

Assessment

Aucar, J.A., N.R. Groch, S.A. Troxel, and S.W. Eubanks (2005). **A review of surgical simulation with attention to validation methodology.** *Surgical Laparoscopy, Endoscopy and Percutaneous Techniques* 15(2): 82-89. ISSN: 1530-4515 (print); ISSN: 1534-4908 (online)

Abstract: The use of simulation technology for teaching and evaluating surgical skills has gained considerable attention in recent years. This is driven by interest in quality of care, concerns over increasing operative complexity, constraints on the use of animal models, limited available patient material, medicolegal pressures, and fiscal mandates for cost-effective performance. Traditional mechanical models are yielding to techniques dependent on electronic technology, including virtual reality. Data to support the validity of simulation techniques for surgical training, assessment, and certification represent only a fraction of the literature available on the subject. Literature searches were conducted in MEDLINE and ERIC, covering the period from 1966 to the present. The electronic and bioengineering literature was not surveyed due to the extensive literature on technology development, distinct from assessment of context specific validity. The search results and the bibliographies of key review articles were examined to identify articles that contained original data, measured performance between cohorts, defined performance measures, and described a standard against which performance was compared. Most of the literature pertaining to simulation techniques for surgical training has been published within the past 5 years and consist of review, opinion, and feasibility articles. There is an emerging body of evidence to establish the validity of simulation techniques for assessing surgical skills. Further refinement of simulation techniques, identification of specific performance measures, longitudinal evaluations, and comparison to practice outcomes are still needed to establish the validity and the value of surgical simulation for teaching and assessing surgical skills prior to considering implementation for certification purposes.

Bond, W.F., R.L. Lammers, L.L. Spillane, R. Smith-Coggins, R. Fernandez, M.A. Reznick, J.A. Vozenilek, J.A. Gordon (2007). **The use of simulation in emergency medicine: A research agenda.** *Academic Emergency Medicine* 14(4): 353-363. ISSN: 1069-6563

Abstract: Medical simulation is a rapidly expanding area within medical education. In 2005, the Society for Academic Emergency Medicine Simulation Task Force was created to ensure that the Society and its members had adequate access to information and resources regarding this new and important topic. One of the objectives of the task force was to create a research agenda for the use of simulation in emergency medical education. The authors present here the consensus document from the task force regarding suggested areas for research. These include opportunities to study reflective experiential learning, behavioral and team training, procedural simulation, computer screen-based simulation, the use of simulation for evaluation and testing, and special topics in emergency medicine. The challenges of research in the field of simulation are discussed, including the impact of simulation on patient safety. Outcomes-based research and multicenter efforts will serve to advance simulation techniques and encourage their adoption.

Bowyer, Colonel M.W., A.V. Liu, J.P. Bonar, (2005). **Validation of SimPL -- a simulator for diagnostic peritoneal lavage training.** *Studies in Health Technology and Informatics* 111: 64-67. ISSN: 0926-9630 (Print)

Abstract: This study describes a comparison between an animal model and a haptic enabled, needle based, graphical user interface simulator (SimPL), for teaching Diagnostic Peritoneal Lavage (DPL). Forty novice medical students were divided into two groups and then trained to perform a DPL on either a pig or the SimPL. All subjects completed a pre and post test of basic knowledge and were tested by performing a DPL on a TraumaMan mannequin and evaluated by two trauma surgeons blinded to group. The results showed significant improvement over baseline knowledge in both groups but more so in the SimPL group. The simulator group performed better on site selection ($p < 0.001$) and technique ($p < 0.002$) than those who trained on a pig. The finding that a simulator is superior to an animal model for teaching an important skill to medical students has profound implications on future training and deserves further study.

Descriptors: computer simulation, computer assisted diagnosis, medical education, peritoneal lavage, animals, clinical competence, animal models, swine, comparative study, U.S. military, National Capital Area Simulation Center.

Breitmeier, D., Y. Schulz, N. Wilke, K. Albrecht, G. Haeseler, B. Panning, H.D. Troger, and S. Piepenbrock (2004). [**Cricothyroidotomy training on cadavers - experiences in the education of medical students, anaesthetists, and emergency physicians**] **Koniotomieübungen an der Leiche - Erfahrungen in der Ausbildung mit Medizinstudenten, Anesthesisten und Notärzten.** *Anesthesiologie, Intensivmedizin, Notfallmedizin, Schmerztherapie - AINS* 39(2): 94-100. ISSN: 0939-2661 (Print).

