

HIGHLIGHTING RESEARCH
AND OUTREACH EFFORTS AT
THE UNIVERSITY OF KENTUCKY

JULY 2020
ISSUE #0004

EQUINE SCIENCE REVIEW

CA.UKY.EDU/EQUINE
[@UKAGEQUINE](#) ON FACEBOOK/TWITTER

**DEVELOPMENTS IN QUEST TO PREVENT
CATASTROPHIC RACEHORSE INJURIES, 3**
Study shows association between
mRNA biomarkers, injuries.

**LOOK AT EQUINE MARKETS ADMIST
COVID-19, 5**
Likely Kentucky equine industry will
be hit harder than most by contractions.

**ZERO CONFIRMED LEPTO ABORTIONS, 30-
YEAR FIRST," 7**
2019-2020 season, zero equine leptospirosis
abortions in Central Kentucky.

COMPLETE PASTURE RENOVATION, 9
The easy solution is often not the best
solution.



College of Agriculture,
Food and Environment

EDITOR AND LAYOUT

Holly Wiemers, MA, APR communications and managing director; UK Ag Equine Programs | holly.wiemers@uky.edu

EDITORIAL ADVISORY BOARD

Emma Adam, DVM, PhD, DACVIM, DACVS, assistant professor, research and industry liaison, Gluck Center

Craig Carter, DVM, PhD, Dipl. ACVPM, director, UK Veterinary Diagnostic Laboratory

Richard Coffey, PhD, chair, Animal and Food Sciences

Bob Coleman, PhD, PAS, Dip. ACAN, associate professor and equine extension specialist, Animal and Food Sciences

David Horohov, PhD, chair, Veterinary Science, director; Gluck Center, Jes E. and Clementine M. Schlaikjer Endowed Chair, Gluck Center

Laurie Lawrence, PhD, professor, Animal and Food Sciences

Krista Lea, MS, coordinator, UK Horse Pasture Evaluation Program, Plant and Soil Sciences

James N. MacLeod, VMD, PhD, director, UK Ag Equine Programs and John S. and Elizabeth A. Knight chair, Gluck Center

Martin Nielsen, DVM, PhD, Dipl. ACVIM, Schlaikjer professor of Equine Infectious Disease, associate professor, Gluck Center

Mick Peterson, PhD, professor, Biosystems and Agricultural Engineering

Laura Skillman, director, Agricultural Communications Services

Ray Smith, PhD, extension professor, Plant and Soil Sciences

Jill Stowe, PhD, associate professor, Agricultural Economics

DESIGN

Jordan Smith, marketing manager, UK College of Agriculture, Food and Environment

Equine Science Review is a monthly College of Agriculture, Food and Environment newsletter that highlights important equine work happening at the University of Kentucky.



Photo courtesy Jimmy Henning, PhD, extension professor, Plant and Soil Sciences

PROMISING DEVELOPMENTS IN QUEST TO PREVENT CATASTROPHIC RACEHORSE INJURIES

UK STUDY SHOWS ASSOCIATION BETWEEN mRNA BIOMARKERS AND CATASTROPHIC INJURIES IN THOROUGHBRED RACEHORSES

Catastrophic injuries in Thoroughbred racehorses is a top-of-mind concern for the racing industry and for its fans. That sentiment is shared by researchers at the University of Kentucky, who are working to

learn more about the changes happening at a cellular level that might indicate an injury is present before it becomes career or life ending.

Might it be possible to identify an early marker or signal for horses at risk of catastrophic injury, allowing for intervention before those injuries happen? And, if yes, might this type of detection system be one that could be implemented cost effectively on a large scale?

According to Allen Page, DVM, PhD, staff scientist and veterinarian at UK's Gluck Equine Research Center, the short answer to both questions is that it looks promising.

For the past three years, Page, along with UK colleagues, has been analyzing blood samples from more than 1,000 Thoroughbred racehorses. The samples, collected by participating racing jurisdictions from across the country, have come from both catastrophically injured and non-injured horses in a quest to better understand changes that



PHOTO COURTESY MARK PEARSON PHOTOGRAPHY.

might be happening at the cellular level during racing and if there are any molecular red flags which consistently differentiate horses that suffer a catastrophic injury.

An abstract of this research will be presented at the American Association of Equine Practitioners' annual meeting in December and more information about the study's findings will be shared this fall.

"We are definitely encouraged by our findings," Page said. "The ultimate hope is, of course, to develop a screening tool that can be used pre-race to identify horses at increased risk for injury. The results of this study suggest that analysis of messenger RNA expression could be an economical, effective and non-invasive way to identify individual racehorses at risk for catastrophic injury."

This study, as well as a follow up study beginning this month, has been entirely funded by the Kentucky Horse Racing Commission's Equine Drug Research Council.

"It is hard to overstate how much we appreciate the continued support of the KHRC and the Equine Drug Research Council. Their willingness to fund these projects is really a testament to their interest in supporting innovative ideas geared towards improving the safety and wellbeing of horses and riders," Page said.

David Horohov, PhD, chair of the Department of Veterinary Science, director of the Gluck Center and Jes E. and Clementine M. Schlaikjer Endowed Chair, echoed those sentiments, "I am pleased that the EDRC is able to continue to provide support for this important study and that Dr. Page is able to continue his work on finding ways to protect our equine athletes."

Joining Page in the research from UK's Gluck Center are Emma Adam, DVM, PhD, DACVIM, DACVS, assistant professor, research and industry liaison, Horohov, James MacLeod, VMD, PhD, John S. and Elizabeth A. Knight chair, director of UK Ag Equine Programs and professor



PHOTO COURTESY MARK PEARSON PHOTOGRAPHY.

of veterinary science and Ted Kalbfleisch, PhD, associate professor.

Previous research has shown that many catastrophic injuries occur in limbs with underlying and pre-existing damage, leading to the theory that these injuries occur when damage accumulation exceeds the healing capacity of the affected bones over time. Since many of these injuries have underlying damage, it is likely that there are molecular markers of this that can be detected prior to an injury.

The identification of protein biomarkers for these types of injuries had been explored in previous research, albeit with limited success. The focus of this project, measuring messenger RNA, had not yet been explored, however. The overall objective was to determine if horses that had suffered a catastrophic injury during racing would show increased inflammatory mRNA expression at the time of their injury when compared to similar horses who were not injured. It turns out that this theory might be on to something.

