

ARIZONA

Simulation Technology and Education Center

ANNUAL REPORT 2015-16



The University of Arizona
Health Sciences

From the Executive Director of ASTEC



No matter how much we plan and forecast, each year brings the Arizona Simulation Technology and Education Center (ASTEC) new and unexpected challenges. This year has seen ASTEC garner research funding from the National Institutes of Health, the National Science Foundation, and most recently, a Department of Defense contract to further accelerate the University of Arizona's ranking as one of the premier medical simulation facilities in the US.

In addition, ground has broken on a new multi-disciplinary education building that will provide the UA with the most advanced simulation facility in the country. Efforts are well underway to ensure that the UA can provide coordinated clinical research and bio-industrial opportunities for simulation between the COM – Phoenix, COM – Tucson, and Banner Health. ASTEC is committed to playing a vital role in the newly designed curriculum for the medical schools and members of the ASTEC staff and faculty serve on every committee in the curriculum revision to ensure it will reflect the ever-increasing role of simulation in immersive education and training in healthcare.

Respectfully,

A handwritten signature in black ink, appearing to read "Allan J. Hamilton".

Allan J. Hamilton, MD, FACS

Executive Director

Arizona Simulation Technology and Education Center (ASTEC)

Annual Report: Academic Year 2015-16

Executive Overview

- ▶ ASTEC is excited to announce the construction of a new Health Sciences Innovation Building (HSIB) with 35,000 ft² designated for medical simulation training, research and development. The building is scheduled to open in 2018.
- ▶ ASTEC continues to expand its research commitments with current grants from the National Institute of Health (R01), National Science Foundation (NSF) and contracts from the Department of Defense (DOD).
- ▶ ASTEC ranks among the highest nationally in terms of the number of unique learners and the number of unique sessions, providing a wide range of simulation activities for the full spectrum of healthcare providers.
- ▶ Of our total 2015-2016 simulation training sessions, 54% were dedicated to residents and staff of the Banner University Medical Center (BUMC), demonstrating the increasing role of simulation as the preferred method of graduate and continuing medical education.
- ▶ As a national leader in the development of artificial tissue, ASTEC has devised new methods for creating more realistic models, many of which incorporate the use of 3D modeling technologies.
- ▶ With financial support from the University of Arizona IT Student Advisory Board, ASTEC has established our own 3D Printing Laboratory for the design and production of artificial tissue models.
- ▶ ASTEC has achieved Accreditation from the Society for Simulation in Healthcare in the areas of Research, Assessment and System Integration and is now 1 of only 10 institutions nationally with accreditation in all areas of medical simulation expertise.
- ▶ For the first time this year, ASTEC hosted the annual Cardiology Fellows Endovascular Simulation Training Course that featured 11 industry partners for interventional cardiology technologies and devices.
- ▶ ASTEC has been chosen by Laerdal-SonoSim as a reference site for the testing of a new innovative ultrasoundable skin technology designed for Laerdal's line of advanced adult computerized mannequins.
- ▶ ASTEC has been designated as 1 of 4 control sites for the national Leadership Education Advanced During Simulation (LEADS) study funded by the Agency for Healthcare Research and Quality, US Department of Health and Human Services.
- ▶ As part of the All Together Better Health VIII Conference, ASTEC conducted the first intercontinental real-time interprofessional medical simulation between Oxford University and the University of Arizona



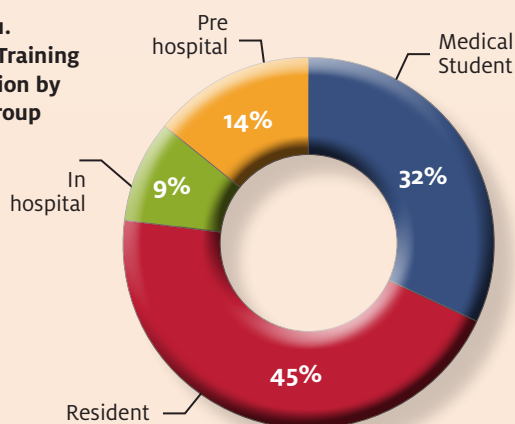
ARIZONA SIMULATION TECHNOLOGY AND EDUCATION CENTER

GROWTH

ASTECC opened on August 5, 2005, and has now begun its 12th year of operation. Over the past several years, we experienced a tremendous growth in utilization rates as demand for simulation training increased throughout the University of Arizona Health Sciences (UAHS), Banner – University Medical Center (BUMC), and numerous external first responder organizations. Over the last year, in particular, the utilization rates for residents and UAMC staff markedly increased so that they now make up a combined 54% of all training hours at ASTEC (see figure 1 for the FY16 breakdown in the four major user groups). This trend has come in part from an increased emphasis on using simulation technology for competency-based assessment as well as for systems and human factors testing.

In response to a national increase in demand for more simulation-based education in all areas of healthcare education, UAHS is devoting 35,000 sq. ft. for a new, state-of-the-art, interprofessional simulation center. It will encompass the entire seventh floor of the new Health Sciences Innovation Building (HSIB) and will incorporate the latest in simulation technology, including virtual reality and haptic training devices, game-based learning systems, realistic synthetic artificial tissues, and the latest in high fidelity human patient simulator technology. The new space will also include bio-innovation labs, a makerspace workshop, and a centralized command center that will operate a 3,000 sq. ft. fully immersive SimDeck surrounded by multidisciplinary range of patient care and operating rooms. This radical design will allow us to accommodate any request for simulation training and/or testing event, from a large-scale mass casualty or hospital-based internal disaster to multi-station competency-based procedural assessments for large learner groups.

