

17 teams from 12 different medical schools across the country. During the 2017 AIUM Annual Convention 23 teams from 17 schools participated. A third SonoSlam © competition is scheduled for the 2018 AIUM Convention with a limit of 30 teams.

SonoSlam© is an annual national medical student competition designed as a way to promote ultrasound education within the undergraduate medical community. This is the first description of an event of this scale to include ultrasound education, gaming, and competition among medical students in the United States.

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Title: SonoSlam© : A National Point-of-Care Ultrasound Competition for Medical Students

Short Title: SonoSlam©

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## Introduction

Gaming is a teaching concept that is gaining momentum in the medical education community. Gamification events motivate asynchronous self-study of ultrasound, evidenced by the narrative comments received from the survey. Students and faculty from different specialties and multiple varied institutions found value from this platform to exchange content, discuss curricula, highlight obstacles to implementation, and share success stories. These fun educational gaming events remove barriers that may exist in the traditional curricular setup. Medical educators traditionally use passive methods for content dissemination via textbooks, teacher-driven lectures, viewing of online screencasts, and testing of knowledge retention. Recent studies of adult learners suggest that these may not be the optimal means for educating this population<sup>1-4</sup>. As technology increases access to information, so too does the volume of content a medical student receives. How does an educator combat the challenge of delivering more content within an increasingly burdened curriculum? Recent approaches have relied upon students' independent and blended learning through asynchronous learning tools and a "flipped classroom" structure to cover advanced exploration or skill practice during actual class time. These methods still incorporate a degree of passive learning, while adult learners benefit more from active engagement<sup>5-7</sup>. The incorporation of game-playing to introduce and solidify new medical skills can address these challenges.

The movement to implement point-of-care ultrasound (POCUS) as a core skill for medical students began in 2006. POCUS use has been shown to be a feasible method of integrating basic science teaching, while simultaneously augmenting physical

examination performance, and clinical reasoning through active hands-on ultrasound scanning<sup>8-13</sup>. Although relatively simple to understand, ultrasound requires a new set of spatial orientation and proprioceptive skills. It also requires deliberate practice. The integration of POCUS into longitudinal medical curricula is still young<sup>14-17</sup>. No standardized methodology to POCUS training currently exists. Each medical school takes different approaches using faculty from varied specialties. The concept of developing a contest with students from across the country highlights the enthusiasm for learning POCUS, the strength of faculty collaboration, and the increasing extent of gamification in medical education.

The Ultrasound Challenge was the first documented ultrasound competition among medical students at a single institution. The Ultrasound Challenge 2.0 described ultrasound competition from multiple medical schools.<sup>22, 23</sup> Emergency Medicine developed a specialty-specific ultrasound competition in 2011 called SonoGames®, which targeted the graduate medical education level. Since then, this annual event has attracted participants from over 50% of Emergency Medicine residency programs. Subsequently, residencies started incorporating similar competitions into their weekly didactics, then local medical student competitions called “Ultrafests,” “SonoCups,” or “Sono-Olympics” began appearing across the nation<sup>22-25</sup>.

SonoSlam© was developed as an annual national medical student competition to promote POCUS to the undergraduate medical community in a friendly academic environment.

## Planning

The SonoSlam© Executive Committee is a multispecialty committee composed of experienced ultrasound faculty from across the country. Many have developed their own regional ultrasound events or helped design national events. Seven vendors provided ultrasound equipment. Appendix \_A\_ provides a list of SonoSlam©'s sponsors. The Executive Committee received IRB-exempt approval to evaluate this event through The Ohio State University.

**Recruitment:**

Student participants were invited through the National Ultrasound Student Interest Group (NUSIG) listserv and website communications, the AIUM member listserv, website announcement, and letters to medical school leadership. SonoSlam© was also promoted through social media and by word-of-mouth. Volunteer models for the stations were recruited in similar fashion. Proctors from AIUM membership represented faculty from emergency medicine, internal medicine, radiology, pediatrics, critical care, neurology, and sonographers. Preparation materials and instructions were sent to all faculty proctors ahead of time. This allowed standardization of teaching among the stations.

In 2016, 17 teams from 12 medical schools competed. Each team consisted of 3 students. In 2017, 23 teams representing 17 schools competed (Appendix B). Students in both pre-clinical and clinical years participated and completed post event surveys (Appendix C) with free text comments displayed in Appendix D and specific survey results in table in Appendices E and F.



## Event Layout

### Round 1:

The Executive Committee designed a series of stations that combined open-ended, quiz-style questions with hands-on ultrasound scanning based on anatomic regions.

