THE MANEATER

Vet-school professor reaches continued success with Lameness Locator

Kevin Keegan partnered with equine and engineering communities to construct a lameness detector now used worldwide.

Dave Reisen and Kevin Keegan care for former race horse Miss Priss on Tuesday, Feb. 3, 2015 at Clydesdale Hall on the MU campus. Keegan, professor of equine surgery, helped invent a sensor device called the Lameness Locator to better diagnose horses with laminitis. MARK SCHIERBECKER/STAFF PHOTOGRAPHER

By **Anna Sutterer** | **Feb. 10, 2015**

Tags: **College of Veterinary Medicine** , **Research**

Kevin Keegan, an MU professor, equine surgeon, researcher and business owner, works from a small room with a single desk, two chairs, a computer and a filing cabinet.

The fluorescent-lit room was once a closet, until Keegan needed to be near his treadmill-equipped testing room. A window was put in, and sophisticated cables for motion analysis now line the walls and ceiling. Hand-made sensors litter his desk, and family pictures mingle with old textbooks and papers.

Much of Keegan's life is pieced together. However, like his closet-turned-office, it doesn't matter what it looks like, so much as who and what make it full and possible.

Keegan teaches equine surgery at MU and heads the faculty startup company Equinosis LLC. With the help of MU faculty and engineering connections, he developed the Lameness Locator for an objective method to assess horse lameness. Keegan has devoted over a decade of his life to the research.

The Lameness Locator works by using three sensors placed on the horse, which measure acceleration and movement patterns and send data to Bluetooth-enabled software in real time.

Lameness is the most important medical problem in horses, Keegan said. He estimates around 70 percent of complications are related to lameness.

Horses have different patterns of movement, known as gaits, for each of their four motions: walking, trotting, cantering and galloping. Lameness is an abnormal stance or gait caused by either structural or functional disorders such as trauma or infection, according to the Merck Veterinary Manual.

Early lameness detection consisted of looking at a horse in motion and guessing which one is the affected leg.

"I noticed when I was a very young veterinarian that agreement, even between experts, whether the horse was lame or not and which leg was affected was not consistent," Keegan said. "That always bothered me."

Growing up as a city boy from St. Louis, Keegan knew nothing about horses and was afraid of them for a time. After graduating in 1983 from MU with a doctorate in veterinary medicine, he started in a mixed practice working with all types of animals.

"I did not like the small animal unit," Keegan said. "The smell of dog poop in the morning and all the barking drove me crazy. But then we did a little bit of equine work, and I liked that and started to get along with those people better."

It was the people he found in the equine community that brought Keegan so deep into the field, and he

describes his moving up as flukes brought on by good connections.

In his first year of private practice, he found a small office with two experienced veterinarians who agreed to take him on. A later surgery residency at the University of Illinois eventually brought Keegan back to his alma mater; a colleague from Illinois was a surgeon at MU and needed another hand for a short period.

A week before this phone call, his private practice had burned to the ground. He agreed to the brief position — and stayed much longer.

“I am an alum of the University of Missouri, and I’m never going to leave,” Keegan said.

Shortly after his job acquisition, an endowment for research equipment came in from regular Equine Clinic client Nancy Walton Laurie, niece of Walmart founder Sam Walton. It was time to start solving the problem that began pestering Keegan long ago.

During his residency, Keegan took classes in engineering, as opposed to a common veterinarian resident’s choice to take, for example, advanced cardiology. He takes pride in his “good math background,” motioning up to tattered engineering textbooks on his shelves.

Keegan still required some technical assistance to achieve his research dreams. Thus a collaboration began with Dr. Frank Pai, C.W. LaPierre Endowed Professor of mechanical and aerospace engineering.

Pai would become crucial to the Lameness Locator research. Pai had only been at the university for a year when Keegan approached him in 1998 with his request. He needed help with signal data processing for his designs to determine lameness locations.