Figure 1.
ASTECC Training Allocation by User Group FY16



We continue to be among the most multidisciplinary medical simulation centers in the nation, providing medical simulation training to more than 80 unique learner groups throughout all of the University of Arizona Health Sciences (UAHS) each year. In a continued effort to provide more immersive interprofessional training opportunities, 20% of these teaching activities are provided for multidisciplinary teams while on shift (in situ) within the departments of Emergency Medicine, Pediatrics, and Labor and Delivery. Likewise, for our first responder organizations such as medical flight crews and fire departments, we have begun to take our simulations into the field to practice complicated patient transports. We also provide simulation training to military and federal rescue personnel, community outreach workers, and students in precollege programs. In fact, in the past year, ASTEC provided more than 70 educational outreach opportunities for community healthcare groups, pre-health clubs, and high school and middle school students. ASTEC has truly established itself as the leading training center for the first-responder community in the State of Arizona.

We would like to take this opportunity to welcome Thomas Cahir, MS to our ASTEC team. As a full-time simulation technology specialist, Thomas brings great technical expertise to our team and has taken an instrumental role in implementing new research and development projects.

LEARNER GROUPS

More than 80% of our available weekly schedule is devoted directly to medical simulation training. Much of this time is filled by the following College of Medicine programs:

- ▶ Emergency Medicine Elective
- ▶ Surgery Clerkship
- ▶ Internal Medicine Clerkship
- ▶ Pediatric Clerkship
- ▶ Obstetrics/Gynecology (OB/GYN) Clerkship
- ▶ Year I & II Societies
- ▶ Year I Interprofessional Cardiopulmonary Resuscitation (IPCPR)
- ▶ Year III Intersessions
- ▶ Year III Transition Block
- ▶ Cardiopulmonary Resuscitation (CPR) Elective
- ▶ Surgery Club
- ▶ Family Medicine Interest Group (FMIG)
- ▶ Emergency Medicine Interest Group (EMIG)



Dr. Hamilton provides suture skills instruction for the College of Medicine Surgery Club

Residency makes up our largest user group and includes utilization from the following departments:

- ▶ Surgery
- ▶ Emergency Medicine
- ▶ Internal Medicine
- ▶ Family Medicine
- ▶ Pediatrics
- ▶ Obstetrics/Gynecology (OB/GYN)
- ▶ Pulmonary
- ▶ Anesthesia
- ▶ Tucson Medical Center (TMC)
- ▶ Nephrology
- ▶ Neurosurgery
- ▶ Neurology
- ▶ Rheumatology



Lisa Grisham, NP provides instruction for Lumbar Puncture with Year III medical students

In-hospital programs include the following:

- ▶ BUMC RN Codes
- ▶ In Situ Diamond Children's Pediatric Intensive Care Unit (PICU) Codes
- ▶ In Situ Diamond Children's Neonatal Intensive Care Unit (NICU) Codes
- ▶ In Situ Diamond Children's Pediatric Stepdown Codes
- ▶ In Situ Labor and Delivery Codes
- ▶ In Situ Newborn Nursery Codes
- ▶ In Situ Emergency Medicine Codes
- ▶ Radiology Attending and Staff Codes

ASTEC continues to be a primary resource for first-responder simulation training:

- ▶ Northwest Fire Department (NWFD)
- ▶ AirEvac Emergency Air Ambulance Service
- ▶ Arizona Lifeline Emergency Air Ambulance Service
- ▶ United States Border Patrol
- ▶ United States Army Combat Medics

Other groups include the following:

- ▶ Nurse Practitioner Acute Care Students
- ▶ Certified Registered Nurse Anesthetist Students
- ▶ Residency Electives
- ▶ Mariposa clinic pediatrics faculty and nursing
- ▶ University of Arizona Campus Health
- ▶ Veterinary Science Undergraduates
- ▶ Health Occupations Students of America (HOSA) Club
- ▶ Future Health Leaders Alliance (FHLA)
- ▶ Physiology Club
- ▶ Neuroscience and Cognitive Science Association
- ▶ American Medical Student Association Premedical Chapter
- ▶ Med Cats Pre-Health Club
- ▶ Bioengineering Research Rotations
- ▶ Undergraduate Internships and Independent Study
- ▶ Fostering and Achieving Cultural Equity and Sensitivity Pre-Health Club
- ▶ Undergraduate Biology Research Program (UBRP)
- ▶ International Fellowships
- ▶ A.T Still University Rotations



Banner Pulmonary Fellows responding to a patient with a gastrointestinal bleed



Simulation training collaborative with the Children’s Hospital of Philadelphia, Banner Health, and ASTEC for a train the trainer workshop on treating pediatric patients with congenital heart conditions