Messenger RNA (mRNA) is a single-stranded RNA molecule that is generated from DNA through the process of transcription. This mRNA carries the genetic information specifying a particular amino acid sequence, which can then be used to create a protein through the process of translation. While work looking

at inflammation often involves measuring proteins, Page and his collaborators opted to focus on mRNA due to the limited availability of reagents available to measure horse proteins and concerns about how limited the scope of that research focus would be. Focusing on mRNA expression, however, is not without issues.

According to Page, mRNA can be extremely difficult to work with. “A normal blood sample from a horse requires a collection tube that every veterinarian has with them. Unfortunately, we can’t use those tubes because mRNA is rapidly broken down once cells in tubes begin to die. Luckily, there are commercially-available blood tubes that are designed solely for the collection of mRNA,” he said.

“One of the early concerns people had about this project when we talked with them was whether we were going to try to link catastrophic injuries to the presence or absence of certain genes and familial lines. Not only was that not a goal of the study, the samples we obtain make that impossible” Page said. “Likewise for testing study samples for drugs. The tubes do an excellent job of stabilizing mRNA at the expense of everything else in the blood sample.”

Horses eligible for inclusion in this study were Thoroughbreds entered into any race in one of five participating jurisdictions

from September 2017 to June 2020. To look at the mRNA, these jurisdictions collected specific blood samples either pre-race or post-race from a selection of non-injured horses or immediately from a horse after a catastrophic injury. Once collected, samples were sent in batches to the Gluck Center where they were analyzed using quantitative PCR (qPCR). The names and category (injured, pre-race or post-race) of sampled horses were kept from the researchers by participating jurisdictions until the samples had been fully analyzed.

Once the names and dates of samples were revealed, public records were used to learn more about each horse. Information examined included the horse’s sex, age, race type and whether non-injured horses raced again within three months of the sampled race. For horses who had been injured, more information about the race itself was gathered to determine if there were other factors related to the injury. Additionally, necropsy results, when available, were used to categorize the type of musculoskeletal injury that occurred.

“As of right now, there are four mRNA markers, out of the 23 we have measured with qPCR, that show some significant promise as markers for identifying horses at risk of a catastrophic injury. Obviously, there has been an impact of COVID-19 on our research, so there are still a few more samples to process and add to our data analysis. Once we do that, we plan to submit the findings for publication. Currently, we’re targeting the end of the year to be able to share exactly what we have found so far” Page said.

| *Holly Wiemers, MA, APR, is the communications and managing director of UK Ag Equine Programs.*

A LOOK AT EQUINE MARKETS AMIDST COVID-19

Jill Stowe, PhD, associate professor in the University of Kentucky College of Agriculture, Food and Environment's Department of Agricultural Economics, presented at the UK Ag Equine Programs' monthly Equine Forum virtual meeting June 24 about the impact COVID-19 is having on equine markets.

She began by giving attendees a definition of a recession, which is a period in the business cycle where economic activity declines (often measured by declines in growth in Gross Domestic Product, or GDP). In the U.S., a recession is often defined by two consecutive quarters of declines in GDP.

According to Stowe, a recession results in an increase in unemployment, decrease in income, decrease in consumer spending, rising business failures and a falling stock market. Recessions have many different sources, including bursting of financial bubbles, credit crunches and, as we are experiencing, pandemics. These contractions are a normal part of the business cycle (there have been five recessions in the past 40 years as a reference), but they are normally short-lived; since the Great Depression, the longest recession lasted 18 months, from December 2007 through June 2009.

Stowe said that an "official" U.S. recession (characterized to two consecutive quarters of GDP declines) is likely if the coronavirus pandemic lasts longer than expected, but acknowledged that significant economic hardships are already being realized. For instance, in Kentucky (as of June 4), nearly 886,000 people had filed for unemployment, which is approximately 43% of Kentucky's eligible workforce.

Governments attempt to coun-



PHOTO CREDIT: UK COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT.

teract economic contractions by getting people spending (consumer spending constitutes 70% of GDP) through lower interest rates and fiscal stimulus packages. Since interest rates are already near historic lows, for the current crisis, the government is relying on stimulus checks to encourage consumer spending.

She also noted that there are two types of "normal" economic goods, necessity and luxury. A normal good is one which experiences increasing demand when income rises. The rate of demand increase determines whether the normal good is a necessity or luxury good. When income increases, demand for luxury goods increases at an increasing rate; however, when income decreases (like during a recession), demand declines at an increasing rate. Consequently, industries involving luxury goods are more volatile than necessity goods. Relevant to the discussion at hand, she noted that from an economic perspective, horses are considered luxury goods.

Moreover, the equine industry is one of Kentucky's signature industries and constitutes one of the most important sectors in Kentucky's agricultural economy. In fact, the equine industry has

been characterized as an economic cluster in Central Kentucky, which describes a network of geographically connected organizations and institutions.

Taken together, it is likely that Kentucky's equine industry will be hit harder than most by contractions in the economy. First, in an economic sense, equine markets act like markets for luxury goods and hence are more volatile. Second, due to the equine industry's organization as an economic cluster and its prominence in Kentucky's agricultural industry, the overall impact on Kentucky's economy is magnified and far-reaching.

Stowe considered it instructive to summarize lessons learned from the last recession in 2008-2009 in order to predict how equine markets might react to the current economic climate. Stowe said that nationwide, effects on equine markets included a decline in the number of mares bred and foals produced, a decline in organization memberships, a drop in sales prices and sales revenue, a small decline in competitions and increased animal welfare issues.

The immediate effects of the COVID-19 shutdown have been felt primarily by competitions

and sales, and perhaps to a lesser extent boarding and training operations. The shutdown resulted in the cancellation or postponement of local, regional, national and international equine events, including the postponement of the 2020 Olympic Games and cancellation of more than 2,900 FEI competitions in the three-month span following implementation of COVID-19 restrictions. Losing these competitions has a number of negative consequences, including loss of regional economic development, lost income for individuals and lost revenue for organizations.

The shutdown has also resulted in “clogged” pipelines in the equine market as sales were canceled, postponed, or significantly decreased, she said. Getting the pipeline moving will be a key to recovery and noted that watching the first sales resuming in late June might provide an indication of what is to come for sales later this fall.