The stations were chosen to appeal to a student's broad range of knowledge in preclinical years, as well as multiple specialists' fields of expertise. Questions targeted basic science elements and physical exam correlations that students encounter in the pre-clinical component of their education. Topics included: Physics & Knobology, Head and Neck, Cardiac, Aortic, Musculoskeletal, Hepatobiliary, Renal and Obstetrics & Gynecology. Final questions for each station were peer-reviewed and selected using an iterative Delphi process. This first round was modified in the second year of the event based on participant feedback. In a survey following the initial event students requested to have a scored hands-on component to Round 1. Content was also adjusted to reflect appropriate level of difficulty for their level of training. In the second year, students earned points for scanning ability. Judges had a Google™ form with knowledge based questions as well as scanning tasks. The scanning tasks were scored as correct or not. Judges were given guidance as to what entailed a correct scan to minimize inter-rater variability amongst judges. In the second year teaching was done via scheduled station debriefs.

In the 2016 competition, teams were given a 5 question knowledge assessment via Google Form© on their phones. Following this, station faculty led them through a series of 15-minute hands-on educational scanning sessions augmented by brief PowerPoint

presentations. The scanning component was not graded, but proctors took note of particular students and teams who displayed image acquisition prowess or proficiency with advanced concepts. This portion was modified in 2017 so that teams rotated every 15 minutes through each station without a PowerPoint presentation. Teams were graded by a combination of correct answers provided during the quiz portion of the station (Fill in the blank questions) and completion of scanning tasks. Point totals were tabulated in real time using a Google Form® platform designed to calculate team scores. Once scores were submitted, expert proctors reviewed the quiz answers with the teams and offered feedback on their scanning techniques.

In the first year of this event, round 1 was used to eliminate a portion of the teams. In 2017 all teams progressed to Round 2.

### **Round 2:**

Round 2 tested hands-on skills in a head-to-head series of five game stations. These stations incorporated clinical scenarios that were designed to match and evaluate students' progression into the MS3 and MS4 years. Each station required scoresheets that totaled up to 100 points, with specific instructions given to station proctors to ensure consistency in scoring. Teams received 3 minutes of station explanation and rules, 15 minutes of competition time, and 2 minutes for debrief before rotating to the next station. In each station, the students rotated responsibilities to avoid one student performing all the scans.

**2016**

### Station 1: *SonoSkeleton*

One team member blindly chose a ping pong ball labeled with an anatomic structure out of a bucket that held 100 labeled balls. A second team member had to accurately scan the structure on the volunteer model. The third team member assisted in directing the scanner. Each accurately identified structure was worth 1 point.

### Station 2: *Help! I need a doctor...or a medical student*

This station utilized the SonoSim™ LiveScan product, with 5 clinical scenarios (20 points each) representing patients in shock created by the company specifically for SonoSlam©. They created a scoreboard divided into 3 columns: Diagnosis, Ultrasound Pathology, and Treatment. Students attached flashcards to the scoreboard matching correct diagnoses with preprogrammed pathology (found by SonoSim™ probe detection of RFID tags affixed to a volunteer model) and treatment plans. Points were awarded for each correct matching scoreboard placement.

### Station 3: *A pain in my belly*

Team members needed to correctly identify abdominal anatomy and pathology shown on PowerPoint slides, characterize images as normal or pathologic, and finally scan the appropriate structure on the volunteer model. Ten case-based scenarios (10 points each) were created that required structure identification, image acquisition, and image interpretation.

### Station 4: *The nerve of these people!*

6 clinical scenarios (15 points each) described patients suffering specific injuries that required nerve blocks for analgesia. Team members received points for correctly naming the nerve that needed to be blocked for each case, describing the dermatomal distribution of that nerve, and identifying the approach to performing the nerve block. An additional 10 points were awarded if each member of the team successfully simulated a nerve block using a low fidelity model (linguine noodles placed in tofu).

Station 5: *The land down under*

The MedaPhor™ Scantrainer, a haptic transvaginal pelvic simulator device, tested students on 2 computerized cases. The first case detailed a pathologic obstetrics case, and the second focused on non-pregnancy gynecologic pathology. Each case consisted of 10 tasks that included proper insertion and positioning of the endocavitary probe, identification of relevant structures, and identification of pathologies. Each correctly completed task was awarded 5 points, for a total of 50 points per case and 100 points per station.

**2017**

As in 2016 there were 5 stations in Round 2.