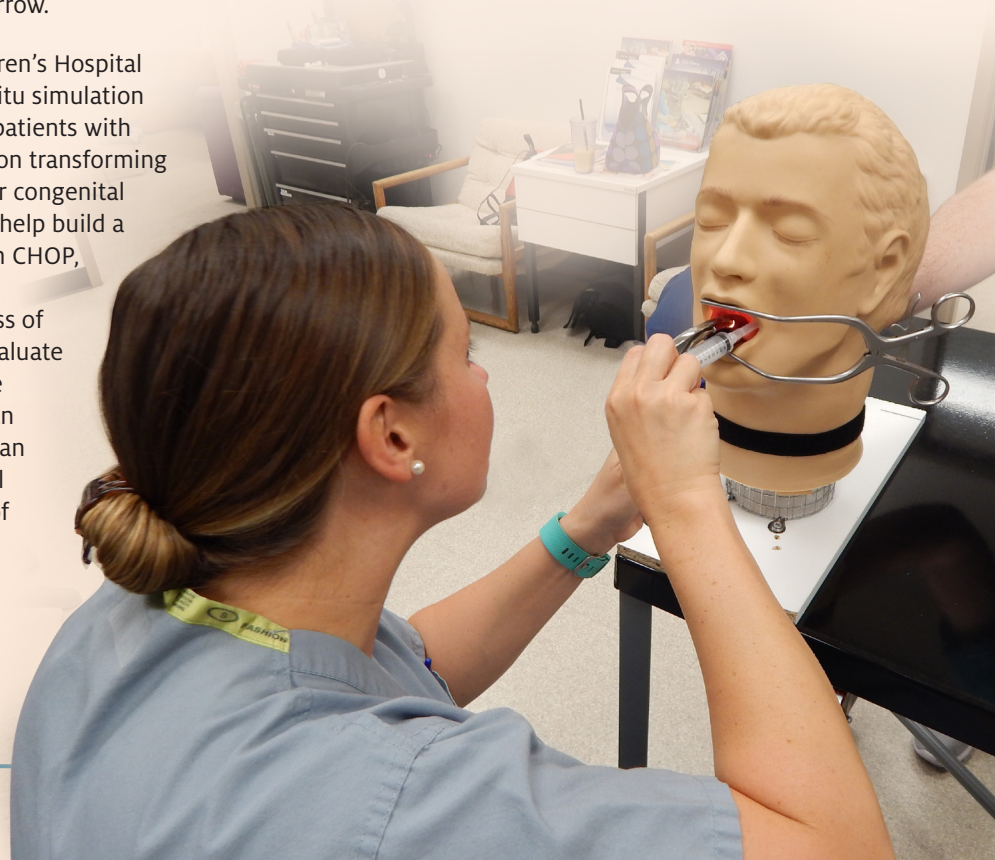
HIGHLIGHTS OF TEACHING ACTIVITIES

ASTEC has enjoyed its new partnership with Banner University Medical Center (BUMC). Banner is dedicated to providing the best training for its faculty and residents and has long been committed to using medical simulation to achieve its educational objectives. We look forward to working together to advance our ongoing efforts to produce the best-trained doctors of tomorrow.

ASTEC and BUMC collaborated with Children’s Hospital of Philadelphia (CHOP) to develop an in situ simulation curriculum for management of pediatric patients with congenital heart disease. BUMC is intent on transforming the hospital into a center of excellence for congenital heart disease and has recruited ASTEC to help build a training program. With expert advice from CHOP, we have completed the framework of the curriculum and are currently in the process of developing assessment instruments to evaluate the progress of trainees over time. We are hopeful that the success of this project can highlight how a UA-BUMC collaboration can promote simulation training in the clinical environment to advance the integration of academic with clinical medicine.

A second year emergency medicine resident prepares for incision and drainage using ASTEC’s peritonsillar abscess task trainer

This past year for the first time, ASTEC hosted the American College of Physicians (ACP) Arizona 2016 Medical Simulation Satellite Session. Working in collaboration with Kwan S. Lee, MD, Medical Director of Cardiology at BUMC and Dixie Swan, Executive Director of ACP Arizona, ASTEC hosted a 1-day conference for medical students at the University of Arizona College of Medicine. The conference featured 6 training stations including thoracentesis, lumbar puncture, central line placement, NG tube placement, endotracheal intubation and intraosseous line placement. The conference was rated very highly by participants on faculty knowledge, quality of the sessions, and faculty ability to provide constructive feedback.





Cardiology fellows practice a pericardiocentesis procedure on ASTEC's task trainer, which allows for ultrasound guided needle insertion



Certified registered nurse anesthetist students practice intubation using a flexible scope

Under the leadership of Kwan S. Lee, MD ASTEC was chosen along with the Mayo Clinic in Phoenix to host the semi-annual Cardiology Fellows Endovascular Simulation Training Course that featured 11 industry partners for Cardiology devices and equipment and provided simulation training for our residents, fellows and attending faculty. Fellows were able to orient themselves to new devices and practice invasive procedures including pericardiocentesis and catheter placement on simulated models and virtual reality training devices. The 1-day event was a huge success. ASTEC received positive feedback from both the vendors and the Cardiology faculty and is looking forward to hosting the event again next year.

To advance the simulation training experience for our General Surgery residents, ASTEC has partnered with Applied Medical, a medical device company that provides cholecystectomy simulation training models. We have begun to integrate these models into our quarterly intensive laparoscopic training day to supplement the Fundamentals of Laparoscopic Surgery (FLS) curriculum.

Supported by funding from the George C. Marshall foundation and under the leadership of Kathleen Piotrowski, DNP, CRNA, Certified Registered Nurse Anesthetists (CRNA) from the University of Arizona have begun to use ASTEC as their primary teaching lab for learning procedural skills in airway management including cricothyrotomy, endotracheal intubation as well as lumbar puncture, arterial line placement, and central line placement. Likewise, stimulated by financial support from a Federal Demonstration Partnership, Acute Care Nurse Practitioners (ACNP) have partnered with ASTEC to launch a Simulation Training Program to promote the acquisition of procedural skills.

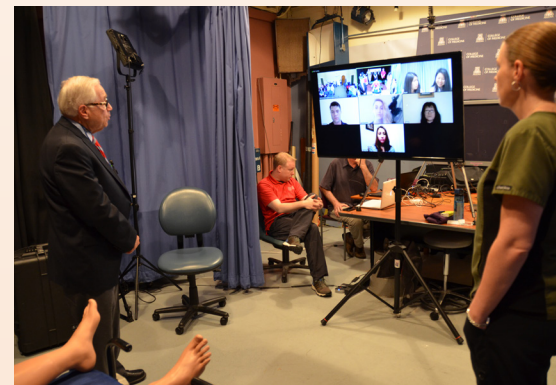
ASTEC continues to host Pulmonary and ED simulation fellowships, a year-long advanced airway curriculum organized by Jarrod Mosier, MD Assistant Professor of Emergency Medicine.

This past year, ASTEC celebrated the 10-year anniversary of the interprofessional cardiopulmonary resuscitation (IPCPR) simulation exercise. Hosted in collaboration with the University of Arizona Colleges of Nursing, Pharmacy and Public Health, this exercise marks the first interprofessional experience of our students training in various healthcare professions and is always regarded as a great opportunity to meet and work with future colleagues. Given the increasing role of telemedicine in healthcare, we designated 4 training sessions this year to introduce our students to remote learning technologies with great success. Sally Reel, PhD, Vice President for Interprofessional Education, was invited to present at the All Together Better Health Conference held in Oxford, England

where ASTEC was able to demonstrate how to incorporate remote learning opportunities with high fidelity medical simulations. We look forward to future collaboration and are proud of the role we have been able to play to promote interprofessional learning and practice.



