



Session III-3: Development of non-animal teaching/training models

Session III-3: Oral presentations

III-3-712

An ethical scoring system for the production and assessment of alternatives in education and training

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Assessment of non-animal alternative tools in education and training is a process that must address a range of pedagogical, ethical, environmental and economic issues. Within the ethical field, criteria include whether and how animals were used in the production process, broader ethical issues presented by content and design, and potential for replacement of harmful animal use. To encourage humane production of alternatives and to facilitate assessment and implementation, InterNICHE has developed an ethical scoring system that forms part of a comprehensive review and assessment process. The potential for international implementation and associated widespread replacement is scored through judging an alternative's ability to meet and exceed the teaching objectives of a conventional practical class, and its accessibility, opportunities for translation and other criteria. The pedagogical and training aims of an alternative, with both explicit lessons and implicit messages, also play a role in the scoring, with alternatives developed for acquisition of knowledge and skills for the purpose of animal care scoring higher than those for the purpose of animal ex-

perimentation. When an alternative reflects progressive teaching approaches and technological innovation, and when holistic representations rather than instrumental use of animals are made, it also scores higher. In the production of video and software alternatives for anatomy practical classes, the use of animal cadavers that are ethically sourced according to the InterNICHE Policy on Alternatives and Animal Use in Education and Training would contribute to a higher score than a product that used killed animals. The use within physiology and pharmacology software of existing data or mathematical algorithms rather than data derived from new animal experiments would also contribute to a higher score. Examples of the process of ethical scoring for a number of existing alternatives will be presented, with an exploration of the criteria and their weighting. The process is being applied to alternatives detailed in the InterNICHE book and database "From Guinea Pig to Computer Mouse" (2nd ed.), available and updated on-line at www.inter-niche.org, and is being discussed with producers to improve the nature and quality of new products.



III-3-115

Ex vivo pulsed heart model for cardiac surgical and interventional product development and training

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An *ex vivo* pulsed heart model was developed to simulate a beating heart in an operating room environment. The heart and aorta of the pig was obtained from a local abattoir. The use of discarded organs increases the overall use of the animal and reduces the need for dedicated research animals.

The objective was to develop a clinically relevant beating heart model with direct visualization of the intra-cardiac structures for development of surgical and interventional products as well as education and training. The heart was perfused with saline that circulated along the natural blood flow pathway with inflow through the left atrium and outflow through the aortic valve. The pump function of the heart was achieved through a changing left ventricular volume that developed a left ventricular pressure pulse. The preload and afterload were created from separate hydrostatic columns and reservoirs that also provided system compliance and pulse damping of pump induced artifacts. Solid-state micro-pressure transducers were located in the left atrium, left ventricle, and aortic root to provide real time pressure monitoring and phase relationships. Left ventricle vol-

ume and pressure modulation were controlled with an external piston pump through an apical balloon cannula.

The model simulated an operating room environment with anatomical orientation of the heart and aorta on the surgical table, cardiac surgical instruments, ultrasound imaging equipment, and cardiopulmonary bypass extra-corporal pumps. Laparoscopic cameras positioned in the left atrium, left ventricle, and aortic root provided direct visualization of intra-cardiac structures such as the mitral and aortic valves, atrial appendage, intraventricular septum, chordae tendinea, papillary muscles, etc. High-resolution cameras provided imaging of native valve function, surgical techniques, prosthetic devices, and the coronary ostium for catheterization.

The *ex vivo* pulsed heart model simulated a beating heart in an operating room environment for product development and training. The use of harvested porcine hearts may be reanimated to approximate *in vivo* conditions for evaluation of device performance while reducing the use of live animals for research.

III-3-146

Transparent laparoscopic simulator with adjustable physiological conditions for product development and surgical training

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Laparoscopy dates back to around 1901, when it was reportedly first used in a gynecologic procedure performed in Russia. The popularity of the technique as a diagnostic and treatment tool has increased dramatically since the early 1980's to today where it is a widespread procedure for various surgeries. A novel bench top model is presented that simulates the anatomical and physiological conditions present during laparoscopy.

The objective was to create a bench top laparoscopic simulator with adjustable physiological conditions to aid in the design and development of laparoscopic devices and to be used as a surgical trainer.

The laparoscopic chamber approximates the volume and aspect ratio of the human adult abdominal cavity during distention,

providing the physical constraints of conventional laparoscopic surgery. Environmental conditions of insufflation pressure, temperature, and humidity are also included, eliminating the need for dedicated research animals. Multiple access ports accommodate both 5 and 10-12 mm trocars in the anterior and lateral planes allowing placement of cameras and instruments.

The Transparent Laparoscopic Simulator enables rapid prototype evaluations and training of medical professions without the use of dedicated research animals. Environmental conditions in the chamber may be created to simulate a broad range of patient conditions by controlling insufflation pressure, temperature, and humidity. The transparent walls of the chamber provide direct visualization of the device being used or the test being



performed, instead of indirect imaging with a camera and monitor as in conventional laparoscopic surgery. Alternatively, the chamber may be covered to hide the interior and allow for training with the use of a conventional monitor. The full field of view

provides the investigator an unobstructed three-dimensional assessment. The laparoscopic chamber has been used for new product development, surgical training and design validation.