Abstract: OBJECTIVE: Should the technique of surgical cricothyroidotomy be practiced on cadavers and should it be a compulsory part of the teaching curriculum? Is it wise to use a speculum for the insertion of the endotracheal tube? What is the optimum size of the tube? METHODS: A surgical cricothyroidotomy with a speculum was carried out on 30 cadavers from the Institute of Legal Medicine, Medical School Hannover. This took place as part of a official and voluntary course for students of advanced semesters, anaesthetists and emergency doctors with the subjects "cricothyroidotomy, chest drainage and venous cut-down". The surgical cricothyroidotomy without the use of a speculum was carried out on 5 cadavers by two clinicians well practiced in this technique. The elapsed time between skin incision and the insertion of the endotracheal tube was measured on all five subjects. After the course the participants were asked if they were able to carry out a cricothyroidotomy in an emergency. They were also asked whether this course should be a compulsory part of their curriculum and whether practical sessions should take place. During autopsies at the Institute of Legal Medicine the length of the ligamentum conicum was measured on 40 corpses with reclined and non-reclined heads. RESULTS: The average time of storage of the cadavers was 4.2 days +/- 1.9 days. The cricothyroidotomy was possible on all 35 cadavers. In one case (3,3 %) the result was a complete rupture of the cricoid cartilage. In 5 cases (16.7 %) the horizontal incision was torn due to prising with the speculum. Difficult situations always occurred when the skin incision was not exactly in the midline. The average time to place the endotracheal tube into the trachea by the surgical procedure of cricothyroidotomy was 22.4 seconds +/- 3.1 seconds (minimum 18 seconds, maximum 26 seconds). 10 % of the medical students and 50 % of the anaesthetists and emergency doctors felt they would be prepared to carry out a cricothyroidotomy in an emergency. 90 % of the students and respectively 80 % of the anaesthetists and emergency doctors stated that

they would like to practice the technique on a cadaver again. Almost all participants were of the opinion that the course should be integrated as a compulsory course in a future educational curriculum. The average distance between the thyroid cartilage and the cricoid cartilage was 9.5 mm +/- 1.9 mm with non-reclined head (minimum 6 mm, maximum 14 mm) and 11.9 mm +/- 2.5 mm with reclined head (minimum 7 mm, maximum 18 mm). The average difference of distances was 2.4 mm +/- 1.2 mm (minimum 1 mm, maximum 6 mm) in reclined and non-reclined heads. **CONCLUSIONS:** In our opinion it is highly recommended that the technique of cricothyroidotomy should be practiced on cadavers and that the course should become a compulsory part in a future educational curriculum. In addition the incision of the ligamentum conicum using dilators or a speculum is not to be recommended from the point of view of this study. The tracheal tube used in this study (reinforced wire tube, ID 6.0) was best suited for surgical cricothyroidotomy.

Descriptors: cricoid cartilage, surgery, thyroidectomy, anesthesia, cadaver, humans, intubation, students, medical education.

Cherry, R.A., J. Williams, J. George, and J. Ali (2007). **The effectiveness of a human patient simulator in the ATLS shock skills station.** *Journal of Surgical Research* 139(2): 229-35. ISSN: 0022-4804 (Print)

Abstract: **BACKGROUND:** The use of simulation as a teaching adjunct in Advanced Trauma Life Support (ATLS) has not undergone rigorous psychometric testing. We hypothesized that an advanced, computer-controlled human patient simulator (HPS) would be a useful adjunct to the ATLS shock skills station. **MATERIALS AND METHODS:** Forty-four PGY-1 residents enrolled in ATLS courses were randomized into control (CTL) and experimental (EXP) groups. All students took a shock-specific pre- and post-test multiple choice question examination (MCQE). The EXP group used the HPS in the shock skills station; the CTL group was taught in a traditional manner. All students participated in an experimental, shock-specific objective structured clinical examination (OSCE) session at the end and had their performance evaluated. The EXP group was asked to evaluate the teaching effectiveness of the shock skills station. **RESULTS:** There were no statistically significant differences between the EXP and CTL groups with respect to the pre- and post-test MCQE or the change in scores. The groups were similar in their overall performance during the shock-specific OSCE. The EXP and CTL groups were equivalent with respect to shock recognition, identification of the type of shock, and ability to select the correct treatment plan. The shock skills station was rated from very good to excellent in 91% of the EXP group versus 63% in the CTL group. The EXP group rated the simulator most helpful in learning to analyze data from the monitors. **CONCLUSIONS:** Use of an advanced HPS during the ATLS shock skills station was equivalent to traditional teaching scenarios based on psychometric testing. Students subjectively preferred the simulator as a teaching tool and found it most useful in learning how to integrate data from hemodynamic monitors into clinical decision making.

Descriptors: continuing medical education, methods, life support, diagnosis, patient simulation, shock, clinical competence; computers; education, humans.

Chou, D.S., C. Abdelshehid, R.V. Clayman, and E.M. McDougall (2006). **Comparison of results of virtual-reality simulator and training model for basic ureteroscopy training.** *Journal of Endourology* 20(4): 266-271.

Abstract: BACKGROUND AND PURPOSE: The traditional method of acquiring surgical skills is by apprenticeship and involves an extensive period of training with patients. Model-based and virtual reality simulation is gaining interest as alternative training, allowing repetitive practice in a low-risk environment. The objective of this study was to determine if a materials, model-based training format and an interactive virtual-reality simulator could provide equivalent teaching of basic ureteroscopy skills to the inexperienced medical student. SUBJECTS AND METHODS: Sixteen first-year medical students received the same didactic session and video viewing on cystoscopy, guidewire access to the upper urinary tract, and ureteroscopy with intracorporeal laser lithotripsy and stone extraction by the same instructor. The participants were then randomized into two study groups: Group 1 was trained on the ureteroscopy training model (TMU) from Limbs & Things and Group 2 on the Symbionix UROMentor virtual-reality simulator (VRS) until the participants could perform the procedure independently. Two months later, the participants independently performed a ureteroscopic procedure on a pig kidney/ureter model and were graded from 1 to 5 on their ability to complete the steps of the procedure and the quality of their performance (handling of tissue, efficiency, instrument handling, knowledge of instruments, flow of operation, use of assistants, and knowledge of the specific procedure) for a possible total of 35 points. RESULTS: All participants were able to perform the steps of the procedure correctly. The TMU group and the VRS group received a mean of 22.9 +/- 4.8 and 23.6 +/- 5.4 points, respectively (P = 0.38) for their qualitative assessment. CONCLUSION: The medical students' skills and ability to perform a basic ureteroscopic stone-management procedure was independent of the training modality (VRS or TMU). Incorporating either of these devices into the preliminary training of urology residents may improve their initial clinical performance of these skills.