ASTEC continues its commitment to training Southern Arizona's Air Evac flight nurses and flight paramedics in quarterly full-day simulation sessions. These trainings are comprised of 2-3 competency-based clinical scenarios and several procedures, including chest tube insertion, intubation and cricothyrotomy. They make use of the full complement of task trainers and high-fidelity computerized mannequins available in the ASTEC lab and



In a joint effort with the Department Interprofessional Education, Collaborative Practice & Community Engagement, the Arizona Telemedicine Program, ASTEC conducts a multidisciplinary simulation training that included remote learner participation while broadcasted to an audience at an international conference in Oxford, England.

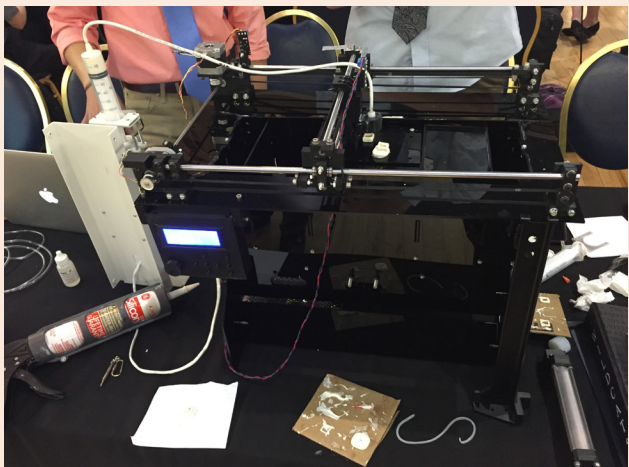


A member of ASTEC's College of Engineering Senior Design Team works on development of a soft tissue 3D printer

provide an example of ASTEC's ability to create highly structured healthcare environments for competency-based assessment. We are proud to serve our pre-hospital care providers and thereby to provide a link between the pre-hospital and the in-patient care setting.

As part of the effort to become a center of innovation for the advancement of technology in healthcare, ASTEC continues to make strides by partnering with faculty and undergraduate students from the University of Arizona Colleges of Engineering. This past year, ASTEC sponsored 6 students from the College of Engineering to complete their senior design project, a semester-long project that culminated in the development of a 3D printer with soft tissue printing capabilities.

ASTEC's popularity continues to be demonstrated by the positive data generated from feedback and satisfaction surveys. We have consistently scored in the 98th percentile on anonymous feedback questionnaires and are clearly considered a favorable educational experience by all learner groups. In fact, the most consistent comment is that all current users of ASTEC would like more designated time for medical simulation education.



Completed design of a soft tissue 3D printer

OUTREACH

As part of the UAHS community outreach effort, ASTEC is making simulation technology available to students of all ages who have an interest in healthcare. We provide internship opportunities for numerous high schools throughout Tucson for students who are planning to transition to college with an emphasis in pre-health. One of the main objectives of our outreach activities is to raise health care literacy among young and underserved populations in Tucson. To achieve this goal, we work closely with the Office of Diversity Inclusion at the College of Medicine and accommodate groups of students in our lab to engage in hands-on simulation activities.

The following is a full list of regular outreach activities conducted by ASTEC:

- ▶ High School Pre-Health Fellowships
- ▶ Med-Start Summer Program
- ▶ UA Pre-Med Camp
- ▶ Camp Scrubs
- ▶ BASIS Summer AZ Telemedicine Program
- ▶ Summer Institute on Medical Ignorance
- ▶ Volunteer for Intercultural and Definitive Adventure educational series
- ▶ Summer Youth Institute
- ▶ High School Tech Educators
- ▶ Passport to High School
- ▶ Undergraduate Biology Research Program (UBRP)
- ▶ Area Health Education FHL Summer Camp
- ▶ Tohono O'odham Future Healthcare Leaders Summer Camp
- ▶ Boy Scouts of America

ASTEC continues to work closely with the Arizona Telemedicine Program (ATP) under the leadership of Ronald S. Weinstein, MD to provide educational opportunities to members of the Arizona Area Health Education Centers (AHEC) Program throughout Arizona. In the past year, ASTEC travelled to Apache Junction, AZ to lend our simulation expertise to the Greater Valley Area Health Education Center (GVAHEC). Using our low-fidelity MamaNatalie birthing mannequin and our wireless pediatric mannequin SimJunior, we conducted a birthing scenario and a pediatric cardiac arrest scenario with students from Medicine, Nursing and Public Health. GVAHEC is the Greater Valley branch of five health education centers in Arizona dedicated to recruiting and training competent health professionals to meet the growing needs in urban, underserved and rural areas. To demonstrate the potential of telemedicine in connecting rural sites with larger training centers, our training was streamed live to the Northern- and Western Arizona Area Health Education Centers (NAHEC & WAHEC), where remote attendees were able to assist with interventions and participate in the debriefing.



Working with the Arizona Health Education Center (AHEC) program, ASTEC performed simulation-training events at a rural health center that was broadcasted remotely to similar centers across Arizona

Additionally, ASTEC provides independent research opportunities for undergraduate and pre-medical students, including international student research rotations. In the past year, four former independent study students were accepted to medical school at the University of Arizona. We are proud to offer undergraduates the opportunity to conduct research and participate in creating medical simulation environments that help prepare them for medical school.

TEACHING MODULES

ASTEC continues to upgrade equipment where necessary to meet the rising demand of simulation training in medical education. This past academic year, we added several new computerized mannequins and individual task trainers for unlimited practice of routine and highly advanced medical procedures.

We acquired Laerdal's Premature Ann™ simulator, a 25-week preterm neonate mannequin, to better serve the training needs of the Acute Care Nurse Practitioner (ACNP) Simulation Training Program. We also upgraded our adult mannequin to Laerdal's SimMan® 3G Advanced Patient Simulator, the most technologically advanced simulator ideally suited for training rapid assessment of trauma emergencies. We have also replaced our birthing simulator with Lucina® from



Neonatal residents conducting intubation during a simulated code on the Laerdal Premature Anne™ patient simulator

CAE Healthcare, which is capable of functioning as both an advanced birthing mannequin as well as a non-gravid adult female mannequin.

