EQUINE INNOVATORS PODCAST TRANSCRIPT

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Optimizing Barn and Arena Ventilation with Dr. Morgan Hayes

Stephanie L. Church, TheHorse.com
Welcome to The Horse's Equine Innovators Podcast, sponsored by Zoetis Animal Health. I'm your host, Stephanie Church, Editor-in-Chief at The Horse.

Every day, researchers at universities and other institutions around the world are investigating new ways to care for and understand our horses and the horse industry. In this podcast series we talk to those innovators to learn more about their work.

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Okay, let's get started with today's conversation.

Right now many of us are in the throes of managing horses during winter, lugging heavy barn doors shut at night, and some of us are working our horses in indoor arenas.

This makes today's topic, horse barn and indoor arena ventilation, especially relevant.

Our guest today is Dr. Morgan Hayes, assistant extension professor in biosystems engineering within the University of Kentucky (UK) College of Engineering.

Dr. Hayes is a unique combination of vocations; she's both an engineer and an Extension specialist focused on animal husbandry.

She works to find ways to improve environments to which animals are exposed by providing education on ventilation, energy, water, and temperature requirements in barns. Welcome, Dr. Hayes.

Dr. Morgan Hayes
Oh, thank you very much for having me.

Dr. Morgan Hayes

Stephanie L. Church, TheHorse.com

Thank you. And, so, how did you end up researching topics that impact horses?

Dr. Morgan Hayes

That's an interesting question. So, I grew up thinking that I was going to be a veterinarian, which I think most people that are passionate about animals do. And I found my home in engineering, I am in a family of engineers. So, when I started in college, I really focused in on agricultural engineering as a way to mesh my passion for animals and my love of engineering.

And, over time, I've worked with a bunch of animals, livestock species, poultry, pigs, dogs, you can hear one in the background here, cattle, and, also, when I came to Kentucky and started my position here, I saw a real need in the horse industry to provide some support to farmers and horse owners that really are struggling with barn environments.

Stephanie L. Church, TheHorse.com

Okay, so, tell me about those things that you saw. How did you see that need? What were some things you saw in the barns and arenas?

Dr. Morgan Hayes

Sure, so, one of the things that was really interesting is when I first started at Kentucky, I had a graduate student
who was interested in joining my group. She had spent 20 years, you know, working with horses, training, riding, grooming. And she really made me aware of a lot of the facets of the horse industry, something I hadn’t been familiar with prior to meeting her. We ended up in a lot of really interesting discussions about what the needs were for the horse industry. Specifically, challenges within the barns, and then we ended up on a really in-depth discussion about indoor arenas—something that I had no experience with prior to meeting her and something which we found in looking at the data. There's not a lot of information out there at all right now for someone who wants to build or manage an indoor arena. There's not a lot of guidance, you know, available for horse owners and managers.

Stephanie L. Church, TheHorse.com
Yeah. So, for many of our listeners, it's winter and an indoor arena is a big part of their lives right now. What is it about indoor arenas that makes them difficult to aerate or to provide ventilation in?

Dr. Morgan Hayes
Oh, there's a couple challenges. One of the really challenging things about an indoor arena is anticipating the number of animals that are going to be working at one time, however many horses that is, the time of day at which we’re trying to do it.

Also, you know, the arena footing tends to be dusty. A lot of people are trying to manage dust due to that footing. And what they end up doing is they, a lot of times, use water as a management strategy, which is effective. But there's a fine balancing act between putting enough water on the footing to keep the dust down, but not so much water that it rains on your head while you're riding in the arena.

Stephanie L. Church, TheHorse.com
Indeed. And you also have to think about it freezing and such, too, this time of year.

Dr. Morgan Hayes
Oh, absolutely. Yeah, you don’t want your footing to freeze. That would be really challenging. And people generally want to be comfortable when they ride. So, there's also that balancing act that people want to close the arena up to try and keep it a little bit warmer. But if it's overly closed, it tends to be very stale.

Stephanie L. Church, TheHorse.com
So, tell me about the research that you are conducting right now on indoor arenas. How have you gone about collecting your information?

