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The Science of New Life: Equine Reproduction and Veterinary Innovation at Lincoln Memorial University

BY CYNTHIA MWENJA, PhD

Lynda Miller, professor of Theriogenology and Large Animal Department Head at Lincoln Memorial University (LMU), collaborates with both colleagues and students to develop vital solutions for addressing issues in equine reproductive health. She also partners with campus stakeholders to create and validate simulation models for veterinary clinical training. Every aspect of Miller's research program is dedicated to preparing the next generation of veterinarians for excellence in the field.

During Miller's undergraduate years, she was drawn to the field of theriogenology—the branch of veterinary medicine which involves all aspects of animal reproduction, including obstetrics, disease, and physiology. She was curious about physiology and hormones before she ever took a course that covered those subjects, and the field of theriogenology offered the opportunity to explore both subjects in depth.

Due to her interest in equine reproduction, Miller chose to pursue graduate studies with Mats H.T. Troedsson, who is now a professor at the University of Kentucky's Maxwell H. Gluck Equine Research Center. After beginning doctoral work, she took a break from graduate equine reproduction research to earn her doctorate in veterinary medicine. She later resumed her studies with Troedsson and earned a PhD in equine reproduction from the University of Kentucky; she also completed her residency in veterinary medicine and became board certified so that she could later teach theriogenology at the university level.

Now at LMU, Miller's research program in equine reproductive health is growing, and she often engages in collaborative research with Troedsson at Gluck. In one collaboration, Troedsson and Miller focused on equine fertility, working with a PhD student from the University of Copenhagen to improve their understanding of tissue fibrosis in the equine endometrium. Such fibrosis can decrease fertility, so addressing this issue can support better breeding outcomes. Troedsson, Miller, and their team studied the functions of proteins and lipids in the endometrium to gain insights regarding the mechanics of the fibrotic scarring. Miller also researches whether using probiotics in semen for artificial insemination can decrease antibiotic use.

An ongoing collaborative project between Troedsson and Miller aims to develop protein-based diagnostics for bacterial biofilms from in vitro equine uterine sampling. Biofilms, Troedsson says, are complex communities of bacteria within a matrix of proteins and lipids; their presence can prolong infectious disease. Biofilm density tends to prevent antibiotics

from reaching bacteria at the bottom of the film, thereby leading to antibiotic resistance. In this long-term research project, Troedsson and Miller hope to become able to determine whether an animal has a biofilm through identifying the matrix proteins involved. Troedsson states that if they can find a diagnostic method to find equine biofilms in utero, then they can know when to combine therapies to treat horses with uterine infections more effectively.

Troedsson and Miller are also seeking ways to decrease antibiotic resistance by reducing antibiotic use where possible. In their current project focusing on this issue, they are looking for a substance which can extend the storage life of semen that is kept for artificial insemination. Currently, a low dose of antibiotics is commonly added to the semen stored for this purpose, and the issue is that the antibiotics are then introduced to the uterus with the semen. Low doses of antibiotics are particularly apt to increase antibiotic resistance over time, so Troedsson and Miller are looking for an alternative to correct the issue. One



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possibility is that of probiotics, though Troedsson notes that the challenge is that these substances are also bacteria; even if they promote a healthy biome, they could be harmful if out of balance. Troedsson and Miller are trying to find an effective combination and concentration of probiotics which might minimize harm to sperm, maximize semen storage life, and decrease the chances of promoting antibiotic resistance.

LMU veterinary students also have opportunities to complete summer research with Troedsson and his colleagues at Gluck, which maintains a population of horses to serve as research animals. Troedsson points out that gaining exposure to veterinary research can help students understand how they might continue engaging in research as they move into their own professional lives as veterinarians and/ or faculty members. LMU students spend summers collecting data at Gluck; they then evaluate the data and write research papers under Miller's direction at LMU during the school year. Miller affirms that LMU does also have a herd of animals,

but they are primarily used for teaching, not research. Miller and her students are, however, able to do some non-invasive projects with the horses at LMU. For example, one current project is comparing outcomes between horses who receive probiotic supplementation and a control group.

As an educator, Miller is keenly focused on ensuring that the next generation of students is exceptionally prepared for their future careers. Since education in veterinary medicine is competency based, students need to learn technical skills with safety for both themselves and the animals they work with. For this reason, she considers her educational research equally important to her equine fertility work.

Miller's current educational research centers on creating and refining the simulation models that veterinary educators use to teach many clinical skills. Such simulators allow students to establish their abilities by repeatedly practicing skills until they reach competence. While veterinary students do

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need to work with live animals to gain some of the knowledge and abilities they need, they can acquire many needed skills by working with simulation models, thereby promoting animal welfare and limiting animal distress. For example, students can work with injection and epidural simulation models to learn the landmarks and practice multiple times. One LMU model uses a barrel to represent the body of a cow, with a fake spinal column and tail so students can practice procedures such as venipuncture of the coccyx. LMU also has models of the full heads and necks of a horse and a cow so students can practice I.V. insertion, as well as subcutaneous and intramuscular injections. The simulation models provide invaluable resources for students to become skilled in these procedures before performing them on actual animals.

Some veterinary clinical skills simulation models are commercially available, but many are not, reports Julie Hunt, associate dean of

Clinical Sciences and professor of Veterinary Medicine at LMU. To fill the gap, Hunt and Miller collaborate to research the creation of simulation models for a wide variety of clinical skills. Once they produce a preliminary design, they work with Robert Brockman, head of LMU's model lab; his team fabricates the models, including students in the work. Miller appreciates Brachman's gifts in producing artistic and realistic models, as well as his instinctive understanding of what each model needs. During the model development phase, Miller, Hunt, and their research team give feedback for refinement.

