, ironically, it is the 20-plus hours a day that a horse stands idle that are likely to have a significant impact on his "soundness of wind."

Horses that are stabled indoors experience the greatest challenges to the respiratory tract. But the good news is that as owner, trainer, or breeder, you have the ability to influence your horse's environment in ways that promote his respiratory health or, at the very least, do not detract from it.

## AIRWAY HEALTH

To sufficiently change your horse's environment, first it is helpful to understand what exactly might be plaguing the airways. Dr. Susan Holcombe, a veterinary specialist in surgery and equine critical care who also holds a PhD in nasopharyngeal function/dysfunction, is actively involved in the Equine Pulmonary Laboratory at Michigan State University's College of Veterinary Medicine. She is well-versed in equine airway physiology and environmental effects on airway health.

Holcombe describes two common lower respiratory syndromes that occur in horses: heaves (also called recurrent airway obstruction or RAO) and inflammatory airway disease (IAD).

"Heaves or recurrent airway obstruction is an inflammatory condition of the lower airways characterized by spasm of the bronchioles, presence of mucous plugs, and chronic changes in the bronchiolar walls—these things combined lead to airway obstruction of the terminal branches of the respiratory tree," explained Hol-



Performance of the equine athlete is dependent on the capacity of air bellowed through its lungs

combe. "The incidence of heaves increases with age, and no genetic predisposition has been identified, but some family lines seem to be more predisposed to the disease. Heaves in horses is thought to be caused by allergy to inhaled antigens, such as 'dust' from feed and bedding."

One such dust offender includes mold proteins (antigens), such as *Micropoly-spora faeni*, *Aspergillus fumigatus*, and *Faenia rectivirgula*.

Holcombe notes, "A horse with heaves demonstrates clinical signs that include coughing (a productive, wet cough—meaning something is coughed up, or an unproductive cough), exercise intolerance, an increased respiratory rate, flared nostrils, and a double expiratory effort that may create a heave line. A heave line is the result of hypertrophy (overdevelopment) of the external abdominal oblique muscles of the abdomen during forced expiratory efforts. The appearance and severity of the clinical signs may vary depending on the duration of the episodes."

In contrast, while inflammatory airway disease is also associated with reduced exercise tolerance, a horse affected with IAD doesn't typically experience airway obstruction or have to make excessive ef-

forts to breathe, as with heaves. Holcombe notes that IAD is a much less severe form of airway disease, and it is most commonly diagnosed in young performance horses.

"These horses are normal at rest, although some cough intermittently," she said. "They have mucus accumulation within the trachea and increased inflammatory cells (white blood cells, such as neutrophils) identified in tracheal aspirates, bronchoalveolar lavage, or with a lung wash."

Dr. Melissa Mazan, a veterinary internal medicine specialist and director of the Equine Sports Medicine Program at Tufts University's School of Veterinary Medicine in Massachusetts, weighs in on the impact of air particulates in the development of heaves or IAD. "There is a lot of debate about what the relationship is between IAD and heaves," she said. "Currently, we consider that IAD is an inflammatory condition of the airways that does not have an infectious etiology. We don't know how much is due simply to the high particulates found in equine stables, or if there is a genetic or immune-function component to it. I often encounter horses whose history includes many years of signs that are compatible with being IAD, such as coughing





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during exercise and gradually declining exercise tolerance, which two, three, or five years later has turned into heaves with the horse showing clearly recognizable signs of respiratory em-

barrassment. High-level lung function testing isn't required to recognize a horse with a clinical episode of heaves as that horse is usually standing there, rocking back and forth with the effort to breathe."

Holcombe summarized research findings by saying, "Environmental issues, such as ventilation, respirable particulates, endotoxin, and the quality of bedding and feed, are likely factors in the development of inflammatory airway disease, a common syndrome in sport horses and racehorses. The mean duration of inflammatory airway disease is significantly higher for horses maintained in a dusty environment compared to horses kept in a less-dusty environment, suggesting that convalescence from disease is prolonged by environmental contaminants. Additionally, stabling is associated with inflammation of both the lungs and throats of horses that live primarily in stalls (20 hours daily) compared to horses that live at pasture."

Will all stabled horses develop heaves? Mazan replied, "No, absolutely not. There appears to be a population of horses in which this does develop, and it makes sense to keep their surroundings as dust-free as possible. Interestingly, Australian horses that are traditionally kept in paddocks or open-air barns have not historically developed heaves, but they have developed IAD. Colleagues of mine from Australia mention that closed, 'American style' barns have become popular in Australia, and that for the first time they are seeing heaves in horses."