Dr. Morgan Hayes
So, we knew, anecdotally, when we started working on this project, that people were going to have issues with the environment in the indoor arena. But the first step in the process was to send out an anonymous online survey.

And we had over 400 responses on the survey, from different horse owners, riders, trainers that use these arenas. And what we found was that people were very concerned about the environment, you know; over 70% of them expressed concerns about both dust and also excessive moisture in these arenas. And people also expressed concerns about lack of air movement.

Once we knew that these environmental concerns really existed, the next step was to start going out and making assessments of some of these arenas.

So, we’ve been out to, I’d say, between 30 and 40 arenas, specifically here in Central Kentucky.

And what we’ve been doing is measuring the spatial variability in lighting, air temperature, airspeeds, humidity levels, roof temperatures, floor temperatures, all sorts of things within the arena, just trying to understand how that arena functions. And, currently, we have a number of arenas that we’re measuring the environment over time. So we can see how much it varies throughout the day. Hopefully, we can then sort of compile all this data. It’ll give us enough information to start making some guidance, recommendations for those people that are managing these arenas.

Stephanie L. Church, TheHorse.com
That's really interesting. So, can you describe just the range of types of arenas that you’ve seen? Have some of them had stalls right around the edges of the arena, or is the barn separate?

What types of arenas have you seen so far?

Dr. Morgan Hayes
Absolutely. So, one of the things that's actually pretty interesting, we've actually looked at just covered arenas, independent arenas that stand alone, arenas with stalls attached, arenas where the stalls are attached through a breezeway. And we are pretty careful to note sort of that interaction, because having the horses in stalls within the

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arena adds another facet to the challenge, because then we're housing the horses and we're managing the arena as a riding surface simultaneously. And it gets a little bit trickier when we have both things happening at once.

**Stephanie L. Church, TheHorse.com**
I would imagine. So, what have you found so far?

**Dr. Morgan Hayes**
So, what we found so far is that some people really have a pretty good handle on how to manage their footing and other people find it more challenging. There's a lot of different materials that we use as footing within the arena, and they have different characteristics. We've been working on some Extension publications, specifically about that footing and the management of it. Because I think for a lot of people, that is a good first step.

We also know that most arenas don't have great ventilation, they don't instinctively approach that as one of their primary thoughts when they build an arena, mainly because the people that build arenas are people that build large pole structures and ventilation isn't their primary focus.

**Stephanie L. Church, TheHorse.com**
Yes, indeed, I rode in an arena on Sunday. It was about 22 degrees outside; I don't know what I was thinking. But it was a covered arena out near Paris, Kentucky, and it was lovely. The footing was well-maintained, and, you know, I could tell that this was a comfortable space, both on a 22-degree day and I'm sure it is when it's 95 degrees in the summer and humid, too. So, some people really do it right.

**Dr. Morgan Hayes**
Sure, so, I always like to preface this with, people shut up barns for the most part, for their comfort. You know, instinctively, when we close up the doors on the barns, and all the windows, we're doing it because it's more comfortable for us to muck out a stall or to clean an aisleway or to do whatever, not completely bundled up with our heavy mittens and hats and gloves on. The horses themselves are actually very adaptable. Their thermoneutral zone even on a clipped horse would go down to about 40 degrees Fahrenheit. So, the horses do extremely well in cooler climates. It's really us as humans that don't do well in those cooler climates.

So, we want to really be careful when we think about opening or closing a barn that we're doing it for the horses' benefit, because if we close it up too tight, we do end up with some air quality issues in those barns.

**Stephanie L. Church, TheHorse.com**
Indeed, and you're talking about these thermoneutral zones for horses and you study other types of animals, I'm just curious where on the spectrum does the horse land, since you've worked with pigs and cows and other animals?