ASTEC has been chosen by Laerdal and SonoSim as a reference site for the Laerdal-SonoSim Ultrasound Solution, a new innovative line of "wearable skins" with ultrasound capabilities that is used with Laerdal's SimMan® 3G. This technology will now allow us to include diagnostic ultrasound with pathological findings, such as a FAST exam, into full-scale simulations.

In an effort to enhance ultrasound training for medical students, ASTEC was awarded a grant from the University of Arizona IT Student Advisory Board to purchase the SonoSim® Ultrasound Training solution. This system is an ultrasound simulator with a laptop computer-based platform that allows a learner to scan and recognize real patient pathology. The machine can be used with real patients as well as with computerized mannequins. As such, it can be easily integrated into a clinical training scenario in which imaging is required to establish a medical diagnosis. We plan on using this technology to train medical students and residents to improve their diagnostic skills and clinical decision-making.

Funding was also provided by the University of Arizona IT Student Advisory Board to purchase a Simulab Paracentesis task trainer. This trainer is ultrasoundable and allows users to perform the procedure from diagnosis to draining simulated ascetic fluid from the peritoneal cavity.

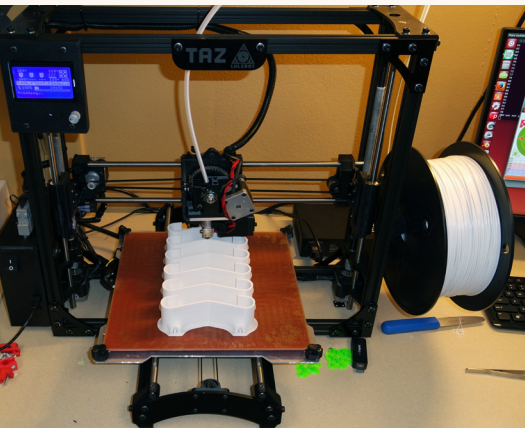
Finally, ASTEC has upgraded its Fundamentals of Laparoscopic training stations by purchasing the latest trainer box model along with an individualized mobile cart for each. This will enhance our capabilities for preparing general surgery residents for their standardized testing with the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES).



General Surgery Residents practicing the tasks that are part of Expert Laparoscopic Surgery Project

ARTIFICIAL TISSUE DESIGN

Ongoing is ASTEC's research to develop and perfect synthetic materials for surgical dissection, intravenous therapy, high-risk invasive medical procedures, and microsurgery simulation. The lab was designed to efficiently integrate development and production, furthering our mission of creating cost-effective, highly realistic training models. This mission has been strengthened in the last year by the opening of



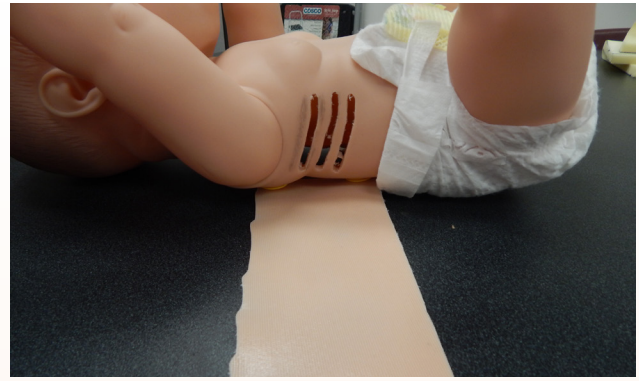
Printing multiple suture pad chassis in ASTEC's 3D printing lab



Creating a large intestine model in ASTEC's artificial tissue laboratory

create medical training devices that allow trainees to practice medical procedures in a risk-free environment.

In the past academic year, we have developed several new artificial tissue models and upgraded existing ones for human factors research and for regular use in medical simulation training.



A supine-lateral view of ASTEC's pediatric thoracostomy model

The following is a complete list of artificial tissue models developed by ASTEC since our opening in 2005:

- ▶ Adult and pediatric peripheral intravenous access
- ▶ Umbilical cord venous access [UPGRADED]
- ▶ Adult and pediatric chest tube [UPGRADED]
- ▶ Tibia compound fracture with arterial bleeding
- ▶ Uterus with ectopic pregnancy
- ▶ Various wounds and lacerations
- ▶ Bifurcation of common carotid artery
- ▶ External carotid to internal carotid bypass
- ▶ End-to-side anastomosis
- ▶ Bowel anastomosis [UPGRADED]
- ▶ Silicone wound models with pressurized blood perfusion [UPGRADED]
- ▶ Adult silicone trachea
- ▶ Pediatric silicone trachea
- ▶ Extracorporeal membrane oxygenation (ECMO) model
- ▶ Cesarean section (C-section) model
- ▶ Intravenous (IV) access tissue pad [UPGRADED]
- ▶ Abscess model
- ▶ Burned skin model [UPGRADED]
- ▶ Congenital adrenal dysplasia model
- ▶ Adult intraosseous placement model
- ▶ Jugular vein distention model
- ▶ Ultrasoundable pericardiocentesis model [NEW]
- ▶ Pericentesis model [NEW]
- ▶ Ultrasoundable peritonsillar abscess model [NEW]

RESEARCH

This past year, ASTEC achieved accreditation from the Society for Simulation in Healthcare (SSIH) in the areas of Research, Assessment, Systems and Integration. We have continued to develop our research facilities while creating new partnerships with internal academic partners at the University of Arizona and partners from the private sector invested in advancing medical education and training through simulation. ASTEC has initiated a number of new research initiatives while continuing to pursue ongoing projects.