## THE BREATHING ZONE

A favorite pastime and essential activity of a healthy horse is eating high-fiber forage, such as hay and/or pasture. Holcombe reported on several studies in which scientists investigated the effects that eating hay has on airway inflammation in horses.

"Colleagues in Dr. Ed Robinson's laboratory at Michigan State University measured the dust or particulate content of the air around the horse's nose (referred to as the breathing zone) during various stall activities and found that eating hay increases respirable dust," she said.

These studies showed that while a horse eats hay, dust might be 30 to 40 times higher in the breathing zone than in the rest of the stall, whereas if the horse is fed low-dust products, such as pellets, quality hay cubes, or haylage, the dust levels are equivocal throughout the stall. She said other projects have demonstrated that

horses that eat hay (round or square bales) have increased airway inflammation compared to horses that graze pasture. Ironically, although a high-forage diet, such as hay, contributes to gastrointestinal health, she said, "Hay, unfortunately, can be a source of dust and airway contamination for horses."

Mazan similarly describes how the stall environment can have a huge impact on health of the respiratory tract, noting, "Particulate levels are very high, especially during the feeding period and during stall cleaning—as high as 12-15 mg/cubic meter if you measure within the horse's breathing zone. This is much higher than OSHA-recommended (Occupational Safety and Health Administration) dust exposures for humans."

She also noted that indoor arenas pose an additional potential risk by aerosolizing dust and debris as horses move around the arena, particularly with dry footing: "One study showed particulate levels as high as 60 mg/cubic meter, which is astoundingly high," she said. Not only are the horses exposed to high levels of inspirable dust, but so are riders, grooms, and workers.

What is in Those Dust Motes?

Mazan helps us understand one source of environmental pollutants that has a marked effect on the airways: "Endotoxin is the most important component of the cell walls of Gram negative bacteria. When you think of a horse with a severe infection, such as pleuropneumonia, many of the symptoms you see, such as fever and high heart rate, are due to endotoxin. What most people don't realize is that the ordinary components of barn life, such as grain, hay, bedding, and horse dander, are all chock full of endotoxin.

"There are many studies in both humans and laboratory animals showing that inhaled endotoxin causes airway inflammation; humans that are exposed to high levels of inhaled endotoxin, such as people who work in chicken or poultry barns or in cotton factories, all have greater declines in lung function over the years," Mazan continued. "Other studies demonstrate that inhaled endotoxin causes airway inflammation in horses, and in Australia research shows that horses that are exposed to greater amounts of endotoxin through their bedding or through their feed are also at greater risk of developing airway inflammation."

In addition, there are other environmental contaminants that irritate the airways: ammonia and mold, as examples. Mazan stressed that ammonia is a strong irritant to the lungs. She also described the effect of moldy hay as a primary source of irritation: "Moldy hay is more offending to the airways than clean, 'bright' hay; baked, chopped hay, such as Dengie, and fermented products, such as haylage, are even lower in dust. You have to be really



careful with any fermented hay product, as it can harbor botulism toxin if not prepared properly.”

Mazan urged the horse owner to buy these products only from a commercial vendor. She also said paper or pelleted bedding is preferable because its dust content is lower than straw, shavings, or sawdust. “Interestingly, many people think of shavings or sawdust as being so much better for their horse’s lung health, but it is actually quite dusty,” she said.

Mazan also reported, “The form of heaves known as ‘summer pasture-associated recurrent airway obstruction’ that is seen in horses from the South occurs more often during times of the year when mold spores are found in high concentrations in the air. We suspect that this may explain why even in New England many horses have exacerbations of heaves during hot, humid weather, not just during the winter when they are confined to stalls.”

### **DETRACTING FROM PERFORMANCE**

Holcombe reported that airway inflammation can have a major impact on performance, particularly of a horse engaged in high-speed sports such as racing: “Horses with an array of clinical signs that includes poor racing performance, coughing, and mucus accumulation in the airways are frequently diagnosed with inflammatory airway disease. These horses may fade at the three-quarter pole, have reduced stamina during training, and have protracted recovery following hard works, evidenced by increased and prolonged respiratory rate and effort. They are not febrile, have normal appetites, and have no clinical evidence of systemic disease at rest. It seems that the stress and increased effort of intense exercise—such as racing or race training—amplifies the clinical signs.”

