

## Simulations in veterinary education

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A medical simulation is defined as “a device or set of conditions that aims to imitate real patients, anatomic regions, or clinical tasks.”<sup>1</sup> Simulations and models are being used increasingly in veterinary training. Possible reasons for this movement include societal pressure to decrease use of live animals for teaching; fewer faculty available to provide training in technical skills; less money available for expensive laboratory training; increasing tertiary caseload at veterinary teaching hospitals, which minimizes student exposure to common presentations and opportunities to practice common technical skills; and lack of required internship/residency training.<sup>1,2</sup> Another reason may be increasing pressure from society for competency-based education. “While student learning is clearly the goal of education, there is a pressing need to provide evidence that learning or mastery actually occurs.”<sup>3</sup>

The great value of teaching using simulations, including models, is that there are no consequences to failure, animal use is minimized, opportunities for repeated practice are readily available, and the system can be optimized for each student to ensure progressive acquisition of skills and knowledge.<sup>4</sup> In a simulation, students can explore “what if” without consequence, increasing their learning.<sup>5</sup> Simulations may enhance student abilities, specifically decreasing things like time to complete procedures or increasing their overall skills when working with client-owned animals.<sup>6,7</sup>

One concern about use of models is lack of a clinical context; students must be reminded that technical skills are not carried out in a vacuum and must learn to complete those technical tasks while also considering communication skills, teamwork, and other aspects of professionalism.<sup>8</sup> Models also are best used in a progressive manner, for example as a first step to be followed by practice on cadavers, and then on live animals. In one study evaluating simulation training for laparoscopic surgical skills, novices showed gains after training on a simulator but experienced practitioners did not, suggesting that they had already mastered the level of training that was possible using that particular simulator.<sup>9</sup>

Technical expertise requires students to undertake deliberative practice, defined as repeated attempts at a given skill with continual incorporation of feedback.<sup>8,10</sup> Best use of simulators includes the following features:<sup>10-12</sup>

- Students are presented with specific goals and established procedures to meet those goals. Students also are provided with examples of what not to do. Use of a specific rubric clarifies student expectations and enhances consistency of grading.
- Feedback is provided during the learning experience.
- Learners have the opportunity to repeat the procedure, incorporating feedback to enhance performance. Expectations for student responsibility for deliberative practice are articulated.
- The simulation provides a constant feeling of challenge and may vary in difficulty as the learner’s skills increase.
- Simulations are embedded within a larger curriculum.

Simulators can be low fidelity or high fidelity, with fidelity defined as approximation of a real-life situation. Examples of low fidelity simulators include plastic tubing filled with colloidal oatmeal as a Doppler flow phantom for ultrasound training, and gelatin-filled examining gloves to mimic parenchymatous organs and latex tubing to represent hollow organs for surgery training.<sup>13,14</sup> Examples of high fidelity simulators include dynamic multi-media environments into which students can be immersed while performing tasks with team members, on-line case simulations that require students to demonstrate steps in clinical decision-making, and virtual reality representations of animal models based on 3D medical imaging and computer-based tracking of student performance.<sup>15-17</sup>

While extremely sophisticated simulators exist, with some incorporating virtual reality elements to make the experience as authentic as possible, this is not always associated with greater learning. In one study comparing training in placement of intravenous catheters using a student driven interactive multi-media system with a virtual reality simulator to an instructor-led demonstration and practice on plastic

arms, skill acquisition was the same between the two groups and the students were more satisfied with the latter method because they craved the immediate feedback specific to their situation.<sup>4</sup> Higher fidelity simulators also are expensive and may require special expertise to use, both as a student and an instructor.

Surgical skills are difficult for students to acquire because of concerns about use of live animals for teaching and anxiety on the part of the students. Many studies have been done evaluating use of models and cadavers as alternatives to surgery training on live, anesthetized animals. A megastudy identified 17 studies in veterinary medicine, human medicine, undergraduate coursework and high school biology courses evaluating dissection skills and surgical skills, and showed that alternative instructional methods in all cases were equivalent or superior to training with live, anesthetized animals. These included computer simulations, plastic models, soft tissue models, and cadavers.<sup>18-21</sup> A recent study evaluated use of video games as a method of enhancing student surgical skills; skills in laparoscopy were enhanced by video game training but traditional surgical skills were not.<sup>22</sup> Similarly, in a study evaluating use of high-fidelity models versus live animals for training in performance of ovariohysterectomy of dogs, those students trained on live animals showed much greater confidence and skill in the abdominal approach than did those students trained using a simulation.<sup>20</sup> This highlights need for evaluation of specific microskills being developed within a simulation and promotes the concept of creating a context that is as realistic as possible to ensure student acquisition of skills on models is transferable to live animals.

A study evaluating cardiopulmonary resuscitation (CPR) training using hands-on training along with an interactive computer program or watching of videotaped or live demonstrations identified equal ability of students to gather knowledge but better technical skills in the interactive computer group than in the group that watched demonstrations.<sup>23</sup> A canine CPR model also has been described and was associated with increased student knowledge and clinical proficiency in CPR.<sup>24</sup> Human simulators may be modified to produce a high fidelity veterinary simulation. An example is use of a human anesthesia simulator to help students practice anesthetic monitoring and handling of critical events; students trained on the simulator showed increased skills on clinical patients and were overwhelmingly supportive of use of this model for training before working on client-owned animals.<sup>6</sup>

Two models for training in transrectal palpation have been described in the veterinary literature. The Haptic Cow uses touch feedback and computer-based instructor visualization of student progress within the model to help students learn the tactile skills of transrectal palpation. Students report great value in not being pressed for time while using the model the way they would be if they were examining a live animal, and having the instructor know where they are in the tract and what they are feeling, in a way that could not be replicated using a live animal. Students expressed concern that the simulation was too low in fidelity, stating, "The real cow pushes your hand out."<sup>25</sup> The Breed'n Betsy is another model for transrectal palpation. Students trained on this model in one study had more difficulty localizing organs and evaluating structures on the ovary than did students trained using live animals.<sup>26</sup>

The Society for Theriogenology and American College of Theriogenologists identified a core curriculum for DVM training, which includes the technical skills listed below (Table). It may behoove those members interested in education to more systematically consider what models might already exist or might be created to ensure progressive acquisition of theriogenology skills in veterinary students. In one study evaluating transrectal palpation of cows, it was determined that students need to perform transrectal palpation on more than 200 cows before they are able to consistently identify and evaluate structures.<sup>26</sup> There is great value in finding more ways for our students to practice skills to help them reach the level of competence desired.

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Table: Technical skills by species in core curriculum

TECHNIQUE	SPECIES
Transrectal reproductive examination	bovine, equine
Ultrasound of the reproductive tract	bovine, equine
Breeding soundness examination / Semen collection and evaluation	bovine, equine, small animal
Passage of pipette / biopsy instrument / insemination pipette into uterus	bovine, equine
Neonatal resuscitation	bovine, equine, small animal
Anesthesia	bovine, equine, small animal
Teat surgery	bovine
Caslick's surgery	bovine, equine
Ovariectomy / ovariectomy	bovine, equine, small animal
Castration (descended and cryptorchid)	bovine, equine, small animal
Cesarean section	bovine, equine
Perineal reconstruction	equine