Foshay, W.R. and P.T. Tinkey (2007). **Evaluating the effectiveness of training strategies: performance goals and testing.** *ILAR Journal* 48(2): 156-162. ISSN: 1084-2020 (print)

Abstract: The Public Health Service policy, Animal Welfare Act regulations, and the *Guide for the Care and Use of Laboratory Animals* all require that institutions provide training for personnel engaged in animal research. Most research facilities have developed training programs to meet these requirements but may not have developed ways of assessing the effectiveness of these programs. Omission of this critical activity often leads to training that is ineffective, inefficient, or unnecessary. Evaluating the effectiveness of biomedical research and animal care training should involve a combination of assessments of performance, competence and knowledge, and appropriate tests for each type of knowledge, used at appropriate time intervals. In this article, the hierarchical relationship between performance, competence, and knowledge is described. The discussion of cognitive and psychomotor knowledge includes the important distinction between declarative and procedural knowledge. Measurement of performance is described and can include a variety of indirect and direct measurement techniques. Each measurement option has its own profile of strengths and weaknesses in terms of measurement validity, reliability, and costs of development and delivery. It is important to understand the tradeoffs associated with each measurement option, and to make appropriate choices of measurement strategy based on these tradeoffs arrayed against considerations of frequency, criticality, difficulty of learning, logistics, and budget. The article concludes with an example of how these measurement strategies can be combined into a cost-effective assessment plan for a biomedical research facility.

Granger, N.A. and D. Calleson (2007). **The impact of alternating dissection on student performance in a medical anatomy course: are dissection videos an effective substitute for actual dissection?** *Clinical Anatomy* 20(3): 315-321. ISSN: 0897-3806 (print); ISSN: 1098-2353 (online)

Abstract: The way in which anatomy is taught to first year medical students at the University of North Carolina at Chapel Hill was recently changed, so that first year students are now divided into two groups that dissect alternately. The effect of this change on both written and practical test performance was analyzed by comparing grades from 2004 with those from the previous year (2003), when students performed all the dissections. A statistically significant decrease ($P < 0.05$) from 2003 was noted on three of the four written test scores in 2004, while practical examination scores in 2004 fluctuated from lower to higher than those in 2003, depending on the unit of material being covered. However, the number of students failing each of the examinations (written and practical combined) was statistically greater on only one of the four examinations in 2004. Scores of the two groups dissecting alternately in 2004 were essentially the same on the practical examinations. There was no difference in the number of questions answered incorrectly between these two groups in the two practical examinations where comparisons were made. Furthermore, students who dissected a particular structure did not score significantly better on practical questions concerning that structure than students who had not dissected it. The effect of the availability of step-by-step dissection videos on student practical examination scores is also discussed. We conclude that the change in the curriculum had a significant impact on the students' written examination performance, given the same material in the course. The reasons for this include student course load, increased need for self-study, and a loss of a learning opportunity in the dissection laboratory, all of which affect student comprehension and retention of the material and their ability to use it in problem solving.

Hall, R.E., J.R. Plant, C.J. Bands, A.R. Wall, J. Kang, and C.A. Hall (2005). **Human patient simulation is effective for teaching paramedic students endotracheal intubation.** *Academic Emergency Medicine* 12(9): 850-855. ISSN: 1553-2712 (online)

Abstract: **OBJECTIVES:** The primary purpose of this study was to determine whether the endotracheal intubation (ETI) success rate is different among paramedic students trained on a human patient simulator versus on human subjects in the operating room (OR). **METHODS:** Paramedic students ($n = 36$) with no prior ETI training received identical didactic and mannequin teaching. After randomization, students were trained for ten hours on a patient simulator (SIM) or with 15 intubations on human subjects in the OR. All students then underwent a formalized test of 15 intubations in the OR. The primary outcome was the rate of successful intubation. Secondary outcomes were the success rate at first attempt and the complication rate. The study was powered to detect a 10% difference for the overall success rate ($\alpha = 0.05$, $\beta = 0.20$). **RESULTS:** The overall intubation success rate was 87.8% in the SIM group and 84.8% in the OR group (difference of 3.0% [95% confidence interval {CI} = -4.2% to 10.1%; $p = 0.42$]). The success rate on the first attempt was 84.4% in the SIM group and 80.0% in the OR group (difference of 4.4% [95% CI = -3.4% to 12.3%; $p = 0.27$]). The complication rate was 6.3% in the SIM group and 4.4% in the OR group (difference of 1.9% [95% CI = -2.9% to 6.6%; $p = 0.44$]). **CONCLUSIONS:** When tested in the OR, paramedic students who were trained in ETI on a simulator are as effective as students who trained on human subjects. The results support using simulators to teach ETI.