**Dr. Morgan Hayes**
Sure. So, cows have a slightly larger thermoneutral zone. They go a little bit lower. But generally, you know the cows and the horses, because of how their body digests grasses and other materials, they tend to be really good and
efficient and they produce a lot of heat in those processes. Also, they’re big animals and that helps them as well. Smaller animals, like pigs, tend to be a little bit narrower on their thermoneutral zone. Interestingly, chickens, because they have all those feathers, they’re actually really adaptable, as well. I always think it’s interesting to note to something like a cat doesn’t actually do well in the cold as much as they are extremely adaptable to the warmer temperatures. So, typically, there’s cows, and horses that are really good at colder temperatures tend to have heat stress, maybe a little bit earlier, than the smaller animals that tend to handle a little bit more heat better but don’t really handle the cold quite as well.

Dr. Morgan Hayes

No, providing a little fresh air specifically into the stall is a good thing. Most barns are designed for natural ventilation. So, most either have some opening at the eave where you’re able to crack a window or something like that to bring fresh air into the stall. And then, if the barn is set up correctly, all that air can exhaust out through like cupolas that are up in the ridge of the roof at the peak of the roof. And the heat from the horse being in that stall is going to cause some of that stale air to rise anyway. So, if we can set up the barn to bring a little bit of fresh air right into the stall, it is absolutely a good thing for those horses.

Stephanie L. Church, TheHorse.com

That’s so interesting. I know we have a variety of critters in our barn; we have the horses, of course. And then we have the cats that wander through and the dogs, also. And I know that some of my friends who manage horses, they have chickens in their farm, as well. So, thinking about all the species as we as we manage our animals.

So, when you’re talking about the barn being closed up and how it creates some issues, so what you’re saying is that if my window on my stall is broken and there’s like a little air coming through, that’s not a bad thing, right?

Dr. Morgan Hayes

Great, that’s very practical advice, thank you. So, in other areas of the world, it’s summer, of course, or it’s like Florida, so it’s simply mild year-round, and I know that people have broken out their stall fans. So, in the barn where I keep my horse, Happy, we have a mixture of purpose-designed stall fans, industrial grade fans, and those plastic Walmart box fans among the boarders.

So, a few years ago, I installed a fan that is designed for use in a horse barn and I mounted it really high up at kind of an angle over his feed bucket. It points down at him in the summer and I like to think it provides him a little bit of relief from the summer heat, while keeping off the bugs. I understand that you and your grad students have done some research on these fans, or all types of fan use. What did you find?

Dr. Morgan Hayes

Yeah, so we have done some work on fan use in the stalls and what we really found was that the fans are really … they make us happy and they do provide some air exchanges within the space, but what they don’t tend to provide is really uniform air movement over the whole stall.

Specifically, the box fans that you reference from Walmart or any sort of box store, those fans really only provide a small area that gets air movement. So only where you attach them onto that grate with your bungee cord or however you’re attaching them there. There’s only a small area right in front of that fan that really feels any sort of air movement.

Those higher mounted fans are able to develop a little bit wider jet, so you get your movement over a little bit more
area. But again, the air movement is not extremely fast over most of the stall. And the angle that that fan is set at really changes where that air movement is felt. So we want to be really thoughtful about how we set up these fans to get air movement where we want it, because we’re probably not going to get it everywhere.

**Stephanie L. Church, TheHorse.com**

Okay, so what about … I’m curious about your study design setup. I’m just trying to imagine what it was like when you were trying to collect this information. Did you put sensors on the horses themselves, or were they on pieces of equipment in the in the stall?

**Dr. Morgan Hayes**

A great question. So, the way we set up this study is we used two stalls, and in one stall we put a box fan on the grate, on the aisleway, and the other one, we had a mounted fan, that was up by the eave. More like what you’re describing, more of an industrial fan that’s set up for a horse stall.

In both cases we put sensors in the stall, one sort of sort of behind the feed bucket in a spot where the horse couldn’t eat it, and the other one, just above the door, where the horse would go in and out of the stall. We didn’t put any sensors on the horses themselves. And the other thing we did was we actually, when the horses were out in the pasture, we took air movements in a grid pattern at basically shoulder height, at about five feet, and then also at about four inches off the ground throughout the stall, so we could see how air was moving within that stall when there wasn’t a horse in there, so we could figure out where the best locations for air movement were.