III-3-291

STARR Trainer, an alternative to live animal usage, for product development and surgeon training

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Trans-Anal Rectal Resection (STARR) is a surgical treatment for obstructed defecation syndrome (ODS), a condition of chronic constipation associated with anatomical anomalies of the pelvic floor and rectum. Ethicon Endo-Surgery developed two staplers to enable surgeons to perform this STARR surgery. These staplers allow the surgeon to resect full thickness rectal wall via a minimally invasive trans-anal approach. The goal of this study was to develop a STARR trainer as an alternative to live animal usage for both product development and for use during surgeon training.

Ex vivo methodology was explored as a means to study staple line integrity and staple line burst pressure during product development. A stand was developed as a tool to suspend harvested

porcine tissue, distal colon and rectum, in the correct orientation and tension to perform suture placement, device orientation and tissue resection.

The stand, STARR Trainer, allowed easy and consistent placement of the staple lines for staple line testing. It was easy to view traction suture placement, in folding of the tissue into the staple anvil and the final staple line. These features also made the stand a useful tool in training surgeons. Animal usage for training was reduced by 67% after implementing the STARR Trainer.

The STARR Trainer is an effective alternative to animal use for product development and surgeon training.

III-3-442

The use of rat skull model for teaching learning methods for bleeding

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It is necessary to collect blood from small rodents for different experimental or diagnostic procedures, and this requires training and the use of anesthetized animals for students to learn the various techniques of bleeding. Plastination (P) is the most important technique for preservation of biological specimens.

Our objective was to propose the use of the skull and plastinated heads for the training of students, without sacrificing animals.

The P methodology consists of slowly replacing tissue fluids and a portion of the tissue lipids with a polymer under vacuum. The results are clean, dry, odorless and durable real biological specimens. It keeps the dissected specimens from deteriorating. Waste adult rats were obtained and heads and skulls were prepared by thermal maceration and mechanical removal of soft

tissues. Each skull was bleached with hydrogen peroxide. Other heads had the skin left intact and other heads were retired. They were fixed in 10% buffered formalin. After dehydration with acetone, silicone infiltration was performed.

Rat skulls were obtained with and without soft tissues to demonstrate the anatomical relationship and provide a training model for the collection of blood from the retro-orbital sinus, as well as the facial vein.

The advantages of this model is the elimination of the use of live animals, reduction of trauma induced in animals during learning, reduction in the anxiety caused to students when handling live animals. The rat head is an ideal model for education, skills development and refinement of the bleeding technique.



III-3-459

Simulation of animal experiments using mannequins, chemical sensors and computer software

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The computer assisted learning (CAL) of animal based experiments has substantially contributed to replacement of animals in education and training. However, CAL does not enable the user to develop skills like surgical techniques, dose administration techniques, preparation of drug solutions and recording of biological responses, which are acquired by performing a wet lab experiment. These skills play a crucial role in actual research activities. Hence, to reinforce the experimental details, there is a need to enrich CAL techniques by combining them with mannequins and chemical sensors. Such combination can lead to better virtualization of the animal experiment and help students develop maximum experimental skills.

The teaching aid developed by us completely simulates the invasive blood pressure recording procedure in rats and dogs.

This module can be used to routinely teach/learn/demonstrate the experiment of invasive blood pressure recording in rat/dog in the same way as it is performed in wet lab experiments. Using this artificial rat/dog along with dummy drug solutions and related software, effects of different drugs on the blood pressure can be demonstrated. "Exam mode" incorporated in the relevant software can be used for conducting exams on these experiments.

The combined use of mannequins, sensors and CAL can simulate the animal based experiments in totality and can prove to be a complete replacement for a few experiments on animals in education and training.

Session III-3: Poster presentations

III-3-047

Focus on animal welfare, the role of the 3Rs in the wellbeing of animals on the African continent

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Since the 1970s, the concept of the 3Rs (Replacement, Reduction and Refinement) has had a major influence on the field of laboratory animal science. Refinement refers to improvements to housing and care and procedures, which minimize actual or potential pain, suffering, distress or lasting harm and/or improve animal welfare in situations where the use of animals is unavoidable. Reduction refers to the lifetime experience of the animal. There is evidence that refinement not only benefits animals, but also improves the quality of research findings. Reduction refers

to methods which minimize animal use and enable researchers to obtain comparable levels of information from fewer animals or to obtain more information from the same number of animals, thereby reducing future use of animals. The main aim of this paper is to highlight the plight of animals on the African continent; it focuses on the abuse of animal rights by those who innocently violate these rights and those who don't believe that animals too have rights.