Descriptors: allied health personnel, education, intubation, intratracheal, patient simulation, adolescent, adult, aged, educational measurement, humans, manikins, teaching methods.

Hedlund, C.S., G. Hosgood, and S. Naugler (2002). **Surgical education: attitudes toward animal use in teaching surgery at Louisiana State University.** *Journal of Veterinary Medical Education* 29(1): 50-55. ISSN: 0748-321X (Print)

Abstract: Concerns over the use of animals in teaching have led to a reduction in the number of live animal laboratories. A survey of 275 students and faculty was conducted to characterize their attitude toward the use of animals in teaching surgery. Respondents favored live animal use. They believed that model laboratories were helpful in learning aseptic technique and suturing skills but less helpful in learning tissue handling, dissection, hemostasis, or anesthesia.

Hesselfeldt, R., M.S. Kristensen, L.S. Rasmussen (2005). **Evaluation of the airway of the SimMan full-scale patient simulator.** *Acta Anaesthesiologica Scandinavica* 49(9): 1339-45. ISSN: 0001-5172 (Print)

Abstract: BACKGROUND: SimMan is a full-scale patient simulator, capable of simulating normal and pathological airways. The performance of SimMan has never been critically evaluated. METHODS: Sixty subjects (anesthesiologists, nurse anesthetists, and anesthesia residents) performed mask ventilation, laryngeal mask insertion and endotracheal intubation on SimMan. The simulator's airway was evaluated using visual analog scales (VAS) and by measuring the subject's performances. RESULTS: The SimMan full-scale patient simulator's airway is generally acceptably realistic but it significantly differs from the human airway in important aspects. Mask seal was more difficult than in humans whereas Laryngeal mask (LMA) insertion and function was acceptable. The distance from the teeth to the vallecula was too short. Cervical spine mobility was significantly reduced in the 'reduced neck movement' mode but the intubation was only slightly more difficult than in the 'normal' mode. CONCLUSION: The SimMan full-scale patient simulator's airway is generally acceptably realistic but it significantly differs from the human airway in important aspects. The user must be aware of these aspects in order to obtain maximum benefit from training and evaluation scenarios and when using the simulator for testing new equipment and techniques.

Descriptors: medical education, anesthesiology, intratracheal intubation, manikins, clinical competence, humans, laryngeal masks, larynx, neck, artificial respiration, teeth.

Howe, L. M., H.W. Boothe, and S.M. Hartsfield (2005). **Student assessment of the educational benefits of using a CD-ROM for instruction of basic surgical skills.** *Journal of Veterinary Medical Education* 32(1): 138-43. ISSN: 0748-321X

Abstract: RATIONALE FOR STUDY: At Texas A&M University, introductory-level surgical lecture and laboratory notes were converted to a CD-ROM format that included illustrative photographs as well as instructional videos demonstrating the basic surgical skills that all students were required to master. The CD-ROM was distributed to all students in place of traditional paper notes in the second-year surgical class in the professional veterinary curriculum. The study reported here was designed to evaluate the educational benefits of the use of the CD-ROM in place of traditional paper notes by examining the attitudes and practices of students before and after exposure to the CD-ROM format. METHODOLOGY: An anonymous survey was distributed to students in the second-year introductory surgery course on the first day of class

and again on the last day of class. Responses to questions were tabulated, response frequencies determined, and Chi-square analysis performed to determine differences between initial and final responses. **RESULTS:** On the final survey, 89 per cent of students responded that the instructional videos definitely helped them prepare for the laboratory, and 77 per cent responded that they were more likely to practice techniques learned from the CD-ROM videos than those learned from traditional study materials. The majority of students believed that the CD-ROM improved both the course (60 per cent) and their learning experience (62 per cent) as compared to traditional paper notes. **CONCLUSIONS:** Including instructional videos on the CD-ROM enhanced the educational experience of the students by promoting preparedness for laboratories and promoting practice of techniques learned from the videos outside of the laboratory.

Descriptors: CD-ROM, computer-assisted instruction, surgery, education, attitude to computers, computer simulation, veterinary, humans, program evaluation, students

Jones, N.A., R.P. Olafson, and J. Sutin (1978). **Evaluation of a gross anatomy program**

without dissection. *Journal of Medical Education* 53(3): 198-205. ISSN: 0022-2577 (print)

Abstract: Freshman medical students have been participating in an experimental multimedia gross anatomy program at Emory University for five years. The program includes audiovisuals, computer-assisted instruction, and tutorial sessions using prosected specimens. No lectures are given nor is dissection permitted. Experimental and traditional groups were compared by intramural written and practical examinations and by an extramural written examination prepared by the National Board of Medical Examiners and the Association of Anatomy Chairmen. Study of 35 intramural examinations given to five classes showed students in the traditional course with significantly higher performance in three examinations and students in the experimental course with significantly higher performance in six examinations. Neither group's performance was significantly higher on any extramural examination. It was concluded that, as measured by conventional examinations, students in the multimedia program with prosection tutorials learned human anatomy as well as those in the traditional lecture-dissection program.