Station1: SonoMini

This station used the SonoSim™ LiveScan product, with 5 clinical scenarios (20 points each) representing pediatric patients created by the company specifically for SonoSlam©. They created a scoreboard divided into 2 columns: Diagnosis and Treatment. Students were given a stem and were tasked with scanning to identify

pathology (found by SonoSim™ probe detection of RFID tags affixed to a volunteer model) and then to state the indicated treatment plan. Points were awarded for each correct matching scoreboard placement.

#### Station 2: *SonoCharades*

This station divided the team into 3 individual roles. One member was given a structure or a clue about a structure. They would acquire the image and other members had to guess what the target structure was based on a saved image without being able to point or give any further clues. The scanner was not able to talk or gesture but rather merely improve the image to facilitate the correct answer being guessed. Points were awarded for correct answers.

#### Station 3: *Hit or Miss*

Using a simulator provided by Kyoto Kagaku America, Inc. and homemade phantoms, the students had to scan and identify the foreign bodies and lesions. The other team members then needed to biopsy the sample in plane and out of plane. In the homemade phantom, team members had to find foreign bodies representing ultrasound artifacts of shadowing and reverberation. Teams received bonus points for correctly identifying the foreign body.

#### Station 4: *Put me in Coach*

This station focused on musculoskeletal pathology. In this station, student 1 would review an ultrasound clip of a particular pathology and identify the pathology. Student 2 was then responsible for identifying the normal version of the pathology on a model.

Student 3 demonstrated a physical exam maneuver to assess for the pathology. Students rotated through roles.

#### Station 5: *US Password*

This station assessed communication skills and ultrasound knowledge. Student 1 selected a slip of paper with an ultrasound structure (i.e. transverse proximal aorta). Student 2 was a blindfolded sonographer. Student 1 had to give clues to Student 2 (blindfolded sonographer) and Student 3 without naming the structure or saying “forbidden words” mentioned on the slip of paper. Once the structure was correctly identified, Student 3 had to give instructions to Student 2 (blindfolded sonographer) to obtain the structure on the model. Student 3 had to freeze the image once they felt they had the correct image. Students rotate with each new image.

The 2 teams with the highest scores after Round 2 advanced to the Final Round 3.

#### Round 3

Round 3 began with a “peel and reveal” tile game, in which a short case scenario was verbally delivered to the teams while its accompanying ultrasound clip was displayed on a screen visible to both teams. Small obscuring squares covered the image and were slowly removed in random order. The first team to correctly identify the image was awarded points dependent on the number of remaining tiles. There were 10 cases for the “peel and reveal” game; additional bonus points were awarded after each case to the team that correctly answered corresponding clinical management questions.

Round 3 ended with a “scan off” in which a member from each team entered a concealed area to demonstrate a specific structure on a live model. Models were matched by ultrasound faculty for body habitus and sonographic windows. The audience was blinded to the teams scanning and was polled to determine which scan was most accurate. The student that performed the more accurate scan won points for his or her team. The team accruing the most points at the end of Round 3 became the overall winner of SonoSlam.

#### Sonologist:

In addition to the team awards, individual scanning ability was recognized. Throughout the event, 4 unidentified experts circulated the room watching teams scan. These experts noted participants that consistently demonstrated excellent scanning techniques (good hand position, grip, anchoring, draping, and probe manipulation) and repeatedly acquired high quality images (appropriate probe, mode, depth, gain, centering of key structures). These 4 expert judges compared their results to establish which student would win the SonoSlam© Sonologist Award.

#### Summary

SonoSlam© is a multispecialty ultrasound competition for medical students. It proved to be a feasible and successful method of stimulating interest in medical school ultrasound and encouraging lifelong learning habits through active participation. During this one-day event, students reported improved confidence in general knowledge, image acquisition and overall performance including clinical management decisions. These techniques allowed students to delve into subject material that was completely novel to

them. As technological advancements increase accessibility to point-of-care ultrasound education at student and faculty levels, events like SonoSlam© bridge knowledge and skill gaps in enjoyable ways.

The third SonoSlam© event will be held March 24, 2018 at the AIUM Annual Meeting in New York City. Future efforts will focus on sustainability of this event and streamlining of logistic processes involving vendor support, funding, faculty support, space, and financial burden on students for travel and participation. The committee also plans to host a networking event for students and faculty in addition to a one day ultrasound “boot camp” the day after the event. This event will allow students to review content from the competition and attend lectures on implementation of ultrasound into curricula and hands on sessions on clinical applications. In addition, the committee hopes to measure the objective impact events like these have on knowledge acquisition, technical skill improvement, and information retention though the means of doing this has yet to be established. Finally, the national scalability of the SonoSlam© event and its effect on expansion of ultrasound teaching and standards of teaching will be surveyed.

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