Boarding and training operations across the world have been faced with a variety of restrictions. In some areas, riding was prohibited and barns were closed to all but essential employees. Many equine professionals were, for a time, were unable to give lessons, clinics and coach at competitions.

At the onset of the COVID-19 restrictions, equine veterinary clinics delayed elective procedures for a time. As restrictions were gradually lifted and with human protections still in place, they are now able to operating close to normal. Hay and feed markets, which are actually more sensitive to weather variations, seem to be unaffected, but should labor shortages arise, availability issues and/or price increases may ensue.

According to Stowe, the long run outlook will depend on a number of factors. The longer the economic restrictions last, the larger the impact will be. In addition, whether the recovery follows

a V-shape (quick recovery), a U-shape (a prolonged recovery), an L-shape (no recovery), or something in between. Going forward, unemployment, GDP and disposable income will all be important metrics for recovery in the equine industry.

Stowe and colleague Bob Coleman, PhD, PAS, Dip. ACAN, associate professor and equine extension specialist in UK’s Department of Animal and Food Sciences, are launching a research project estimating the impacts from COVID-19 in Kentucky, specifically focusing on breeding, sales, competitions and boarding and training facilities. They will be distributing a series of surveys beginning this fall and expect to be able to share results in 2021.

| *Holly Wiemers, MA, APR, is the communications and managing director of UK Ag Equine Programs.*

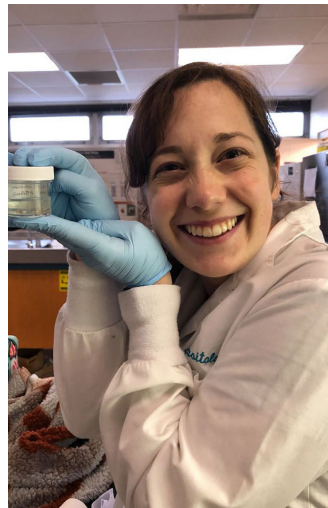
KENTUCKY “EQUINOMICS”

In 2019, the equine industry was the second largest agricultural sector in Kentucky as measured by cash receipts

In 2008, more than 90% of U.S. equine cash receipts were realized in Kentucky.

The 2012 Kentucky Equine Survey estimated that the industry contributes a state-wide economic impact of \$2.99 billion and over 40,000 jobs.

ASHLEY STEUER WINS PRESTIGIOUS AWARD



At the yearly scientific conference organized by the American Association of Veterinary Parasitologists (AAVP) in June, Ashley Steuer, DVM, PhD, Zoetis Resident in Veterinary Parasitology at the University of Kentucky Gluck Equine Research Center, was awarded AAVP/Merck Outstanding Graduate Student.

You can see her presentation, which reflects on her career path so far and her vision for the future, on the Gluck Center’s Facebook page [here](#).

ZERO CONFIRMED EQUINE LEPTO ABORTIONS, A 30-YEAR FIRST, DEMONSTRATES POWER OF RESEARCH LEADING TO A SUCCESSFUL VACCINE



PHOTO COURTESY ERIN DESNOYERS.

According to information compiled by the University of Kentucky Veterinary Diagnostic Laboratory, the 2019-2020 reproductive season saw something that hasn't been seen for at least 30 years, a season without one confirmed equine leptospirosis abortion in Kentucky's Bluegrass region.

The milestone wasn't a happy accident, but rather a result of work amongst many people at UK and within the equine industry, said Craig Carter, DVM, PhD, Dipl., ACVPM, FNAP, director and professor of epidemiology at the UK VDL. The outcome of this collaboration was a licensed leptospirosis vaccination introduced in 2015 by Zoetis.

While assessing the loss to other states is impossible, the UK VDL estimates that the disease cost Kentucky's Bluegrass Region a total of \$102 million in losses from 1993 to 2012, with an average loss of \$3-5 million each year.

Leptospirosis is a bacterial

infection that can lead to abortion, chronic uveitis – also known as moon blindness – or kidney failure in horses. It is a zoonotic disease, which means it can also infect humans, as well as pets and other livestock. It is a disease found worldwide, especially in developing countries. The bacterium thrives in wet climates, so horses exposed to standing water, flooding, wetlands, streams or ponds have a greater likelihood of coming into contact with and being infected by it.

"In the midst of all the COVID-19 chaos and stress, I was thrilled with the great news presented to me by Dr. Jackie Smith, UKVDL epidemiologist, that our lab did not confirm any cases of equine leptospiral abortion for the 2019-2020 reproductive season," said Carter. "From everyone here at the UKVDL, our national leptospirosis study team, and horse owners everywhere, we thank Zoetis for their efforts to develop,

test and market the first licensed leptospirosis vaccine for the horse. We are all humbled to have had a role in this process. Many thanks also to Dr. Jaci Boggs who led the vaccine project at Zoetis."

The drive to develop a vaccine started in Kentucky with a national epidemiological study, funded by the Kentucky Thoroughbred Association/Kentucky Thoroughbred Owners and Breeders. That study, which took place between July 2010 and April 2011, looked at the sero-prevalance (level of exposure to pathogen in a population, as measured in blood serum) of leptospirosis among horses in the United States and Ontario, Canada. Researchers studied the residual sera from Equine Infectious Anemia submissions at 30 diagnostic laboratories. The study of 1,495 horses showed evidence that there was leptospirosis exposure and infection across 29 states in the U.S. as well as in Ontario, Canada, and that this exposure could lead to abortion in mares, clinical disease in horses and foals and could present a risk of zoonotic disease in farm workers and equine veterinarians.

Subsequently in 2014, Zoetis conducted a national study evaluating serum from more than 5,000 healthy horses nationwide. The study demonstrated that 75% of healthy horses in 18 states have been exposed to one or more types of leptospire. This in turn led to a commitment by Zoetis to create a licensed vaccine against leptospirosis for the horse. LEPTO EQ INNOVATOR® – introduced in 2015 – is the first and only equine



PHOTO COURTESY MARK PEARSON PHOTOGRAPHY.

vaccine to help prevent leptospirosis caused by *L. pomona*. Demonstrated safe for use in pregnant mares, LEPTO EQ INNOVATOR helps prevent leptospiremia caused by *L. Pomona* which could, but has not been demonstrated to, help reduce the potential risk of equine recurrent uveitis (ERU) infections, abortions or acute renal failure caused by *L. Pomona*.