SURGERY

Foveated Endoscope

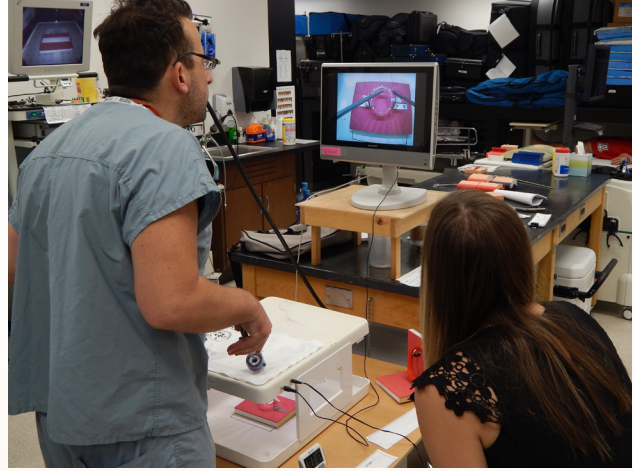
Working with Hong Hua, PhD from the College of Optical Sciences on an NIH-funded project, ASTEC is testing a new foveated endoscope, a camera used in minimally invasive surgery to visualize the surgical working space. The camera has the ability, via a high-magnification fovea, to preferentially zoom on specific anatomical structures while maintaining the overall panoramic view of the working space. This allows surgeons to obtain high visual magnification while still maintaining their peripheral vision. We hypothesize that this will both reduce the number of camera manipulations required during a procedure and also prevent inadvertent collisions of instruments with structures in the peripheral field not visible with current cameras on high magnification. ASTEC is working with graduate students from the University of Arizona College of Electrical Engineering to design a simulated surgical platform with obstacles that will test the ergonomic advantages of the foveated endoscope.

Computer Assisted Surgical Trainer (CAST)

Jerzy Rozenblit, PhD, head of the Model Based Design Laboratory at the College of Electrical and Computer Engineering has secured a National Science Foundation (NSF) grant to continue our collaborative work to design a Computer-Assisted Surgical Trainer. The objective of the next phase of development will be to design and implement an intelligent, adaptive guidance controller for surgical space navigation and to implement visual guidance techniques through augmented reality. The ultimate vision of our team is to create a smart training environment that will promote surgical training through haptics-based guidance of optimal instrument movement.

Expert Laparoscopic Surgery Project

Working with Iman Ghaderi, MD, MSc, ASTEC has begun to assist with the design and validation testing of six new advanced laparoscopic tasks to be implemented alongside of the existing Fundamentals of Laparoscopic training curriculum for general surgery residents. The curriculum is composed of more complex laparoscopic tasks that require a higher level of skill to raise the standard of simulation training in the General Surgery residency.



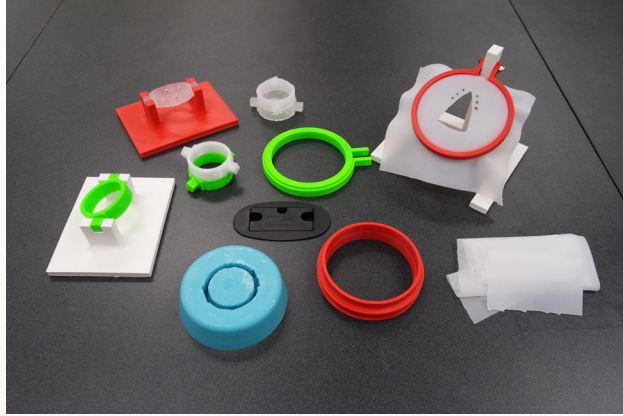
General Surgery Chief Resident performing laparoscopic procedures to assist in validation of the tasks for the Expert Laparoscopic Surgery Project

Artificial Tissue 3D Printing Laboratory

With financial support from the University of Arizona IT Student Advisory Board, ASTEC has opened a designated space in the College of Medicine for a 3D printing laboratory equipped with a LulzBot TAZ 5 printer and a NextEngine 3D Laser Scanner. The lab was opened as an effort to promote collaborative work between the Colleges of Engineering and Medicine. Along with our fully-equipped artificial tissue lab, the addition of the 3D printing lab now allows us to centralize our design process from computer-aided design (CAD) of new training models, to 3D printing of tissue molds, and lastly to creation of soft-tissue silicone anatomic models. In its first 3 months of operation, undergraduate engineering students have worked with medical students, residents and ASTEC staff to create a collection of new training models for research and training purposes that are now being regularly used in our lab. These include a heart model designed for US-guided pericardiocentesis, an umbilical venous catheter model, a pediatric chest tube chassis, a microsurgery tool kit for practicing microsurgical techniques, and a suturing jig that accommodates our customized bleeding suturing pad.



ASTEC's umbilical venous catheterization model, which has a built in fluid reservoir



Various laparoscopic advanced task models created in the ASTEC 3D Printing Lab

The suturing jig is part of the design efforts of 2 undergraduate Engineering students from the University of Arizona to develop a portable suture evaluator for training medical students. The objective of the project is to create a portable, low-cost trainer that will provide objective feedback to students on their suturing technique, including the spacing and alignment of their stitches in both interrupted and uninterrupted sutures. This project demonstrates the integration of computer hardware and software design with artificial tissue models that has become to embody the research mission of ASTEC. It will provide us with measurable outcomes and give us further insight on how to best train our medical students.



Mass production of ASTEC's bleeding tissue models

This project demonstrates the integration of computer hardware and software design with artificial tissue models that has become to embody the research mission of ASTEC. It will provide us with measurable outcomes and give us further insight on how to best train our medical students.



Emergency medicine residents practicing lateral canthotomy, a collaborative with SynDaver™ Labs comparing synthetic versus porcine models



Partnerships

ASTEC has continued its research partnerships with SynDaver Labs in our mutual dedication to developing real-life artificial tissue models to replace the use of cadaveric models. Last year, in collaboration with Dr. Vivienne Ng, Assistant Professor and Director of Emergency Medicine Simulation, ASTEC tested a new lateral canthotomy model in a direct comparison with traditional porcine models. ASTEC and SynDaver were also awarded a Department of Defense (DOD) Simulation and Training Engineering Services (STES) grant in collaboration with Cole Engineering Services, Inc. to design and test a novel chest tube model for training military personnel in management of acute combat-related chest injuries.