Knight A. (2007). **The effectiveness of humane teaching methods in veterinary education.**

ALTEX-Alternatives to Animal Experimentation 24(2): 91-109. ISSN: 0946-7785 (print)

[http://www.altex.ch/resources/2_07S091109Knight_korrqxd.pdf]

Abstract: Animal use resulting in harm or death has historically played an integral role in veterinary education, in disciplines such as surgery, physiology, biochemistry, anatomy, pharmacology, and parasitology. However, many non-harmful alternatives now exist, including computer simulations, high quality videos, "ethically-sourced cadavers" such as from animals euthanased for medical reasons, preserved specimens, models and surgical simulators, non-invasive self-experimentation, and supervised clinical experiences. Veterinary students seeking to use such methods often face strong opposition from faculty members, who usually cite concerns about their teaching efficacy. Consequently, studies of veterinary students were reviewed comparing learning outcomes generated by non-harmful teaching methods with those achieved by harmful animal use. Of eleven published from 1989 to 2006, nine assessed surgical training--historically the discipline involving greatest harmful animal use. 45.5% (5/11) demonstrated superior learning outcomes using more humane alternatives. Another 45.5% (5/11) demonstrated equivalent learning outcomes, and 9.1% (1/11) demonstrated inferior learning outcomes. Twenty one studies of non-veterinary students in related academic disciplines were

also published from 1968 to 2004. 38.1% (8/21) demonstrated superior, 52.4% (11/21) demonstrated equivalent, and 9.5% (2/21) demonstrated inferior learning outcomes using humane alternatives. Twenty nine papers in which comparison with harmful animal use did not occur illustrated additional benefits of humane teaching methods in veterinary education, including: time and cost savings, enhanced potential for customisation and repeatability of the learning exercise, increased student confidence and satisfaction, increased compliance with animal use legislation, elimination of objections to the use of purpose-killed animals, and integration of clinical perspectives and ethics early in the curriculum. The evidence demonstrates that veterinary educators can best serve their students and animals, while minimising financial and time burdens, by introducing well-designed teaching methods not reliant on harmful animal use.

Lynagh, M., R. Burton, and R. Sanson-Fisher (2007). **A systematic review of medical skills laboratory training: where to from here?** *Medical Education* 41(9): 879-887. ISSN: 0308-0110

Abstract: OBJECTIVES: The aim of this review was to evaluate the effectiveness of medical skills laboratories or simulators. In particular, it aimed to determine if performance in medical skills laboratories is transferable to actual clinical performance and maintained over time. METHODS: A range of databases was utilised to search for relevant papers published from 1998 to June 2006. Articles were included in the review if they met a number of criteria that included the evaluation of a skills laboratory or simulator for the purpose of procedural skills training, that participants were either undergraduate medical students or postgraduate medical trainees, and that the study used a randomised, controlled trial (RCT) research design in evaluation. RESULTS: A total of 44 RCTs were identified for inclusion in the review. Overall, 32 (70%) studies reported that simulator training significantly improved procedural skills performance in comparison with standard or no training. Twenty (45%) RCTs assessed the transfer of simulator performance to clinical skills performance; however, 8 of these used animal models, not real patients. Only 2 studies assessed the maintenance of skills post-intervention, both at 4-month follow-up periods. CONCLUSIONS: Medical skills laboratories do lead to improvement in procedural skills compared with standard or no training at all when assessed by simulator performance and immediately post-training. However, there is a lack of well designed trials addressing the crucial issues of transferability to clinical practice and retention of skills over time. Further research must be carried out to address these matters if medical skills laboratories are to remain an integral component of medical education.

Mabry, R.L. (2005). **Use of a hemorrhage simulator to train military medics.** *Military Medicine* 170(11): 921-925. ISSN: 0026-4075 (Print)

Abstract: BACKGROUND: The leading cause of preventable battlefield death is extremity hemorrhage. This study examines how current first aid training for the management of severe extremity hemorrhage can be improved by using a patient simulator. METHODS: This was a prospective trial involving two cohorts of U.S. Army combat medic trainees. The control group received the standard first aid training for bleeding, including lectures and practical exercises. The study group received the same lectures but was exposed to a hemorrhage simulator during the practical exercises. Both groups were then evaluated during a field exercise 7 weeks later. RESULTS: The study group showed a statistically significant improvement in the time it took to

stop severe extremity hemorrhage in a simulated patient. **CONCLUSIONS:** Simple innovations in training may play a significant role in preparing medics (and combatants) to care for injuries they will encounter on the battlefield.

Descriptors: emergency medical technicians, combat medics, hemorrhage, manikins, military medicine, military personnel, cohort studies, prospective.

McFetrich, J. (2006). **A structured literature review on the use of high fidelity patient simulators for teaching in emergency medicine.** *Emergency Medicine Journal* 23(7): 509-511. ISSN: 1472-0205 (print)

Abstract: High fidelity simulators are commonly used educational tools, mainly in anaesthesia. This literature review examines the use of simulators for teaching in emergency medicine and covers some of their advantages and disadvantages, and evidence for their use.