III-3-215

Outcomes of efforts of Mahatma Gandhi – Doerenkamp Center (MGDC), India, to replace animal dissections in life science and biomedical science education

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The Mahatma Gandhi Doerenkamp Center for Alternatives to Use of Animals in Life Science Education was established in July 2009 by the Doerenkamp-Zbinden Foundation, Switzerland, with sensitization and motivation of stake-holders to replace use of animals in education as the principal mission goal. This Center works to achieve excellence in life science education by introducing value-based learning systems. Realizing the removal of countless animals from the wild and subjecting them to the gruesome dissection for purpose of understanding animal anatomy and evolution, the Center has fixed university and college teachers as the principal target group to reach, since they are the ones who decide on the curriculum. The Center conducts localized workshops/seminars for these teachers at different places across the country. Within a very short span of time the Center has organized about 20 such programs. These are one full day programs starting with addresses by a team of academics who are emotionally attached to the concept of alternatives. The participants are told how archaic dissection is as a learning

tool, how the large scale removal of animals from their natural habitats can potentially disturb the ecosystem and hamper the biodiversity, how this practice defies the animal protection laws, and how students are turned to become violent towards the animals, etc. The participants are motivated to turn to humane and value-added science education by adopting several alternatives. A momentum and an expectation are built when the participants are given an on-screen demonstration of the various digital alternatives. In the afternoon the participants handle the computer mouse to learn animal anatomy, physiology, etc. The programs culminate in a discussion session where doubts and apprehensions are discussed and students are asked to record their feedback. In light of the enormous success, several universities have already revised their zoology/life science curriculum and the digital alternatives have started finding place in it. This presentation will review the feedback of the participants and the initiative from the regulatory authorities of higher education in India to support the efforts of MGDC in this endeavor.

III-3-465

Replacement of animal use in medical physiology

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The replacement of animal use in medical education with non-animal methods and techniques often yields both ethical and technical advantages. Particular emphasis is related to ensure the efficiency and validity of computer simulations regarding animal use replacement. The aim of the study was to clarify the medical student attitude toward computer simulation during the laboratory practice in medical physiology.

89 medical students (31 male and 58 female; 20 ±2 years old) at Skopje's Faculty were given questionnaires regarding the computer program: Renal function in humans by Sheffield BioScience Programs, UK. The students usually used PCs as follows: regularly 57%; fairly often 17.9%; sometimes 17.9%; and 1.1% rarely with learning purpose of 51%. At the end of the laboratory classes the students had to answer with: strongly

disagree (SD); disagree (D); neutral (N); agree (A); and strongly agree (SA).

To study physiology using animal experiments the students answered with: A 40.4%; SA 20.2%; D 8.9%; and SD 14.6%. The majority of the students preferred working with computer simulations in small groups: 47.1% A and 38.2% SA, and with its good data presentation 70.7% A and 10.1% SA. For replacement in animal use 16.8% A and 20.2% SA, but D 24.7% and SD 19.1%.

From the obtained results we may conclude that the medical students accept the computer simulation in medical physiology due to good data presentation, studying together in small groups but still don't completely accept to leave the conventional experiments within animal use.



III-3-487

Strategies for replacement in the medical physiology laboratory in Centro Universitario de la Costa (Puerto, Vallarta) of Universidad de Guadalajara

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The approach in the formation of human resources in health sciences at the Centro Universitario de la Costa, has led us to try to give to the medical and nursing students an integral formation that includes human development as an assignment, free to be taken by any of these students. This has led us to search for alternatives to the use of animals for the teaching of medical physiology.

Since 2008, we acquired the Biopac Student Lab, which has allowed us the opportunity for self-experimentation, using the students as volunteers, to observe the most common physiological variables, and strengthen the learning in the laboratory. Therefore, we have developed a group of outstanding students,

which have created a physiology manual with detailed protocols to implement different practical activities in the physiology laboratory.

In 2011, we received a new Biopac Student Lab Advanced and an upgrade of the current Biopac Student Lab thanks to the support of Interniche. With all this, we can reinforce the strategy to replace the use of animals in our lab and start using it in other departments of the Centro Universitario and other campus on the university net. The combination of a program of human development and the challenge of using alternatives in medical education as extracurricular activities will give us a plus in the formation of human resources in health sciences.

III-3-496

International practical training on *in vitro* methods

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With the recent advancements in the adoption of a considerable number of alternative methods to animal testing by the OECD, and the global harmonization of the world commerce, the importance of providing education on the adopted alternative methods throughout the world is becoming increasingly necessary.

In particular, the specifics of the *in vitro* test method protocols, the importance of ensuring good laboratory practices, proficiency, reliability and relevance of the method for regulatory purposes, calls for an education preferentially based on practical demonstrations and/or hands-on-training.

Such training is essential to scientists performing *in vitro* tests, and is also key for regulators to gain the necessary understanding and make critical assessments of the *in vitro* data. Furthermore, such training could favor standardization of regulatory assessment and decisions on hazard properties of chemicals across the world.

As an example, a practical workshop is currently being organized in Brazil by IIVS, SeCAM, University of Goiás and a local organizing committee comprised of representatives from government, regulatory agencies, academia, industry and scientific associations. Such an inclusive composition allows for transparent and open discussions on the aims and goals of the workshop. The practical training will be provided by IIVS on assays that are currently accepted at the OECD level, and will focus on the technical steps of the adopted *in vitro* protocols (highlighting the critical steps for data assessment), good laboratory practices, and finally the interpretation of results for regulatory purposes. Details on the concepts and organization of the practical trainings will be provided.