As Miller and Hunt began this research collaboration, they not only wanted to produce simulation models to teach their students vital veterinary skills, but they also wanted to determine how effective specific models were in teaching those skills—and how well the abilities transferred to working with live animals. After a model is created and

refined, then, they also validate the design by collecting data on its use and efficacy; additionally, they construct scoring rubrics to assess students who work with the model. Some skills suited to simulation include artificial insemination, delivering foals, and performing c-sections, as well as equine and bovine castration, prolapse reduction, and laparoscopic procedures. Their design for an artificial sheep insemination model is currently in the process of securing a patent. Hunt and Miller have published their findings and presented their clinical skills simulation model research around the world.

Once a model has been created, refined, and validated, Miller and Hunt generate micro credentials that students can earn through demonstrating competency in performing specific skills on a simulation model. For example, a student might earn a bronze badge by doing bovine palpitation and telling Miller what they are feeling and what their findings



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mean. Students can then earn more advanced silver and gold badges by showing additional knowledge and skills on the subject. Once the badges are earned, the students have them to show demonstrated skills in specific areas. In addition to the benefit of simply having these skills in their repertoires, these micro credentials can be helpful for students in securing externships or post-graduate employment before they become licensed veterinarians themselves.

Miller and Hunt include student researchers in their clinical skills simulation model development work. Miller highlights the ways that this experience gives students meaningful opportunities to take part in the entire research process, including designing the study, validating the models, and presenting the results. As she mentors students through these steps, they learn that ongoing research is not separate from the practice of veterinary medicine; it is a crucial element in solving real

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world clinical problems.

In addition to her extensive research program and teaching responsibilities, Miller also takes up often-unseen academic labor as a member of the exam committee of the American College of Theriogenologists. Candidates must meet certain benchmarks in their residency programs in order to qualify for the exam, which is given annually in July. Miller says that each new exam demands a full year to write and refine. First, the chair chooses the topics of questions and divides the work among committee members. Throughout the fall, committee members write and review their assigned sections; in January, the whole team reviews the entire draft exam. During the spring, committee members suggest wording changes and other adjustments. Due to the extensive and meticulous work required, Miller notes that the exam is usually only fully finalized one or two weeks before it is given. Such painstaking work underlies assessment in many fields and should be recognized for the ongoing support for field rigor that it represents.

Miller offers a model for faculty members who wish to pursue their personal research interests while also contributing to educational research in their fields. Her research program in both arenas offers meaningful opportunities for her students to gain research experience, which ultimately prepares them to reach their full potential in the field of theriogenology.



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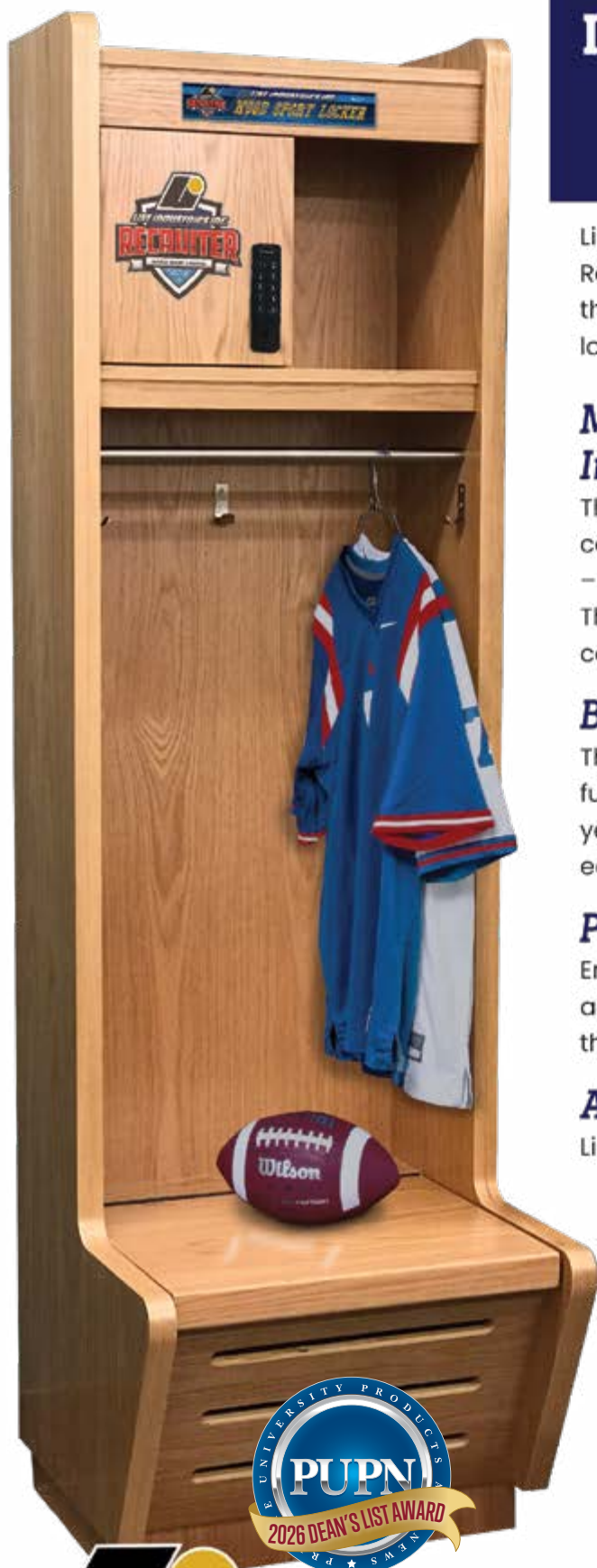


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