Neequaye, S.K., R. Aggarwal, I. Van Herzeele, A. Darzi, N.J. Cheshire (2007). **Endovascular skills training and assessment.** *Journal of Vascular Surgery* 46(5): 1055-1064. ISSN: 0741-5214 (print)

Abstract: **OBJECTIVE:** Evolving endovascular therapies have transformed the management of vascular disease. At the same time, the increasing use of non-invasive vascular imaging techniques has reduced the opportunities to gain the required basic wire and catheter handling skills by performing diagnostic catheterizations. This article reviews the evidence for alternative tools currently available for endovascular skills training and assessment. **METHODS:** A literature search was performed on PubMed using combinations of the following keywords; endovascular, skills, training, simulation, assessment and learning curve. Additional articles were retrieved from the reference lists of identified papers as well as discussion with experts in the arena of medical education. **RESULTS:** Available alternatives to training on patients include synthetic models, anesthetized animals, human cadavers and virtual reality (VR) simulation. VR simulation is a useful tool enabling objective demonstration of improved skills performance both in simulated performance and in subsequent in-vivo performance. Assessment modalities reviewed include time action analysis, error analysis, global rating scales, procedure specific checklists and VR simulators. Assessment in training has been widely validated using VR simulation. Rating scales and checklists are presently the only assessment modalities that have demonstrated utility outside the training lab. **CONCLUSION:** The tools required for a structured proficiency based endovascular training curriculum are already available. Organization of training programs needs to evolve to make full use of modern simulation capability for technical and non-technical skills training.

Patronek, G.J. and A. Rauch (2007). **Systematic review of comparative studies examining alternatives to the harmful use of animals in biomedical education.** *Journal of the American Veterinary Medical Association* 230(1): 37-43. [Note: Comments in: *J Am Vet Med Assoc.* 230(11):1622-3; author reply 1623; *J Am Vet Med Assoc.* 230(5):657; author reply 657-8.

Abstract: **OBJECTIVE:** To systematically review the published literature for controlled studies comparing learning outcomes of traditional methods that require the terminal use of animals (eg, dissection, live-animal surgery, and live-animal laboratory demonstrations) with outcomes obtained with alternative teaching methods. **DESIGN:** Systematic review. **STUDY POPULATION:** Controlled studies published between 1996 and 2004. **PROCEDURES:** PubMed

was searched with the following keywords, used alone and in combination: educational alternatives, nonlethal teaching methods, veterinary alternatives, medical education, and nonterminal animal use. Cited references of retrieved reports were reviewed to identify additional reports. Reports were selected for review only if a comparison group was included. RESULTS: 17 studies that were randomized controlled trials or nonrandomized trials that included a comparison group were identified. Five involved veterinary students, 3 involved medical students, 6 involved university undergraduate students, and 3 involved high school biology students. Sample size ranged from 14 to 283 students. Eleven studies appeared to be randomized, parallel-group trials, 4 involved comparative groups to which participants were not randomly assigned or for which the randomization process was not clear, 1 was a 2-period crossover study, and 1 involved a retrospective review of grades. In all 17 studies reviewed, results associated with the alternative method of instruction were not significantly different from or superior to results associated with the conventional method. CONCLUSIONS AND CLINICAL RELEVANCE: Although the number of controlled studies identified was small, the results seem to support more widespread adoption of alternative teaching methods in biomedical education.

Ramshaw, B.J., D. Young, I. Garcha, F. Shuler, R. Wilson, J.G. White, T. Duncan, and E. Mason (2001). **The role of multimedia interactive programs in training for laparoscopic procedures.** *Surgical Endoscopy* 15(1): 21-27. ISSN: 0930-2794 (print); 1432-2218 (online)
Abstract: BACKGROUND: The application of minimally invasive techniques to the performance of abdominal surgery by general surgeons has been perhaps the greatest advance in the history of general surgery. The safe adoption of many of these procedures, however, has been hampered by significant obstacles, mainly due to the problem of providing adequate training for surgeons. Outside of animal and cadaver labs, most training has been didactic in nature, and adoption rates after completion of these courses are discouraging. Multimedia interactive training has been used in a number of high-tech industries with great success. A >60% improvement in the learning curve after multimedia interactive training, as compared to traditional didactic training, has been reported. Multimedia interactive training programs for surgeons that use content and input from multiple experts in laparoscopic procedures have now been developed. METHODS: Residents from a general surgery residency program who used these programs were asked to rate their effectiveness in increasing their knowledge and comfort level prior to their participation in a real procedure as the primary surgeon or first assistant. A comparison to other traditional training techniques was also made. Eleven residents completed 41 programs designed to teach one of five different laparoscopic procedures-cholecystectomy, fundoplication, appendectomy, colon resection, or hernia repair. RESULTS: On a scale of 1 to 10, with 10 being the highest, the residents reported that the multimedia interactive training programs raised their knowledge level of the procedure from 6.0 to 8.7 (+2.7 point value increase after using the multimedia interactive program). The programs increased their comfort level when actually called on to perform or assist with the procedure from 5.3 to 8.1 (+2.8 point value increase after using the multimedia interactive program). In comparing the value of training methods for learning laparoscopic procedures, the residents rated text, lectures, videos, and animal labs at 4.7, 5.1, 6.0 and 7.3, respectively. By comparison, the residents rated the multimedia interactive training program at 8.8. CONCLUSION: The use of multimedia interactive training programs in addition to current laparoscopic training courses may help to increase the safe adoption of laparoscopic procedures. These programs may be a beneficial adjunct to residency training

programs.