“Equine leptospirosis is a costly, devastating and underdiagnosed disease that can affect the entire equine industry,” said Jaci Boggs, DVM, MS, DACVIM, senior equine technical services veterinarian at Zoetis. “We were honored to collaborate with industry leaders to further research the effects of Leptospirosis and introduce

LEPTO EQ INNOVATOR which targets *L. Pomona*, the serovar most frequently associated with the disease in horses, providing horses the protection they need. It is exciting to see the power of research and the positive impact this vaccine has had in Kentucky’s Bluegrass Region this past season with zero confirmed equine leptospirosis abortions.”

According to Carter, there were many people involved in the research leading to the vaccine. Some of the key individuals included:

- Bill Bernard, DVM, Dipl. ACVIM, then an equine medicine specialist with Rood & Riddle Equine Hospital;
- Boggs, who led the effort to

- develop, license and market the vaccine;
- Stuart Brown, DVM, then with Hagyard Equine Medical Institute;
- Carter, who in addition to the research work also served on the Zoetis leptospirosis vaccine committee;
- Noah Cohen, VMD, PhD, Texas A&M University College of Veterinary Medicine;
- Nancy Cox, PhD and dean of UK’s College of Agriculture, Food and Environment;
- Erdal Erol, DVM, PhD, head of microbiology at the UK-VDL;
- Gloria Gellin, MPH, PhD student under Carter;
- Deborah Maples, DVM, head of diagnostic services at the UK VDL;
- Tom Riddle, DVM, Rood & Riddle Equine Hospital;
- Jackie Smith, PhD, epidemiology section head at the UK VDL;
- Meg Steinman, MPH, MT (ASCP), head of serology at the UK VDL;
- David Switzer; then with KTA/KTOB, now retired.

| *Holly Wiemers, MA, APR, is the communications and managing director of UK Ag Equine Programs.*

EQUINE INNOVATORS: AFRICAN HORSE SICKNESS WITH DR. PETER TIMONEY

University of Kentucky researcher Peter Timoney, MVB, PhD, FRCVS, Professor, Frederick Van Lennep Chair in Equine Veterinary Science at the Gluck Equine Research Center, talks about the deadly African horse sickness and what it will take to prevent its arrival in unaffected countries.

This podcast is the third episode in our new “Equine Innovators” podcast series, a collaboration between UK Ag Equine Programs and TheHorse.com, brought to you by Zoetis. You can find the Equine Innovators” podcast on TheHorse.com, Apple Podcasts, Spotify, Stitcher and Google Podcast. Download the podcast [here](#).



COMPLETE PASTURE RENOVATION

When most of us think about pasture renovation, we think of overseeding with desirable grasses like orchardgrass and Kentucky bluegrass.

We've learned after many years of giving advice on pasture renovation that the easy solution is often not the best solution.

When your pasture has major issues, including broadleaf weeds, a high percentage of toxic fescue, unpalatable species like nimblewill, etc., then the best solution may be a complete replacement of the stand.

We know that a complete reseeding is time consuming and expensive, but we have seen many farms drill in more seed year after year, apply multiple applications of herbicides and then still not have the pasture stand they desire. On the other hand, horse farm owners and managers who have "bit the bullet" and started over have consistently had excellent stands after the process was completed.

If you think that some of your pastures are candidates for complete renovation this fall, here are the basic steps that have proven successful for many Kentucky horse farms as well as horse farms throughout the Southeastern U.S.

- Lime and fertilize to soil test recommendations.
- Make sure that toxic fescue has not gone to seed this summer (the toxic seed will germinate in the fall and recontaminate the stand). This is done by haying, hard grazing or bushhogging in late May/early June.
- Stop grazing in early July and allow 5 to 6 inches of regrowth.
- Spray with glyphosate 4-6 weeks before planting – mid to late-July.
- Allow weeds and toxic tall fescue that survived the first spray to regrow.
- Re-spray glyphosate before planting – late August to early September.
- In early to mid-September, just after last glyphosate spray, plant a mixture of orchardgrass and Kentucky bluegrass or other perennial grass species using a no-till seed drill. More and more farms are planting novel endophyte tall fescue varieties because they show good survival but do not produce toxins like KY-31.
- Seed at 25 to 35 lbs/acre and no deeper than ¼ to ½ inch deep. A typical mixture in central and northern Kentucky is 15 lbs/acre orchardgrass, 15 lbs/acre Kentucky bluegrass and 5 lbs/acre of perennial ryegrass. Or 25 to 30 lbs/acre of novel endophyte seeded alone.
- To achieve better ground cover, set the drill at half seeding rate and go over the field twice, the second pass perpendicular to the first.
- Apply a low rate of nitrogen at seeding or in October to enhance stand establishment (40-50 lbs/N/acre-this equals 90 to 110 lbs/acre of urea).
- If broadleaf weeds become



PHOTO COURTESY KRISTA LEA.

- an issue, wait until new grass seedlings reach the four leaf stage (4-6 inches) before spraying, typically late October when there is adequate rainfall.
- Allow good sod development before grazing. Be patient and wait for the stand to develop.
- If you must graze, wait until plants are 8 inches tall and flash graze (use more horses than normal per acre for only a few days).
- Ideally, let your first use of the stand the following spring be light grazing or a hay harvest. Overgrazing can destroy a newly seeded stand.

It can take six months to a year before the new stand has fully established and has a thick sod, but then you will have a productive pasture for many years to come.

While there is no guarantee, this formula has proven successful again and again. Next month we will discuss selecting varieties and seed mixtures.

More information [here](#).

| *Krista Lea, MS, coordinator, UK's Horse Pasture Evaluation Program, and Ray Smith, PhD, extension professor, UK's Department of Plant and Soil Sciences, provided this information.*

SCIENCE SLEUTHS: THE SCIENCE THAT SHAPES DIAGNOSTIC TESTS

PCR: WHAT'S BEHIND COMMONLY USED ACRONYM?