What we found was that the orientation of the fan that was mounted really made the air movement either occur at that five-foot level or at ground level. So, depending on how we tilted that fan that was up high, it really changed where we felt air movement. So if we had, say, a horse that we like to ride, it likes to stand in the stall and we want to put air movement across its back while it’s standing up, we might orient fan one way versus if we wanted to remove ammonia from a stall—something that actually that fan would be more effective at doing—we might orient the fan a little bit differently so it moved air across the ground to get some ammonia out of that stall if we had say, a foal in there lying down quite a bit.

**Stephanie L. Church, TheHorse.com**

Yeah, their little nose right down there by the urine, that would really help.
Dr. Morgan Hayes
So, the leaf blowers stir up a lot of dust. It wouldn’t be my recommendation to use a leaf blower, especially if there’s horses and other humans in the barn, while you’re trying to do that, and you’re not wearing some form of a mask while doing so (although maybe now we’re all wearing masks, so maybe it’s not as bad). But, in general, the dust blowers do disturb a lot of dust, but they don’t necessarily move the dust and dirt out of the barn very effectively.

One of the things I challenge a lot of people on is, moving air is different than providing fresh air. And a leaf blower doesn’t necessarily, isn’t the most effective way to move all those particles out of the barn. It just stirs them up for a minute and then they settle back down over time. So, we don’t necessarily remove those small particles that we’re trying to get out of the barn.

Stephanie L. Church, TheHorse.com
That’s really interesting. So, if I were to have my own barn and have a concrete aisle, I probably would want to get one of the big brooms. Is that a better way to manage those types of situations?

Dr. Morgan Hayes
Absolutely. Yep. A broom will move a lot more of the particles without necessarily stirring them up into the air as much.

Stephanie L. Church, TheHorse.com
So, how can I assess the ventilation in my barn? And if I don’t see those dust motes floating in the air, is my space in pretty good shape?

Dr. Morgan Hayes
That’s an excellent question. So, there’s a couple things. I already mentioned the moisture being an indication of a lack of ventilation. But other things that would be indications of a lack of ventilation would be extremely high temperatures in the barn in the summertime, or extremely high temperatures in the barn in the wintertime. Most barns aren’t really designed to be warm; they might be, say, 5 or 10 degrees Fahrenheit warmer than outside. But if you’re seeing a barn that’s, you know, 20 or 30 degrees warmer than outside temperatures and you don’t have a heater in that barn, that would be an indication that you have the barn shut up too tight.

And, the dust … again, the particle size on dust is very tricky. So, sometimes when you see those dust particles floating in the air, it’s an indication that we have a lot of dust. Other times, the dust particles are not necessarily highly visible to the naked eye. Sometimes people will say, I didn’t see any dust, but I have allergies, that would be an indication that you have a lot of smaller dust particles that are still causing reactions for you, but they aren’t necessarily visible to the naked eye.

Stephanie L. Church, TheHorse.com
Yes, so yesterday, I was looking back at an article in one of the last year’s magazines, where a source was saying that you shouldn’t be able to see beams of sunlight in the barn, because that’s a sign of dust. Is that kind of a good indicator, too, if you’re seeing sunbeams?

Dr. Morgan Hayes
Yeah, well, that would absolutely; that’s light reflecting off of very small particles. It’s not always an absolutely perfect way to assess dust, I mean, but at the end of the day, there’s pretty expensive equipment to monitor dust. So, most people aren’t going to monitor it qualitatively themselves.

Stephanie L. Church, TheHorse.com
Right. Going back to temperature in the barn, do you recommend that people hang a few thermometers around? Or do you just judge whether it’s too warm by feel?

Dr. Morgan Hayes
I don’t think it would be a terrible idea to have some thermometers in the barns. We’ve gotten some really nice equipment now that is waterproof and weatherproof that would provide you with a good temperature reading, usually with a digital display right on it. And sometimes it’s nice to see how the barn is as reacting.