Scerbo, M.W., J.P. Bliss, E.A. Schmidt, H.S. Hanner-Bailey, L.J. Weireter (2005). **Assessing surgical skill training under hazardous conditions in a virtual environment.** *Studies in Health Technology and Informatics* 111: 436-442. ISSN: 0926-9630 (Print)

Abstract: The present study examined the performance of a surgical procedure under simulated combat conditions. Eleven residents performed a cricothyroidotomy on a mannequin-based simulator in a fully immersive virtual environment running a combat simulation with a virtual sniper under both day and night time lighting conditions. The results showed that completion times improved between the first and second attempt and that differences between day and night time conditions were minimal. However, three participants were killed by the virtual sniper before completing the procedure. These results suggest that some participants' ability to allocate attention to the task and their surroundings was inappropriate even under simulated hazardous conditions. Further, this study shows that virtual environments offer the chance to study a wider variety of medical procedures performed under an unlimited number of conditions.

Descriptors: computer simulation, surgical procedures, task performance and analysis, war, clinical competence, internship and residency, Virginia.

Scerbo, M.W., J.P. Bliss, E.A. Schmidt, S.N. Thompson, T.D. Cox, H.J. Poland (2004). **A comparison of the CathSim system and simulated limbs for teaching intravenous cannulation.** *Studies in Health Technology and Informatics* 98: 340-346. ISSN: 0926-9630 (Print)

Abstract: The present study describes a comparison between the CathSim VR simulator and simulated limbs for training IV cannulation. Two groups of physician assistant students underwent 2 hours of training on either method. Performance was assessed before and after training with a standardized assessment form. The results showed that all students improved after training, but the degree of improvement was greater for those trained with the simulated limbs. These findings may be due to differences between the two training methods as well as the methodology adopted in the present study.

Descriptors: extremities, intravenous cannulation, venous cutdown, humans, computer simulation, Virginia

Smolle, J., G. Prause, and F.M. Smolle-Juttner (2007). **Emergency treatment of chest trauma - an e-learning simulation model for undergraduate medical students.** *European Journal of Cardio-thoracic Surgery* 32(4): 644-647. ISSN: 1010-7940 (print)

Abstract: Objective: Appropriate emergency measures are essential in improving the outcome of patients with thoracic injuries. Pathophysiological background and basic principles of emergency treatment decisions should be already taught in undergraduate medical curricula. The effectiveness of a computer simulation model on thoracic trauma management was evaluated. Methods: Forty-one students were enrolled in this pre-test/post-test self-controlled study. Learning experience was based on a complex computer simulation model demonstrating basic mechanisms of thoracic injuries and facilitating the interactive application of various emergency measures. Results: Pre-test multiple-choice results were 72.2% (66.9-77.5) correct answers, which increased significantly to 86.5% (82.6-90.4) in the post-test ($p < 0.001$). The students spent 30 min (23-36) with the interactive learning object. Content analysis of open-ended

feedback revealed a highly significant overall positive judgement ($p < 0.001$), where the importance of 'trial and error' learning, the possibility of being able to 'view a process' and the simplicity of the model were particularly stressed. Conclusions: Computer simulation of chest trauma emergency treatment options is a safe and efficient learning approach in undergraduate medical education, which is highly appreciated by the students.

Stanbridge, R. De L., D. O'Regan, A. Cherian, and R. Ramanan (1999). **Use of a pulsatile beating heart model for training surgeons in beating heart surgery.** *Heart Surgery Forum* 2(4): 300-304. ISSN: 1522-6662 [Note: [http://www.hsforum.com/stories/articleReader\\$275](http://www.hsforum.com/stories/articleReader$275)]
Abstract: BACKGROUND: Coronary artery bypass on the beating heart has undergone resurgence with the introduction of minimally invasive techniques and new stabilizing devices. It is important to develop a method for training surgeons to perform accurate anastomoses despite cardiac motion and to develop the skills needed for consistent results in this demanding field. METHODS: A prosthetic model of the beating heart was created by Limbs and Things, Ltd. (Bristol, UK) and used in our center to simulate clinical situations of beating heart surgery. Anastomotic quality was evaluated using a pre-established set of criteria on patency and suturing with each anastomosis graded on a 12-point scale. RESULTS: The average scores for trainees using the Pulsatile Beating Heart Model were 8.5 while that of the expert surgeon with MIDCAB experience was 11. Defects seen included cross-wall suturing and significant narrowing of the toe of the anastomosis. Scores improved with increasing practice during each session. Operators with more clinical experience scored higher. All surgeons felt the model duplicated the exposure and feel of the tissue characteristic of clinical cases. CONCLUSIONS: The beating heart simulator provides excellent training for new as well as experienced surgeons, provides visual feedback of anastomotic errors, and instills increasing confidence in the participants in their ability to construct accurate anastomoses on the beating heart.