ASTEC has been designated as 1 of 4 control sites for the national Leadership Education Advanced During Simulation (LEADS) study funded by the Agency for Healthcare Research and Quality, US Dept. of Health and Human Services. The study, designed by Oregon Health Sciences University in Portland, Oregon and facilitated at ASTEC by Vivienne Ng, MD examines the potential role of medical simulation in promoting leadership skills in resident physicians in Advanced Cardiovascular Life Support (ACLS) resuscitation scenarios.



Birthing simulation using Laerdal's MamaNatalie®



Conceptual design of the SimDeck in the simulation center for the Health Sciences Innovation Building scheduled for third quarter 2018

FUTURE INITIATIVES

ASTEC is excited to announce the construction of a new Health Sciences Innovation Building (HSIB) with over 35,000 ft² designated for simulation training, research and development. The building is scheduled to open in 2018-2019 and will feature innovative learning spaces including newest developments in virtual reality simulation to create the most realistic learning environment for our healthcare trainees. We have witnessed an exponential growth in training commitments especially in post-graduate medical education as Banner Health has made it a priority to use simulation to teach its residents and faculty. It is our mission to provide the best training opportunities to all members of the University of Arizona Health Sciences.



Utilizing virtual reality technology with Oculus Rift to explore human anatomy

In light of the national trend towards a more compact medical school curriculum, ASTEC is being tasked with providing recommendations how best to incorporate simulation training into the student curriculum to prepare them for their clinical clerkships. We are exploring ways in which a longitudinal simulation curriculum consisting of practical training can be aligned with classroom learning to both enhance student understanding of basic science concepts and facilitate their transition to a clinical setting in a shorter period of time.

Likewise adding to our educational mission, ASTEC will be hosting simulation fellowship positions in Emergency Medicine and Pulmonology this coming year. We are excited to train future educators in our field.

ASTEC is looking to expand its use of 3D technologies in medical simulation training through the construction of a 3D Visualization Bioinnovation Lab that may, in the near future, serve to provide more realistic virtual reality environments for training our medical students and residents.

Responding to student requests for certification classes in Basic Life Support (BLS), Advanced Cardiovascular Life Support (ACLS), and Pediatric Advanced Life Support (PALS), ASTEC is in the process of acquiring certification as a teaching facility and will begin offering courses to students starting in 2017.

PUBLICATIONS

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Amini R, Kartchner, JZ, Stolz L, Biffar DE, Hamilton AJ, Adhikari, S., A novel and inexpensive ballistics gel phantom for ultrasound training. *World J Emerg Med* 2015;6(3)

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ORAL PRESENTATIONS

Hamilton AJ (Invited Speaker), "The Clinical Lightness of Being: How to Find Enlightenment While Shadowing on the Wards," Class Year I and II University of Arizona Health Sciences, May 20, 2016

Hamilton AJ (Invited Speaker), "How Can We Begin to Apply Simulation to Spinal Surgery" Clinico-Pathological Conference, Mayfield Clinic-Cleveland Clinic Winter Clinics for Cranial & Spinal Surgery, Aspen, CO, February 25, 2015

Hamilton AJ (Keynote Speaker), "The Mystery of Memory: A Personal Perspective from the Cellular to the Corporate," Annual Meeting of the Medical Institute for Innovation (MI2), Hyatt Hotel, Bethesda, Maryland, Oct. 12, 2014

Biffar D. "Surgical Navigation Pointer facilitates Identification of Targets in a Simulated Environment," "Video-guided vs. Direct laryngoscopy: Considerations for using Simulation to Teach Inexperienced Medical Students." 2014 Summer Simulation Multi-Conference, The Society for Modeling & Simulation International, Monterey, CA, July 6-10, 2014

Hamilton AJ (Keynote Address), "The Future of Medical Innovation," Canadian College of Medicine Annual Meeting, Phoenix Grand Hyatt, Phoenix, AZ, April 30, 2014

Grisham L, Biffar D. "How mobile can you go? Making the most of your patient simulator outside of the training facility. Human Patient Simulator Network World Conference, San Francisco, CA, Jun. 30-Jul 2. 2013.

Biffar D. "Novel Cardiothoracic Trainer to Improve Interprofessional Education (IPE) during Robotic Surgery," Research Presentation, International Meeting for Simulation in Healthcare, Orlando, FL, Jan. 26-30, 2013.

Biffar D, Hamilton AJ, "Playing Frankenstein: Make Artificial Tissue Come to Life!" 13th International Meeting on Simulation in Healthcare, Orlando, FL, Jan. 26-30, 2012. Biffar D (Invited Speaker), "Bringing Simulation to the Customer: That's How We Roll," Western Regional Human Patient Simulation Network – HPSN, Phoenix, AZ, Nov. 8-9, 2012.

Hamilton AJ (Keynote Address), "Simulation: Training for Moments When Humans Break Down," 3rd Biennial Interprofessional Educational Conference, Collaborating Across Borders III, Tucson, AZ, Nov. 20, 2011.

Hamilton AJ (Keynote Address), "Building a Simulation Think Tank to Improve Regional Health Care," Mayfield Clinic-Cleveland Clinic Winter Clinics for Cranial & Spinal Surgery, Aspen, CO, Feb. 28, 2011.

Hamilton AJ (Invited Speaker), "Code Blue: Can Technology Save Us from a Tidal Wave of Medical Errors?" Healthcare Information and Management Systems Society, Elsevier Healthcare, Orlando Convention Center, Orlando, FL, Feb. 21, 2011.

Hamilton AJ, Jarred J, Biffar DE, "Seizing the Moment: A Step-by-Step Approach to Epilepsy Simulation," Siemens Innovations 2010, Orlando, FL, July 30-31, 2010.