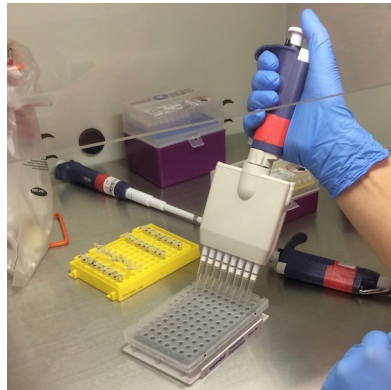
The genetic code of life is made up of genes and regulatory elements encoded by DNA. Initially, following the discovery of the double helix structure of DNA in the early 1950s, science struggled to find the appropriate molecular tools to move the field forward. Since then discoveries have come thick and fast as our understanding of DNA and gene structure and function has blossomed.

While we now take for granted the ability to perform whole genome sequencing, our knowledge stands on the foundations of huge scientific research efforts and breakthroughs. One such breakthrough resulted from a combination of research events that led to the ability to amplify specific targeted segments of DNA using a technique called the Polymerase Chain Reaction, abbreviated PCR. PCR enables small amounts of DNA, previously impossible to detect in a sample, to be specifically amplified to generate quantities many fold, and often many logs, higher in the sample. This greatly facilitates detection and isolation of the targeted DNA sequence using other laboratory methods. If the segment of DNA you are looking for can be characterized as a needle in a haystack, what PCR achieves is to massively increase the number of needles in the haystack. This Nobel Prize winning discovery would forever change the face of science.

What did that mean for the veterinary community?

This gigantic leap forward has enabled advances in diagnostic testing, the discovery of genetic disorders and verifying parentage, to name but a few applications. In terms of diagnostic testing, PCR is routinely used to detect specific disease-associated organisms, such as pathogenic bacteria and viruses. Importantly, these agents can be identified in a sample even when present in tiny numbers.

Previous diagnostic testing methods relied on culturing live bacteria or laboriously isolating vi-



PHOTOS COURTESY DR. EMMA ADAM.

uses, both of which are time consuming and fraught with problems. As such, false negative results and long delays in diagnosis were frequent problems. PCR testing can be performed in a matter of hours and lead to a more rapid diagnosis of disease and timely implementation of appropriate biosecurity measures. For example, most of the diagnostic tests that are currently being used to detect the specific coronavirus that causes COVID-19 are PCR based.

How does it work?

The polymerase chain reaction refers to a series of repeated steps where specific sequences of DNA are identified and amplified using equally specific synthetic 'primers.' Primers are short pieces of DNA, usually about 20 nucleotides long, whose nucleotide sequence provides a perfect base-pairing match to regions on the DNA double helix that flank a site of interest, or target DNA.

This site of interest could be part of a specific bacterial gene or a region that may contain a genetic mutation in a given virus, for example. The sample is heated up to separate the double stranded DNA helix and then cooled slightly to allow the primers to hybridize to specific sites on the target DNA. The special polymerase enzyme, which is stable at high temperatures, then synthesizes the corresponding DNA strand, creating a perfect copy – doubling

the number of copies.

To allow more copies to be made, the cycle is repeated. The sample is heated again, primers hybridize to the original sequence plus each of the new copies, and the polymerase enzyme catalyses the synthesis of another new strand of the DNA sequence of interest. In each reaction cycle, the amount of target DNA doubles, thus literally generating a logarithmic amplification. In fact, if the reaction started with just one copy of target DNA, after 40 cycles, more than a trillion copies of the DNA would be synthesized.

Incredibly sensitive technique

This massive amplification process makes PCR an exquisitely sensitive diagnostic test that can detect minute amounts of target DNA in a sample. It can detect DNA from organisms that are alive and those that are dead if the DNA is still intact. This makes for some issues with regard to the interpretation of results. We will be discussing those concerns in future features of the Equine Science Review, so watch this space.

| *Emma Adam, DVM, PhD, DACVIM, DACVS, based at UK's Gluck Center and Veterinary Diagnostic Lab, is responsible for research and serves as veterinary industry liaison. Jackie Smith, MSc, PhD, MACE, Dipl AVES, is an epidemiologist based at the UK Veterinary Diagnostic Lab.*

UK GRAD STUDENT MOK DEFENDS PHD VIRTUALLY



DR. JAMES MACLEOD, LEFT, INTRODUCES DR. CHANHEE MOK
DURING HER VIRTUAL PHD DEFENSE

ChanHee Mok, newly minted PhD in the University of Kentucky Gluck Equine Research Center, successfully defended her PhD virtually via Zoom and Facebook Live platforms June 18.

Her presentation, titled, “Comparative Chondrogenesis of Interzone and Anlagen Cells in Equine Skeletal Development,” drew from work completed in the laboratory of James MacLeod, VMD, PhD, John S. and Elizabeth A. Knight chair at the Gluck Equine Research Center and director of UK Ag Equine Programs.

According to her bio, Mok, who is from Cheongju, South Korea, earned her bachelor’s degree in animal science from KonKuk University. She decided to pursue graduate school and chose equine science as her emphasis area because there are not many equine scientists with a master’s or doctoral degree in South Korea, even though the equine industry is rapidly growing there. Due to the lack of equine graduate programs in South Korean universities, she elected to study abroad to pursue her higher educational goals.

Located in the region widely regarded as the Horse Capital of the World, UK was her first choice because of its quality equine research and publications. She

earned a master’s degree in equine nutrition from the Department of Animal and Food Sciences in the laboratory of Kristine Urschel, PhD, associate professor.

As she gained academic and practical experience on issues related to horses, Mok recognized the importance of musculoskeletal physiology, in terms of both the biomedical issues and economic priorities within the equine industry. Her dissertation studies focused on the developmental biology of cartilage, comparing two fetal cell types, interzone and anlagen cells, that differentiate into distinct cartilaginous tissues. The research provides a foundation of knowledge for future experiments on cell-based therapies to enhance the repair of structural defects and injuries in cartilage.

Financial support for Mok’s research came from the Hughes Foundation, Morris Animal Foundation, Spy Coast Farm and Gluck Equine Research Foundation. Watch her dissertation [here](#).

| *Holly Wiemers, MA, APR, is the communications and managing director of UK Ag Equine Programs.*

Forage Timely Tips:

- Apply 40-60 lbs. nitrogen per acre to stimulate summer annual regrowth.
- Clip pastures late June/early July as needed to maintain vegetative growth and to reduce weed seeds, but don’t clip lower than 4 in.
- Soil test pastures to determine fertility needs.
- Using [UK variety trial results](#), select varieties to plant in the fall and order seed.
- Use a designated sacrifice lot to feed horses hay and supplements as needed if drought sets in and no forage is available for grazing.