Sutherland, L.M., P.F. Middleton, A. Anthony, J. Hamdorf, P. Cregan, D. Scott, and G.J. Maddern (2006). **Surgical simulation: a systematic review.** *Annals of Surgery* 243(3): 291-300. [Note: Comment in: *Ann Surg.* 243(3):301-3.] ISSN: 0003-4932 (print); 1528-1140 (online)
Abstract: OBJECTIVE: To evaluate the effectiveness of surgical simulation compared with other methods of surgical training. SUMMARY BACKGROUND DATA: Surgical simulation (with or without computers) is attractive because it avoids the use of patients for skills practice and provides relevant technical training for trainees before they operate on humans. METHODS: Studies were identified through searches of MEDLINE, EMBASE, the Cochrane Library, and other databases until April 2005. Included studies must have been randomized controlled trials (RCTs) assessing any training technique using at least some elements of surgical simulation, which reported measures of surgical task performance. RESULTS: Thirty RCTs with 760 participants were able to be included, although the quality of the RCTs was often poor. Computer simulation generally showed better results than no training at all (and than physical trainer/model training in one RCT), but was not convincingly superior to standard training (such as surgical drills) or video simulation (particularly when assessed by operative performance). Video simulation did not show consistently better results than groups with no training at all, and there were not enough data to determine if video simulation was better than standard training or the use of models. Model simulation may have been better than standard training, and cadaver training may have been better than model training. CONCLUSIONS: While there may be

compelling reasons to reduce reliance on patients, cadavers, and animals for surgical training, none of the methods of simulated training has yet been shown to be better than other forms of surgical training.

Theoret, C.L., E.N. Carmel, and S. Bernier (2007). **Why dissection videos should not replace cadaver prosections in the gross veterinary anatomy curriculum: results from a comparative study.** *Journal of Veterinary Medical Education* 34(2):151-156. ISSN: 0748-321X (Print)

Abstract: The goal of our study was to evaluate the impact of a tool intended to eliminate large-animal cadavers from the anatomy laboratory, in view of their prohibitive cost and the logistic difficulties they pose. We sought to determine whether a commented video of the bovine abdominal cavity could effectively replace a prosection of this region. The hypothesis was that students receiving video instruction would achieve lower scores on a post-instructional exam than those benefiting from a commented cadaver prosection. A commented video of the bovine abdominal cavity was compared to a prosection covering identical material. Seventy-five first-year students, having received no prior instruction on the region of interest, were divided into two groups of equivalent knowledge: group A received prosection instruction (N = 38) and group B, video instruction (N = 37). Following instruction, students completed a test on a cadaver, requiring that they correctly match 15 labeled structures with a list of 40 possible answers. Statistical analysis consisted of a repeated-measures linear model with group (A vs. B) as a between-subject factor and time (pre- vs post-test) as a within-subject factor, with significance at $p < \text{or} = 0.05$. Students in group A achieved mean scores of 9.21 ± 0.31 , while those in group B scored 7.65 ± 0.31 . Although both groups significantly improved following instruction, there was a statistically significant difference in the post-instruction scores between groups A and B ($p = 0.0007$), in favor of the prosection group. The major comment in favor of cadaver prosection pertained to the sensory experience; in favor of video instruction, students stressed accessibility to the pedagogical material for autonomous learning and revision as well as superior viewing compared to the setup adopted for prosections. In conclusion, while our data suggest that cadaver prosections are superior to video demonstrations, it is apparent that students can learn bovine abdominal anatomy by both methods. Future investigations on the subject of alternative teaching methods are warranted.

Wong, K., F. Stewart (2004). **Competency-based training of basic trainees using human cadavers.** *Australia-New Zealand Journal of Surgery* 74(8): 639-642. ISSN: 1445-1433 (Print)

Abstract: BACKGROUND: Increasing constraints on operative training in the clinical setting provide impetus for the development of alternative training models. Anatomy dissection courses utilizing human cadavers have been useful in imparting knowledge of human anatomy for surgical trainees. The present study evaluates the impact of competency-based technical skills instruction as an adjunct to cadaveric dissection courses on the procedural skills of basic surgical trainees (BST). METHODS: A single cohort of BST was prospectively evaluated regarding their self-reported confidence and competency in performing saphenous vein cutdowns immediately before and after an anatomy dissection course. RESULTS: Nine BST were evaluated (66% were male). One subject withdrew from the study, leaving eight BST for final analysis. Mean number of years since graduation from medical school was 2.5 years (range: 2-4 years). Seven BST were in their first year of training. All subjects had completed an early management of severe trauma

(EMST) course. Total prior experience of saphenous vein cutdowns for all subjects was a single attempt on a sheep cadaver at the EMST course. The percentage of BST expressing little or no confidence in performing cutdowns decreased after the dissection course (50% vs 0, $P < 0.05$). Mean time taken for completion of cutdown decreased after the dissection course. (5 min 52 s vs 3 min 52 s, $P < 0.05$). Mean size of incision used to perform cutdown decreased after the course. (4.5 cm vs 3.4 cm, $P < 0.05$). The percentage of subjects experiencing complications during cutdown decreased after the course (38% vs 0, $P < 0.05$). **CONCLUSIONS:** Anatomy dissection courses using human cadavers may contribute to improving the confidence and competency of BST in performing saphenous vein cutdowns. Technical training components should be considered as an adjunct to future anatomy dissection courses involving surgical trainees. **Descriptors:** cadaver, competency-based education, medical education, venous cutdown, anatomy, Australia, clinical competence, dissection, humans, saphenous vein.