SonoGames

An Innovative Approach to Emergency Medicine Resident Ultrasound Education

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SonoGames was created by the Academy of Emergency Ultrasound for the 2012 annual meeting of the Society for Academic Emergency Medicine. The assessment of resident knowledge and of the performance of point-of-care ultrasound examinations is an integral component of ultrasound education and is required in emergency medicine residency training. With that in mind, game organizers sought to assess and improve emergency medicine residents' point-of-care ultrasound knowledge, hands-on skills, and integration of knowledge into clinical decision making. SonoGames is an annual 4-hour competition consisting of 3 rounds. In this article, we provide a description of SonoGames and provide a blueprint for an effective and successful educational event.

Key Words—clinical sonography; medical education; point-of-care ultrasound; SonoGames; ultrasound education

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Abbreviations
AEUS, Academy of Emergency Ultrasound; SGOC, SonoGames Organizational Committee

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History and Educational Theory Behind the Games

For more than 2 decades, the specialty of emergency medicine has used point-of-care ultrasound as a key modality for patient care. It is now considered a core competency for residency training.[1–4]

Meeting the Accreditation Council for Graduate Medical Education Milestone competency for point-of-care ultrasound requires not only resident education but also knowledge and performance assessment.[5] Such competency evaluation requires multiple assessment methods.[6,7]

Higher-level assessments become more complex and involve evaluating the effective transition of knowledge recall into performance. It is at this level that competency assessments can begin and learners move past the purely cognitive elements of fact recall and on to the application. Residents must demonstrate their ability to perform and interpret point-of-care ultrasound examinations as they apply previously acquired knowledge.[3] Simulation has been an effective educational tool for teaching learners the application of knowledge and skill and can be used to assess learner competency in point-of-care ultrasound.[8–11]

In May 2011, the Ultrasound Interest Group of the Society for Academic Emergency Medicine became the Academy of Emergency Ultrasound (AEUS). To advance ultrasound education in a novel and interactive way, the new academy leadership organized and designed an event with varying educational assessments and friendly competition.

Content for the various learning and game formats of SonoGames was selected from many sources. These included but were not limited to textbooks of emergency ultrasound, online lectures, online question banks, as well as individually created questions. Leaders derived ideas for the event layout and stations from games held at committee members' home institutions and from papers describing similar events.[12] This article provides a description of SonoGames and a blueprint for an effective and successful educational event.

Preparation

Twelve months before the SonoGames, a 5-person SonoGames Organizational Committee (SGOC) was formed. This committee developed the structure of the 3-round, 4-hour event. Table 1 provides an overview of the 3 rounds.

Participants

All US allopathic emergency medicine residencies were invited to participate. Event advertisements and team registration information were announced through emergency medicine and emergency ultrasound organizational websites, newsletters, and listservs. Each residency could enter a team of 3 residents with 1 faculty captain. The faculty captain prepared the team for the event but did not participate in the competition. Once teams were registered, all received an e-mail primer with ground rules and game day expectations.

SonoGames Content, Testing Strategy, and Educational Interventions

The tenet of point-of-care or emergency ultrasound involves the clinician performing an ultrasound examination at the bedside, interpreting the images, and immediately implementing this into clinical decision making. SonoGames was intentionally designed to assess all aspects relevant to emergency medicine.

Structure of the Event

Round 1

A resident's fund of knowledge, or simple fact recall, can be assessed through the use of of peer-reviewed questions. This is a well-known, accepted, and validated format.[6] Questions were grouped according to increasing levels of difficulty, worth 30, 40, or 50 points. Turning Point Technologies (Youngstown, OH) audience response software with radiofrequency audience response cards was used. A Keynote (Apple Inc, Cupertino, CA) presentation integrated with the audience response system formed the Round 1 format. An emcee on stage hosted the event. Participants were shown an ultrasound image or video clip followed by a multiple-choice question with 5 possible answers. Teams were given 20 seconds to respond. Faculty emcees discussed the correct answer with the audience, including relevant teaching points. Scoring was in real time with immediate results at the end of the round. In the event of a tie, the faster time to answering was used as a tiebreaker. Questions generally fell into one of the following categories:

1. *General knowledge*—tested general ultrasound principles; an image was not necessarily needed.
2. *Technical*—asked participants to determine probe orientation based on an image, to identify anatomy, or to determine whether an image met criteria for interpretation.
3. *Diagnostic*—required participants to make a diagnosis based on an image and clinical scenario.
4. *Management*—asked participants to determine the next step in management given a clinical scenario and ultrasound image.
5. *Evidence-based*—assessed knowledge of best practice based on current and landmark literature.

Round 2

In the first year, 5 teams advanced from Round 1. Based on postevent evaluations, the SGOC increased this to 10 teams for the second year. Figure 1 describes how double the number of teams was accommodated in the same amount of time.

Table 1. Overview of the Educational Structure of SonoGames

Round	Format	No. of Teams Participating	Duration, min
1	Slide presentation of multiple-choice questions; audience members compete with audience response cards	38 in 2012 39 in 2013	60
2	5 stations involving hands-on ultrasound-related challenges	Top-performing teams from round 1: 5 in 2012; 10 in 2013.	100 (20/station)
3	A 2–3-part head-to-head game show–style event	Top 2 performing teams from round 2	30

Round 2 provided live scanning challenges using human and simulation models. A standardized 20-minute format was used at each station: 3 minutes for an introduction describing the rules of the task, 12 minutes for task completion, and 3 minutes of didactic instruction and debriefing. At 2 minute intervals, teams rotated.

During the debriefing session, 1 or 2 moderators and 1 or 2 judges assigned to the station provided direct, personalized feedback to educate the teams. This type of real-time feedback on directly observed performance was considered to have high-yield learning potential.