Source: University of Kentucky Forage News, June 30, 2020

IS RAINED-ON HAY ANY GOOD?

A lot of hay has been cut in recent weeks. The weather was good, but not perfect, as Kentucky weather is notoriously unpredictable. If you got some rain during haymaking, you are not alone. What happens to quality for rained-on hay?

The majority of the damage from untimely rains is the loss of soluble nutrients from the hay (the sugars). Even before rain damage, we lose some sugar during plant respiration that occurs from the time forage is cut until it reaches about 50% moisture content. Rainfall will extend the length of time that the hay is wetter than 50% moisture, leading to more loss of sugars from respiration.

Rainfall also leaches the soluble sugars from hay. The amount of leaching depends on the forage type, the hay moisture content when it rains, the concentration of soluble sugars and the number, amount and intensity of rainfall event(s). Leaf shatter can also be significant in legumes, especially on nearly dry forage.

Hay that has been rained on during curing will also have greater levels of dirt as well as higher numbers of microorganisms that will cause molding in the bale. Finally, the extra tedding and raking that may be needed to cure the crop can lead to further losses, especially in legume hay.

Research done by Mike Collins, PhD, retired UK forage scientist, gives us some insight into the



PHOTO COURTESY DR. JIMMY HENNING.

question of how much quality is lost due to rain. Collins measured the digestibility of alfalfa and red clover forage which experienced rain at different times after cutting (Table 1). In 1980, 1 inch of rain that fell soon after clipping had little negative impact on forage digestibility. In a second study, 1.6 inches of rain during curing (after some drying had occurred) caused significant losses in digestibility. Getting 2.4 more inches of rain on almost dry hay caused further damage, truly making some of the forage of little value (for example, 36% digestibility in rain-damaged late-bloom alfalfa). With severely rain-damaged hay, it may better to leave it on the field, chop it up with a rotary mower to speed de-

composition and minimize shading of the next crop.

Similar research at the University of Arkansas found dry matter losses were below 2% for second cutting orchardgrass with up to 3 inches of simulated rainfall when the forage was 67.4% moisture (moisture level just after cutting). Dry matter losses quadrupled to 8% when the same amount of water fell on forage at 15.3% moisture (moisture level desired for making dry hay).

In the end, deciding what to do with rain-damaged hay is a judgment call. Many factors come into play such as when the rainfall occurs during curing, the amount and intensity and how dry the crop was when rained on. I find it helpful to know that rain immediately after cutting can do minimal damage.

		IVDMD (% DM)				
		1980		1981		
	Maturity	No Rain	1.0 in after clipping	No Rain	1.6 in during curing	2.4 in on dry hay
Alfalfa	Bud	67.6	65.2	72.7	57.2	49.3
	Late Bloom	60.1	58.8	62.3	39.2	36.0
Red Clover	Late Bud	74.6	72.1	68.3	47.2	43.4
	Late Bloom	67.1	62.6	62.1	48.6	43.7

IVDMD = In vitro dry matter digestibility; %DM = percent dry matter

| Jimmy Henning, PhD, is an extension professor in the Department of Plant and Soil Sciences. This excerpt first appeared in the June issue of Famer's Pride.

GRADUATE STUDENT SPOTLIGHT: ANNA PASTERNAK

I had the opportunity to talk to Anna Pasternak, who is a graduate student researcher studying vector-borne illnesses in the University of Kentucky Department of Entomology. She is part of the Kentucky Tick Surveillance Program, a partnership between University of Kentucky and the Kentucky Department of Public Health. Most horse communities are aware of mosquito- and tick-borne diseases that affect horses, but Pasternak advocates for increased awareness by people. She and I talked about the research she has been doing, her interest in One Health and why we need to have greater awareness of the dangers of vector-borne illness.



ANNA PASTERNAK, PHOTO CREDIT: DR. GRAHAM HICKLING, UNIVERSITY OF TENNESSEE.

Can you tell me where you are in your research studies, and how you got interested in ticks and mosquitos?

As a member of the Kentucky Tick Surveillance Program, I collect ticks from around the state and test them for certain pathogens that are causing major tick-borne diseases here in Kentucky. Currently, we're in the second year of the program. When I came to



PHOTO COURTESY ANNA PASTERNAK.

UK, I had a preexisting interest in the links between human/animal health and insects—sometimes

referred to as One Health—from working with my previous entomology professor, Dr. Kelly Johnson, from Ohio University, while also working as a mosquito surveillance intern at the local Athens County Health Department. When I came to UK and learned that Kentucky had never had a tick surveillance program, I had this great opportunity to help build a system that could potentially bridge a better understanding of how ticks play their role into One Health. It's been super successful, and we've been finding a lot of interesting things.

Why should we be worried? What diseases could we get? How and when would we be most likely to get a vector-borne illness?

I don't think anyone should necessarily be worried, but instead, should be aware. Ticks and mosquitoes are something that you just have to live with where we are, and I don't think that they, nor the fear of what they can vector, should keep people from enjoying

the outdoors.

In Kentucky, we have three species of tick that you'll run into often—the Lone star tick, the American dog tick and the Blacklegged tick, as well as other species like the Brown dog tick and even the Gulf coast tick. The most common tick-borne diseases reported in Kentucky are Spotted fever rickettsiosis, ehrlichiosis and Lyme disease, but these species of ticks can also carry other diseases like tularemia and anaplasmosis. Several of these diseases don't only affect people; they are a risk to livestock and pets as well.

Tick activity peaks during the summer months, so that is the time of year when you are most likely to get bitten by a tick and therefore develop a tick-borne disease. However, one of our species, the Blacklegged tick, remains active throughout the winter months as long as temperatures are above freezing, so it's important to always check yourself if you're in an area you think ticks may be, regardless of the time of year. As far

as weather goes, tick activity and humidity hold a positive correlation, because the humidity protects them from drying out. As anyone here can tell you, Kentucky can get really humid, which is all the more reason to be aware of ticks while outdoors.

How can we protect ourselves and be vigilant against mosquito or tick bites?