Hamilton AJ, Jarred J, Biffar DE, "Responding to Contrast Reactions: Everyday Occurrences and Unforgettable Complications," Siemens Innovations 2010, Orlando, FL, July 30-31, 2010.

POSTERS AND ABSTRACTS

Prescher, H., Ng, V., Biffar, D., Barbosa, A., Hamilton A.J. "Development of an Ultrasound Pericardiocentesis Model for Simulation Training." 17th International Meeting on Simulation in Healthcare, Jan. 18-31, 2017

Ng, V., Prescher, H., Reid, S., Biffar, D.E., Hamilton A.J. "A Comparison of Porcine and Synthetic Models for Lateral Canthotomy and Cantholysis." 16th International Meeting on Simulation in Healthcare, Jan. 16-20, 2016

Lovett M.K., Reid, S., Prescher, H., Biffar, D.E., Fiorello, A.B., Hamilton A.J. "Development and testing of a thoracostomy assessment tool through self, peer, and expert evaluation in a simulation environment." 16th International Meeting on Simulation in Healthcare, Jan. 16-20, 2016

Frazier A, Prescher H, Biffar D, Hamilton AJ. "Using rotational casting techniques to create hollow viscous organs." 14th International Meeting on Simulation in Healthcare, Jan. 25-29, 2014

Prescher H, Dreifuss B, Biffar D. "Developing a novel drain loop abscess model for training intern ED residents." 14th International Meeting on Simulation in Healthcare, Jan. 25 - 29, 2014

Prescher H, Biffar D, Tomasa L, Berg M, Grisham L, Mathesen Y, Theodorou A, Hamilton AJ. "A seven-year Collaboration between 3 Colleges to learn interprofessional skills during a CPR team behavior simulation." 14th International Meeting on Simulation in Healthcare. Jan 25-29, 2014

Grover E, Mosier J, Sakles J, Prescher H, Biffar D, Stolz U. "Telepresent intubation instruction is as effective as in-person when instructing naïve intubators." 14th International Meeting on Simulation in Healthcare, Jan. 25-29, 2014

Prescher H, Grisham L, Biffar D, Tomasa L, Theodorou A, Berg M, Hamilton AJ. "Breaking barriers in medical education: The impact of interprofessional cardiopulmonary resuscitation training. Annual AAMC Research in Medical Education (RIME) Conference, Philadelphia, PA, Nov. 4, 2013.

Prescher H, Biffar D, Hamilton A, "The Comparison of High-Definition versus Stereoscopic Display on Standardized Laparoscopic Skill Procedures," 13th International Meeting for Simulation in Healthcare, Orlando, FL, Jan. 26-30, 2013.

Livingston J, Grisham L, Prescher H, "Using Tablet Computers to Facilitate Learner-directed Group Debriefings in Neonatal Resuscitation Program (NRP) Simulation," 13th International Meeting on Simulation in Healthcare, Orlando, FL, Jan. 26-30, 2013.

Biffar D, Poston R, Prescher H, Hamilton A, "Using Interprofessional Education to Improve Robotic Cardiothoracic Surgery Training," 13th International Meeting on Simulation in Healthcare, Orlando, FL, Jan. 26-30, 2013.

Souza A, Biffar D, Hamilton A, "Future Trends in Design of Clinical Simulation Facilities – Maximum Utilization through Minimalist Design," Association of American Medical Colleges (AAMC) Annual Meeting, San Francisco, Nov. 3, 2012.

Biffar D, Jarred J, Prescher H, Culliney S, Grisham L, Hamilton A, "Improving Quality of Care by Training First Responders with High-Fidelity Medical Simulations: A Collaboration between Arizona Simulation Technology and Education Center (ASTEC) and Northwest Fire District (NWFD)," 39th Annual Arizona Rural Health Conference, Tucson, AZ, Sept. 24, 2012.

Grisham L, Thompson J, "Construction of a High-Fidelity, Reusable Model for Neonatal ECMO: Video Presentation," 3rd Joint Meeting, Congenital Heart Surgeons' Society and European Congenital Heart Surgeons Association, Chicago, IL, Sept. 12-15, 2012.

Livingston J, Grisham L, Prescher H, "Impact of iPad-Supported Formative Self-Assessment on Accuracy and Quality of Debriefing in High-Fidelity Neonatal Resuscitation Simulation," Medical Educational Research Day, Tucson, AZ, June 5, 2012.

Grisham L, Thompson J, "Extracorporeal Membrane Oxygenation (ECMO) Simulation in the PICU: Video Presentation," 12th International Meeting on Simulation in Healthcare, San Diego, CA, Jan. 27-Feb. 1, 2012.

Grover E, Mendelson J, Valdez S, Hamilton AJ, Biffar D, Jarred J, Theodorou AA, Grisham L, Prescher H, "IPE PICU Simulation Program," 12th International Meeting on Simulation in Healthcare, San Diego, CA, Jan. 27-Feb. 1, 2012.

Biffar D, Hamilton AJ, Jarred J, Prescher H, Grisham L, Brooks A, Meinke L, "For the Inexperienced, Video Laryngoscopy Is Superior to Direct Laryngoscopy for Airway Management Training," 12th Annual International Meeting on Simulation in Healthcare, San Diego, Jan. 27-Feb. 1, 2012.

Theodorou AA, Hamilton AJ, Berg, Tomasa L, Michaels C, Coleman N, Murphy J, "CPR Simulation: Active Learning about Team Roles and Communication." 3rd Biennial Interprofessional Educational Conference, Collaborating Across Borders III, Tucson, AZ, Nov. 2011.

Feng C, Rozenblit JW, Hamilton AJ, "Is the Dominant Hand Always Better in Minimally Invasive Surgery? A Computerized Hand-Eye Coordination Training Experiment," 11th Annual International Meeting on Simulation in Healthcare, Phoenix, AZ, Jan. 23-27, 2010.

Feng C, "Usability Study of Computerized Surgery Training and Assessment System," 17th Conference on Medicine Meets Virtual Reality, Long Beach, CA, Jan. 2009.



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