It’s also sometimes nice to see how a stall temperature is versus an aisleway temperature. This is one of the real challenges with the barn environment is that typically we measure the barn environment where we stand, and we don’t tend to stand in the stall with the horse to notice if it’s hot where the horses are. We just noticed in the aisle where we’re standing, where there’s a breeze going, that it doesn’t feel hot to us. So, it’s sometimes it’s worth sort of investigating the space where the animal is versus the aisleway, where we tend to spend more of our time.

Stephanie L. Church, TheHorse.com
Yes. You know, last week, I was getting my horse ready to ride and I’ll let him eat on his alfalfa as we’re
getting ready in the stall, and I noticed that I just had to take my coat off and hang it outside the stall while I was grooming. I was getting a little too warm. So, I hadn’t really thought about that. I’ll have to check that out. Maybe open up that window a little more.

**Dr. Morgan Hayes**

He or she, I’m not sure, but produces a lot of heat. Those animals are very effective at producing heat, so as long as we have a way for that heat to get out, it’s certainly worth bringing some fresh air in.

**Stephanie L. Church, TheHorse.com**

Indeed. So, what are some ways that farm owners can improve their ventilation in existing barns?

**Dr. Morgan Hayes**

So, one of the things, you know, I recommend is if you have openings, make sure that they really are open. So, a lot of times there’s something like bird netting, over an eave. And what happens over time is that it gets filled in with dust and particles, and if those openings get too enclosed, then we don’t get air through those eaves. Also, sometimes you’ll see a lot of cobwebs and things like that up at the cupolas, and then air can’t get out up at the top. So, all of those are things that you know, just general cleanliness will really help with.

Also, if your barn isn’t oriented to take wind well, you can use, you know, larger floor fans to try and move some air down the aisleways. And while I mentioned that the fans are not necessarily really effective at cooling a horse by providing enough airspeed to do that, some of the time those mixing fans do move air from an aisleway into a stall. So, if you think the stall isn’t ventilating, but the aisleway is, that is an option for bringing fresh air into the stall. Just don’t expect it to necessarily provide cooling for the horse.

**Stephanie L. Church, TheHorse.com**

That’s interesting. Let’s continue talking about barns for a second. So I’m thinking about our barn where we have big, heavy doors that shut and there’s not bars, but kind of like a chain link over the door, so that’s what the ventilation is over about chest level for the horse—unless you leave your door open and you’ve installed some sort of stall guard or … a stall gate so the horse can put its head out in the aisle. How much do those stall gates and those stall guards help with ventilation in the stall?

**Dr. Morgan Hayes**

Um, so, the more open the stall is, the more air freely moves between the stall and the aisleway. So, some of them are quite helpful especially on a more closed-in door that’s, you know, heavy wood. So, there are some benefits on some of those for exactly that reason. If you already had a very open, grate-style door, I don’t know that you would gain as much benefit from a stall guard.

**Stephanie L. Church, TheHorse.com**

Okay, so you were talking about ways to improve ventilation and barns. How about indoor arenas? Do the same principles apply?

**Dr. Morgan Hayes**

Yeah. So, one thing I do encourage people to think about is, you know, potentially you may have to install a fan on or some form of mechanical ventilation to try and exchange air unless you have some smaller openings. So, some arenas have windows that can be opened. Other ones have doors and only doors, and sometimes in the wintertime that’s more challenging to just open a door all the way up. It provides too much air movement. But both are valid approaches. It’s just making sure that there are some openings especially in the ridge and in the eaves to allow some air movement through that space.

The other real challenge with the arena is we want to only provide the right amount of air movement because there’s not always horses in an arena. So, there are times when having it completely shut is not a problem, but there are other times when we really need a little bit of air movement while we’re working horses in that space.

**Stephanie L. Church, TheHorse.com**

Yeah, we’re very fortunate in our farm to have a pretty large indoor arena, and I think the most people I see in there at once, when it’s busy, it’s probably about three in the evenings but we still keep the door open, the main door open and it doesn’t ever feel too stuffy or you don’t see a lot of dust kicked up. So I think we’ve done a pretty good job of mitigating that.

If our listeners have the luxury of building their own barns and indoor arenas, what are some ways they can prioritize ventilation when they’re working on that design?