The best way to protect yourself is to cover up and use deterrent. If you're in areas where mosquitoes and ticks are likely to be, it's smart to wear long pants and long-sleeved shirts and then apply an insect repellent like Deet or permethrin. It's very important to follow the instructions on the insecticides, as permethrin should not be applied directly to your skin. For animals, using a tick preventative does wonders for preventing ticks in the first place, and keeping fields and lawns mowed and getting rid of leaf litter and grass build up will prevent ticks from hanging around.

If we get a bite and suspect illness, what symptoms should we be looking for, and if we visit the doctor, how do we make sure we are screened for the correct diseases?

Most of the vectored diseases you get from ticks and mosquitoes will leave you with flu-like symptoms—body and headaches, fatigue, nausea, etc.—anywhere from a few days to a few weeks after the bite. With Lyme disease, most cases will manifest as a rash resembling a bullseye. With Spotted fever rickettsiosis, a.k.a. Rocky Mountain spotted fever, the rash begins as small red bumps on the wrists, palms or feet and then grows inward to the body. However, because not every disease will present a rash, it's very important to monitor your health in the weeks following a bite and to contact your physician if you begin to feel sick.

The best way to determine what



PHOTO COURTESY ANNA PASTERNAK.

to watch for after experiencing a bite is to know what bit you. Certain species will only carry certain diseases—this goes for both mosquitoes and ticks. For example, Lyme disease is only vectored by the Blacklegged tick in the entire eastern United States, but many people will see a tick and worry immediately about Lyme disease. By educating yourself about what may be in your area and the basic symptoms of those diseases, you can really help your doctor arrive at a diagnosis and provide proper treatment. Better yet, keep the tick that bit you for later identification if needed.

What sort of research plans does your group have? How will you be rolling them out?

Right now, with the program only in its second year, we're mainly focused on determining population ranges of the different tick species in Kentucky as well as what diseases they're carrying. In the future, I'd like to expand the list of pathogens that we test for and get some local health departments involved with collecting ticks in their respective counties. Additionally, we're in the midst of beginning some tick education programs for the public, which I think will really help in getting the information about vectors and vector diseases out there.

With all the data collected, I'm working with some individuals from UK's College of Public Health to map everything out so that someone can look at the map

and see, for example, where Black-legged tick populations are located throughout the state and where the ones infected with the bacteria causing Lyme disease have been found. Once these maps are done, we're going to make them open for public access for anyone to view.

How often do you recommend checking for ticks? What is the correct way to check?

The best time to check for ticks is whenever you remember to do so. I really don't think you can check yourself too often. Adult ticks are only a few millimeters big when unfed, while nymphs and larvae are only one or ½ a millimeter so they can be easy to miss if you don't take the time to check. I recommend starting at your feet, as ticks will likely be closer to the ground, and move up the body.

If you find one attached, the only safe way is to remove the tick with a set of tweezers by grabbing as close to the skin as you can and pulling straight up, no twisting or bending.

If you have pets that go indoors and outdoors, it's important to make sure they don't have anything hitchhiking into your house—some ticks can survive up to two years without a meal, meaning they can hide out in your home for quite some time without precautions.

In what ways are they transported to different places, and potentially, to our bodies? Can we break that pathway of transmission, or do we just need greater awareness? Farming equipment is actually a major way ticks are transported. They're attracted by the carbon dioxide and heat given off and will cling on in hopes of a meal. I think the way to break that pathway is by being aware and checking your equipment before moving from one field to another. Ticks are also believed to move around on the host—this goes back to properly checking—and so checking any

animals you may transport can potentially stop the spread.

Most people don't think of ticks and mosquitoes as serious dangers. Do we have that wrong?

In hopes of getting a better idea of how tick-borne diseases affect Kentuckians, I've reached out to several people around the state and talked with them about their experiences. I've spoken with victims of Lyme disease who've lost the ability to walk and suffer neurological complications like memory loss because they were improperly treated. Sadly, there seem to still be physicians who don't consider Lyme disease as a possibility when treating patients suffering after a tick bite. When something as complicated as Lyme disease gets into the later stages, it can become very difficult to treat and so catching it early is crucial. Moreover, some individuals have dealt with delusional parasitosis and are left experiencing much more than just physical illness.

Which disease/vector worries you the most, and why?

The Lone star tick is the worst, in my opinion. It has the potential to carry a long list of diseases, is the most common tick in Kentucky according to what we've found so far and is the most aggressive tick here. Most ticks are pretty lazy and will wait until you get close enough for them to cling onto you, but Lone star ticks are "active questers," meaning once they sense a host, they'll orient themselves and march toward it. Also, this is the tick responsible for alpha-gal, or red-meat, allergy which, as far as I know, has no real treatment.

| Karin Pekarchik, MS, senior extension associate for distance learning and founder of the UK Female Equestrian Health and Wellness Community of Practice, provided this information.



MALE BLACKLEGGED TICK,
PHOTO COURTESY ANNA PASTERNAK.



FEMALE BLACKLEGGED TICK,
PHOTO COURTESY ANNA PASTERNAK.



MALE AMERICAN DOG TICK,
PHOTO COURTESY ANNA PASTERNAK.



FEMALE LONE STAR TICK,
PHOTO COURTESY ANNA PASTERNAK.

AAEP PUBLISHES AFRICAN HORSE SICKNESS GUIDELINES

The American Association of Equine Practitioners (AAEP) has published on its website comprehensive guidelines to assist practitioners and regulatory agencies with identification, diagnosis and control of African horse sickness (AHS), an internationally reportable disease of equids that is highly fatal.

Although AHS does not occur in horses in the United States, a current outbreak in Thailand, with a 94% mortality rate, illustrates the devastation possible when the disease affects a naive horse population.

“The potential risk of introducing endemic or transboundary diseases into the country’s equine population cannot be over emphasized, either at the level of the practicing veterinarian or the horse-owning public,” said Peter Timoney, MVB, MS, Ph.D., FRCVS, MVB, PhD, FRCVS, Frederick Van Lennep Chair in Equine Veterinary Science at the Gluck Equine Research Center. “Failure to suspect the occurrence of such a disease could have major consequences, especially when dealing with a contagious disease or a vector borne disease like African horse sickness.”

AHS is a non-contagious, insect-borne infectious disease of equids. AHS is a highly important OIE-listed equine disease and a transboundary disease in the U.S. As such, any suspicion of AHS is immediately reportable to the United States Department of Agriculture (USDA) and State Animal Health Officials in all 50 states and territories.