Holcombe explained, “Even small amounts of tracheal mucus are associated with horses finishing farther back in a race, indicating that mild lung inflammation can impair a horse’s performance. Horses are limited by their lung function, not their cardiac output, so any decrease in lung capacity would likely decrease performance in a horse that is exercising at maximum intensity.”

Mucus accumulates in the airways as a result of inflammation. She clarified further, “The results of a study investigating the effect of tracheal mucus accumulation on racing performance found that horses with no or scant amounts of tracheal mucus were nearly twice as likely to finish well in a race compared to horses with moderate to severe amounts of mucus in their tracheas.”

Mazan also remarked on how airway irritation can detract from performance, particularly of a high-speed athlete. She said, “We tend to see IAD sooner in racehorses because they need every ounce of



**Transportation poses unique challenges to a horse’s airways**

their respiratory reserve. It is far easier to recognize IAD at an early age, when poor performance means that the horse has finished a tenth of a second slower. A racehorse often comes to us with no history of cough or nasal discharge, with the only respiratory sign being that the horse has a slower recovery in terms of respiratory rate. In the ‘sport horse,’ on the other hand, we may not recognize respiratory impair-

ment until the horse is coughing continuously at exercise, or has a chronic nasal discharge.”

Even the act of training and racing on a track can add to airway compromise. A Thoroughbred racehorse embodies the heart and soul of speed and flash, his thundering hooves churning the ground beneath him as he hurtles down the track, neck extended, nostrils flared, inhaling air with each gallop stride. Even with such an idealized image, the reality on the track is somewhat different: The horses’ heads, necks, and chests are smeared with dirt and debris as they run. Similarly, jockey goggles and faces are splattered with dirt, dust, or mud from the materials kicked up from the track.

Mazan described the impact of such debris on the airways, “An innovative study reviewed horse position during a simulated race. As you might expect, the farther away from the lead position, the more particulates the horse was exposed to, and this is exacerbated by dry, dusty surfaces.”

In addition, exercise-induced pulmonary hemorrhage (a horse with this condition is often referred to as a “bleeder”) is known to be associated with lower airway inflammation, so any measures that can be taken to minimize respiratory irritation might help reduce the occurrence of bleeders.

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### AIRWAY TESTING

There are tests that can be done to evaluate the health or damage to a horse's respiratory tract, but Holcombe suggested that such tests are best performed in a medical clinic setting rather than at the track or training center. She said, "If an owner/trainer is concerned about possible lower airway inflammation, your veterinarian should scope the horse to determine if there is mucus in the lower airways. A tracheal aspirate can be performed to determine the quantity of inflammatory cells within the trachea, and a lung wash or bronchoal-

veolar lavage can also be performed by the veterinarian to determine if the horse has increased numbers of inflammatory cells in the lungs."

Another noninvasive form of respiratory testing puts a horse on a treadmill in a standard exercise test and measures blood oxygen levels—this helps predict the presence and severity of IAD.

### STRATEGIES TO REDUCE AIRWAY IRRITANTS

A good dose of common sense can help you sort through the worst of the dust offenders in your horse's environment. Holcombe urged, "Decrease dust as much as possible. Sources of dust include feed, bed-

ding, but also particulates in the barn aisle. The levels of dust and particulate in the air are especially high during barn cleaning. This is a good time to have horses out of the barn."

Mazan couldn't agree more. She commented, "Certainly, it is a good idea to get horses out of the barn when the barn is being cleaned. Our testing showed that particulates remain elevated up to one to two hours after cleaning. It is also a good idea to feed outside."

Holcombe and Mazan summarized some strategies that will minimize the amount of dust horses inhale:

- If the hay is dusty, soak it in water to decrease the amount of dust the horse breathes in when eating.
- Keep the barn aisle damp, especially when it is swept, to decrease dust.
- If possible, turn out horses during barn cleaning to decrease their dust exposure.
- Use the least dusty bedding available. Very clean straw, wood shavings, peat, and some paper bedding products work well.

• Refrain from storing hay overhead or in adjacent stalls, as movement of hay aerosolizes dust and particulates.

• If a barn is designed with the stalls surrounding an indoor arena, keep the arena watered to decrease airborne dust.

• Keep the barn well-ventilated. Open windows and doors as often as possible.

Ammonia also can be a prime offender to a horse's airways, particularly when the horse is confined to a stall in a closed or heated barn. Ammonia fumes are the result of urine accumulation in the barn, particularly of urine-soaked bedding. Methods to reduce the presence of ammonia are similar to those strategies employed to keep dust to a minimum, with a few other twists:

• Clean stalls once or twice a day to remove all urine-soaked bedding, and strip stalls at least weekly.