**Dr. Morgan Hayes**

The first thing I would say is, is really to spend the time to get the barn oriented correctly to take wind and take...
advantage of natural air movement, especially on barns. If we can set it up so that we receive air into some of these stalls and it goes across the barn rather than always directly up the aisleway and then no air moves through the stall, sometimes that’s a real benefit.

Also, sometimes we can do things like make our openings large enough. So, one of the things that happens currently in a lot of barn design is a lot of barns, actually, and arenas are built sort of to human-occupied standards, which means we use a lot of really small openings in the eaves. It looks sort of like on the side of your house you almost use the same sort of vinyl on the eaves, and that doesn’t really provide enough opening for air to come in those eaves to get into those stalls for those horses. So, if we can open those up and just use some bird netting or something like that over those eaves to keep birds out of that area, that would be a far better option.

Also, if you have cupolas, most cupolas now sold in the U.S. are only there to be attractive looking. They don’t actually operate to ventilate. So, if you’re choosing equipment like that, finding ones that actually are designed to allow air movement are really important. Like taking advantage of those natural air movement, the orientation for wind, and then the eave openings, and the roof openings. A lot of that ventilation will happen without you having to do a lot of management, which really helps.

Dr. Morgan Hayes
So this is a great question. So for anyone who’s not from Kentucky, a tobacco barn is a wood-sided barn that is designed to ventilate. Usually, they were located somewhere on a hillside or the top of the hill, and designed to receive wind, because we wanted the tobacco to cure in these barns. And we wanted the air to move in and out all fall so that the tobacco would get warm and cold as temperatures tend to do. Here in Kentucky, we get a lot of pretty drastic swings in the fall going into the wintertime.

They are an excellent option for ventilation, because they are actually designed to ventilate by the nature of how the barn is built. Some people find them challenging in the sense that you can potentially get some precipitation through the wood-sided barns because there are gaps between the pieces of wood, but I think from a ventilation standpoint, they are excellent.

So, I would strongly encourage people to use them for stalls. The work extremely well. I’ve even seen one used, a larger one, retrofitted to be an arena.

Dr. Morgan Hayes
They definitely had air movement. Now, that takes a lot of structural changes to make that work, that seemed to take a lot of wood, but they are a really interesting design that is actually very effective for moving air through those stalls.

Dr. Morgan Hayes
Absolutely.

Dr. Morgan Hayes
Well, I think the questions just keep coming. This is pretty open area for research right now. There’s not a lot of data, so things that we’re working on right now, my student and I are really trying to figure out how much water evaporates from the footing like indoor in indoor arenas, so that we can figure out how much water we really have to add.

You know, a lot of people don’t know how much water to add and they don’t know how to keep their footing at the optimal moisture level and it’s challenging. It’s not something, you instinctively know, you just water when...
you find that you have dust. But figuring out how to maybe more precisely manage watering footing, and then also I'm really interested in dust and air quality overall in both the barns and in the arenas, and characterizing that dust.

As I said before, the dust is really a variable commodity and, and really figuring out how much dust is there and how long it takes for the dust to settle back down. If there's any strategies out there for reducing that dust level, that's certainly on my priority list.

**Stephanie L. Church, TheHorse.com**
Well, we really look forward to seeing those results and learning about what we can do to adapt our own properties. And finally, where can our listeners learn more about the research that you're doing?

**Dr. Morgan Hayes**
Absolutely. So, I do have a website at UK in the biosystems and Ag Engineering department, and also a number of extension materials so, for people in Kentucky that are looking for information like this, we have been actively working on producing Extension publications related to horse facilities for your listeners.

**Stephanie L. Church, TheHorse.com**
OK, cool, thank you. I'll also mentioned that Dr. Hayes gave a presentation on these topics a few years ago, that you can find at TheHorse.com/139299, or you can simply search “equine barn ventilation” on TheHorse.com’s search tool.

Thank you so very much Dr. Hayes for sharing your time and expertise on this important subject. I really do appreciate you coming on the podcast and answering my questions.

**Dr. Morgan Hayes**
Thank you.

**Stephanie L. Church, TheHorse.com**
I also want to thank our sponsor, Zoetis.

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