“We must remain vigilant through the USDA’s strict testing



PHOTO CREDIT: UK COLLEGE OF AGRICULTURE, FOOD AND ENVIRONMENT.

of horses at points of entry into the U.S. and expand awareness among equine practitioners to prevent the potential detrimental effects of AHS and other endemic or transboundary diseases,” Timoney said. “The risk applies not only to horses but also to other equid species, specifically zebra, that are sought after for zoos and privately owned wildlife or safari parks.”

The African Horse Sickness Guidelines, available as a PDF file, were authored for the AAEP’s Infectious Disease Committee by Timoney. The guidelines were edited and reviewed by Abby Sage, VMD, DACVIM, along with the AAEP Infectious Disease Committee.

View the [African Horse Sickness Guidelines](#) or save them to your mobile device. In addition to African horse sickness, [AAEP guidelines for 20 other equine infectious diseases](#) are available on the AAEP website. A [Fact Sheet](#) for horse owners on African horse sickness may also be found on the

Equine Disease Communication Center website.

| *Source:*
AAEP news release, July 2

About AAEP
The American Association of Equine Practitioners, headquartered in Lexington, Kentucky, was founded in 1954 as a non-profit organization dedicated to the health and welfare of the horse. Currently, AAEP reaches more than five million horse owners through its over 9,000 members worldwide and is actively involved in ethics issues, practice management, research and continuing education in the equine veterinary profession and horse industry.

UK WEBINAR SERIES TO HELP FARM FAMILIES WORK THROUGH CURRENT ECONOMIC CHALLENGES

THE SERIES BEGINS JULY 23 AND WILL GO LIVE THE FOLLOWING THREE THURSDAYS AT 7 P.M. EDT/6 P.M. CDT.



The COVID-19 pandemic has put financial, physical, mental and emotional strains on many Americans, including farm families. To help them work through these unprecedented challenges, the University of Kentucky College of Agriculture, Food and Environment is hosting “Crossing through This: Managing Farm and Family in 2020,” a weekly webinar series.

The series begins July 23 and will go live the following three Thursdays at 7 p.m. EDT/6 p.m.

CDT. Hosted by UK agricultural economist Steve Isaacs, the series will feature internationally and nationally renowned speakers in agricultural lending, agribusiness, and agriculture health, safety and wellness.

“These are difficult times for the financial well-being and family well-being of Kentucky farms,” Isaacs said. “This series of Thursday evening webinars is targeted for the whole family.”

Webinar speakers and topics include:

- July 23- David Kohl, professor emeritus at Virginia Tech. A highly sought-after educator with insights and extensive research in agribusiness, Kohl will discuss the impacts of the pandemic, current economic challenges for farm families and prospects for the future.
- July 30- Kohl will discuss the four pillars of business success. He and Isaacs will be joined by Mark Barker, senior vice president for agricultural

lending with Farm Credit Mid-America, who will talk about why it's important for producers to have open lines of communication with their lender. Deborah Reed, UK nursing professor who is internationally renowned for her work in agriculture health and safety, will provide tips for personal well-being.

- Aug. 6- Kohl will discuss life after government supports. Reed will provide additional well-being tips. They will be joined by Brian Lacefield, Kentucky's executive director of the U.S. Department of Agriculture's Farm Service Agency. Lacefield will talk about current FSA programs and loans that can help producers navigate these challenging times.
- Aug. 13- Kohl will present business planning and mental health. Reed will discuss ways farmers and their family members can maintain optimal physical and mental health during times of great uncertainty.

Individuals can register [online](#). Registration is required and closes July 20. Once registered, individuals will receive links to view each of the webinars. Participants will be able to ask questions during the sessions.

| *Source: July 9 news release*

Katie Pratt is an agricultural communications specialist in UK's College of Agriculture, Food and Environment.

UK IN THE NEWS

"**Vet's Corner**," a new endeavor for the series *I am Horse Racing*, focuses on delving into the most common ailments and issues that horses, sport horses, and racehorses often experience. This week, we welcome back Dr. Emma Adam to explain what an entrapped epiglottis is and how it is most often treated. This condition became particularly newsworthy just last year when top 3-year-old Omaha Beach was scratched days before the Kentucky Derby having been diagnosed with it. You'll not only learn what an entrapped epiglottis is, but how many horses can safely return to racing once treatment is complete, just like Omaha Beach! #IAMHorseRacing. See that [here](#).

Source: I Am Horse Racing, June 23

Saratoga main track gets makeover in off-season

Installation of safety rail opens door to refurbish track, improve drainage

The New York Racing Association fulfilled a major capital investment at Saratoga recently that may not offer the grandeur of the 1863 Club or accommodate the picnic area like hundreds of new high-def TVs.

Then again, there's a strong possibility that fans won't be allowed on the grounds for the 2020 meet, anyway, but NYRA considers the latest improvement at Saratoga to be vital to safe, consistent racing there, which should be a benefit for everybody, especially the horses and riders.

Saratoga was the last of NYRA's three tracks scheduled for installment of a so-called safety rail on the inside of the main track, which is much more forgiving than a conventional rail if a horse collides with it.

While NYRA was replacing its old inside rail, the opportunity presented itself to also improve the drainage on the inside and refurbish the track itself in an ongoing effort to maintain consistency and fairness to the surface.

It may not be until racing begins on July 16 that horsemen will be in a position to offer opinions on the renovation, but in the meantime, NYRA is confident this project will pay dividends in the form of safer racing and better capacity to handle the elements.

"You saw 1.4 inches of rain last night, and to have the track in the shape that it was this morning, you would've been [designated] fast by race time," said Glen Kozak, senior vice president, facilities and racing surfaces.

"This is not a sexy project," track surface consultant Dr. Mick Peterson, said with a laugh. "I dug swales and I took all the dirt out, put it in piles and put it back.

"But what it does show is we've got the data to support, year after year, that these types of projects are absolutely critical. So by moving the drainage back further and keeping the crow's feet away from the racing lanes, if there's any kind of speed-up of the water going down through those drains, those aren't in the racing lanes. They're now completely under the safety rail."

Peterson is the executive director of the Racetrack Surface Testing Laboratory and the director of the Racetrack Safety Program at the University of Kentucky, where he is a professor of biosystems and agricultural engineering.

Read the story in its entirety [here](#).

Source: The Daily Gazette, July 2