• Remove horses from stalls while cleaning to minimize exposure to ammonia gases stirred up with raking and pitching of bedding.

• Provide good drainage in stalls and aiseways to facilitate exit of urine, and be sure to clean under mats as necessary.

• Use highly-absorbent bedding materials, such as paper or wood shavings, rather than straw.


• Mix an ammonia-neutralizing product with clean bedding.

Whether you are combating dust or ammonia irritants, provide excellent barn ventilation, avoid closing up a barn when possible, and use ceiling fans and open doors and windows to allow refreshment of air.

Mazan stressed another strategy to keep the environment as clean and dust-free as possible and, thereby, relieve environmental insult on the airways: "When possible,

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**Intense exercise amplifies the clinical signs of inflammatory airway disease**

hire a barn architect to assess barn ventilation and make every possible improvement.”

Where practical, try to implement a barn design that allows ridge ventilation with either louvered cupolas or vents—this promotes passive movement of air flow and requires no motorized equipment to move the air. Exhaust of air through ridge vents is best facilitated when coupled with soffit screens where the walls intersect the roof air then moves in at the soffit level and out at the ridge vents.

The best strategy, of course, is to house horses outside whenever possible to promote a clean air environment.

### **PERSISTENT INFLAMMATION**

It is often thought by owners that if a horse is turned out during the day, this will help settle down airway inflammation, but it is OK to bring the horse back into a stall at night. Holcombe clarified why this is a common misperception: “When horses experience a bout of inflammatory airway disease or an acute attack of heaves, the symptoms will last beyond the time of exposure to the offending agent(s). (Researchers in Newmarket) showed that a bout of inflammatory airway disease in horses lasts on average 15.5 days. A horse with heaves can be in remission when it is turned out to pasture with no dust or airborne antigen exposure. Yet, one night in a dusty barn can exacerbate its disease, causing severe signs of airway obstruction that might last for days, even if the horse is turned back out on pasture.”

Mazan concurred that even a portion of the day spent in stabling is enough to perpetuate respiratory problems: “If you are exposed to dust for 50% of your life, it is still an impressive dose of particulates. You really need to get the horse out of the stable permanently to achieve improvement.”

### **TRANSPORT CHALLENGES**

An equine athlete not only endures assaults from its local environment, but it is often hauled to new locations, spending

a proportionate amount of time in a horse trailer. Holcombe noted that horse trailers and the hauling process pose additional and unique challenges to a horse’s airways. She said, “Tying a horse’s head up in the trailer will increase the number of bacteria in the trachea with the potential to develop purulent respiratory tract secretions. Horses transported more than 200 miles are at risk for developing pneumonia (shipping fever). This is likely associated with stress, increased viral and bacterial exposure as new horses commingle, along with increased numbers of bacteria and amount of mucus collecting in the trachea.”

Mazan also reported on the airway insults that occur in a horse confined to the close quarters of a horse trailer. She said, “Research on transport is finding that bedding and hay contribute to a lot of airborne particulates, and this is exacerbated with a head-up position. Various studies have shown that transported horses experience decreased immune function; based on the findings, it is no wonder that these horses develop pleuropneumonia. Having rest stops and keeping the boxes clean during transport help to greatly reduce airborne pathogens and particulates.”

### **RESPIRATORY VACCINES**

A discussion of respiratory health would not be complete without at least some mention of viral respiratory vaccines and their role in minimizing airway disease.

Viral invasion of the respiratory tract not only causes acute illness, but any time a horse experiences viral invasion of the respiratory tract, the ensuing inflammatory event sets up conditions for future development of IAD or heaves. By immunizing twice annually against the common respiratory pathogens equine influenza and herpesvirus-1 and -4, you can reduce your horse’s risk of contracting a virus. Respiratory vaccines stimulate a horse’s immune system to respond when challenged by viral exposure. If your horse does get sick despite regular vaccination, usually the degree and extent of the infection will be greatly minimized.


### **TAKE-HOME MESSAGE**

The stabling environment poses huge challenges to a horse’s airways in the form of aerosolized dust and mold particulates, as well as ammonia fumes. Good quality hay, absorbent bedding, excellent ventilation, and diligent hygiene go a long way toward minimizing common environmental respiratory insults.

While thorough management strategies, including antiviral immunizations, are critical to maintaining a horse’s respiratory health, whenever possible, a horse will benefit from living outdoors in a clean air environment. 🐾

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