“The work with him was actually very useful for my later research,” Pai said. “I look at the horse and think: structure. It was a very interesting development. I solved their problem first and then I used those measures to solve my own structure vibration and damage inspection problem.”

Pai entered Keegan’s research scene in its infancy, when the plan was to run a horse on a treadmill surrounded by many high-speed cameras to capture all movements.

He developed the original algorithm for the data processing and continues to help the company advance its technology as a co-inventor.

This camera and treadmill method worked decently but was not very practical, Keegan said. It took a lot of time, as horses had to be taught how to run on a treadmill, something that cost more money and resources.

Joanne Kramer, assistant teaching professor of equine surgery, researched with Keegan during her residency at this point in the process.

“He used to always tell me that we were going to get down to two markers on the horse and get the data in the same amount of time we do regular lameness evaluations,” Kramer said. “I never thought it would happen. It’s a good example of how much of a visionary he is.”

Once again, the vision required means, and the means came through another networking partnership. A past professor caught Keegan in passing and suggested he present his papers at the Rocky Mountain Bioengineering Symposium.

A Japanese engineer, Yoshiharu Yanezawa, attended the conference and approached Keegan after his presentation.

“The language barrier was high, so we started sketching on napkins,” Keegan said. “He was an electronics expert, and he thought we could do the same thing we were doing on the treadmill, but with body sensors and over ground.”

Developments began but the inventors lacked financial support. When Keegan could not receive research grants for an already developing product, he created the Equinosis company to vie for National Science Foundation small-business grants.

“The administration here at MU was very supportive,” Keegan said. “In order to get the NSF funds, I had to be paid by my company, which means I had to take sabbatical leave. Thankfully, the department allowed me to do that.”

Equinosis began business in 2007 and sold its first commercial product in 2009. Keegan said he felt anxiety over starting a business at the height of the economic crash in 2008. He said he remembers where he was watching TV when the first thoughts of alarm came.

“For the first four years, we barely made enough money to just stay alive,” Keegan said.

But stay alive and ultimately prosper, they did. The Lameness Locator undergoes continuous progress and is now in its fourth generation of sensor evolutions.

Everything for the product is made at Avatar Engineering in Kansas, and no software development has been sent abroad for cheaper labor.

“It’s amazing,” Pai said. “Nobody believes me when they see the horse has four legs and we only put three sensors on it and can then tell you which leg is lame. That is why we have a company and why this is one of the university's most successful stories.”

Most of Equinosis’ clients are veterinary schools. The company has sold systems in over half the veterinary schools in North America and has users on all continents of the world, barring Antarctica.

“The key is to get in with the younger generation and get them all trained in how to use the equipment,” Keegan said.

MU is also a large believer in the technology. The Equine Clinic uses the Lameness Locator every day to evaluate lamenesses, and it has helped them do a better job of evaluating lameness and whether treatment has been effective, Kramer said.

Several investors agreed with the Clinic's assessment of the Lameness Locator and have financially supported Keegan and his team. Partners of Equinosis include Centennial Investors here in Columbia, Anthony Allan & Quinn in St. Louis and the Life Science Business Incubator at Monsanto Place at MU.

Keegan said he owes everything to MU for their support from the beginning. The university paid the patenting expenses up front and owns the research technology.

Equinosis has also most recently been awarded a secondary phase grant from the National Science Foundation, which Pai said not many achieve.

"It means they think this is a successful business," he said.

The journey continues as Equinosis seeks to improve and provide more forms of evaluation. According to Keegan, there are about 200 systems sold and in use, but his goal is to reach 3,000.

They are looking at a new set of problems, as well. A recent sensor model is being developed to fit a horse's foot so one can measure which foot is touching on the ground more lightly and is therefore most likely lame.

Keegan has been toiling over this one issue for well over a decade, but he said he finds joy and energy in the work. Even with the arrival of competition EquiGait, which uses a similar sensor technology, Keegan said their competitors are still way behind.

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