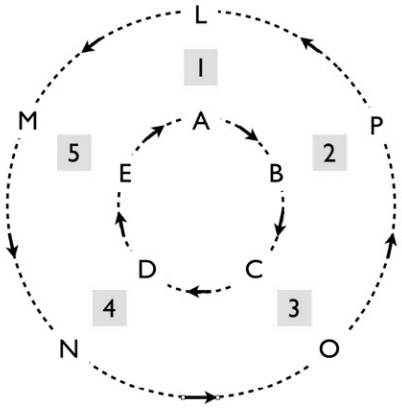
Each station's judges ranked teams on their performance compared to the other teams at the same station. Higher-performing teams were awarded more points.

The 10 stations for Round 2 are briefly described below. Table 2 highlights the ultrasound skills assessed.

Is There Any Body There?

A soft tissue ultrasound phantom held numerous foreign bodies. These foreign bodies differed in material, size, orientation, position, and depth. Each team member was given 3 minutes to scan the phantom. Team members who were not scanning had to draw a map of the phantom with correctly labeled and located foreign bodies. Each team was scored based on the accuracy of the location, orientation, and consistency of the foreign bodies drawn on the map.

Figure 1. Schematic of the 10-team organization of Round 2. Boxed numbers represent stations. The 1st-, 3rd-, 5th-, 7th-, and 9th-place teams were given positions A, B, C, D, and E and rotated clockwise around stations. The 2nd-, 4th-, 6th-, 8th-, and 10th-place teams were given positions L, M, N, O, and P and rotated counterclockwise. Teams in each letter group (A–E or L–P) were scored by the same judges and only against the other teams in their letter group.



Rotation	Station 1		Station 2		Station 3		Station 4		Station 5	
1	A	L	B	P	C	O	D	N	E	M
2	E	P	A	O	B	N	C	M	D	L
3	D	O	E	N	A	M	B	L	C	P
4	C	N	D	M	E	L	A	P	B	O
5	B	M	C	L	D	P	E	O	A	N

Mission: Impossible Scan

Teams predetermined ultrasound views. Team members took turns playing the roles of director, scanner, and operator. The director was shown the name of the view and a list of "taboo" or forbidden words and then had to verbally guide a blindfolded scanner to the correct place on the body. The director could see the image on the screen and talk with the scanner. The operator selected the probe and adjusted the image on the machine (depth and gain) but could not speak to the other team members or touch the patient. Once the view was obtained to the satisfaction of the judge, team members rotated positions. Teams were penalized each time a taboo word was uttered.

Toxic Patient Simulation

This station assessed the clinical management of a patient based on various ultrasound findings. The questions were structured as clinical vignettes and were read to the team. Teams were then asked to demonstrate correct probe placement of the application relevant to the clinical scenario. Once the probe was appropriately placed, teams were shown a corresponding ultrasound video clip. Based on the vignette and video clip, each team answered as many of the 20 multiple-choice questions as possible within the allotted time.

Can You Match That?

The event planner scanned a live human model before SonoGames. Participants were shown an image of the various scans on this model. Residents had to interpret the image and then attempt to replicate it by scanning the same model in real time. Teammates could assist with interpretation, but only 1 participant could acquire the image. Teams matched as many images as time allowed and were scored on accuracy and the number of tasks completed.

A Pain in the Back

This station used the Simulab lumbar puncture phantom model (Simulab Corporation, Seattle, WA). Each team member scanned the model, marked the lumbar vertebral spinous processes in both the midsagittal and transverse planes, and then performed a lumbar puncture at the marked location. Points were awarded based on the time to successful completion of the lumbar punctures.

I'm Not Dead Yet!

A SonoSim simulation machine (SonoSim, Inc, Santa Monica, CA) was used to present 9 clinical cases of criti-

cally ill patients. Each case consisted of a set of ultrasound images with a variety of findings. Cases were listed on a large poster board in a column. Teams were given Diagnosis and Management cards. Teams were asked to match each case with the correct diagnosis and management. They could scan any part of the body based on their clinical suspicion. The simulator would display real ultrasound images corresponding to the anatomic location. Team members took turns scanning with the simulator but discussed the images and cases together. Points were awarded each time the correct diagnosis or management was matched to the case. Additional points were awarded for scanning skills and overall performance.

Stump the Chump

This station involved a head-to-head scan-off between a team member and a designated ultrasound "expert" (nationally recognized emergency ultrasound fellowship director). Scans were performed on live models lying side by side. To begin, the competitor selected a model to scan and then picked a card from a bag on which a task was written. The competitor attempted to complete the task before the expert. As a handicap, the ultrasound expert was delayed 5 seconds and asked to perform all scans with his or her nondominant hand. Competitors were given points if they beat the expert and the image was high quality, fewer points if they beat the expert but the image was deemed suboptimal by the judge, and no points if the image generated was uninterpretable or the expert completed the task first.

It's Neck and Neck

A Simulab (Simulab Corporation, Seattle, WA) central line simulator was used for the station. Team members rotated between 3 roles: sonographer, proceduralist, and instructor. The sonographer and proceduralist were not permitted to see the ultrasound screen, and relied on guidance from the instructor. Before each attempt, the instructor randomly selected 1 among several hurdles. Hurdles included sonographer was not allowed to use his or her hands; both sonographer and proceduralist were required to wear headphones and listen to loud music; proceduralist was required to wear handcuffs; and all verbal communication was required to be in the format of a song. The team attempted to complete the task as many times as possible in the allocated time. Teams were scored on the number of times that the task was successfully completed.

It Takes a Very Steady Hand

This station used a MedaPhor (Medaphor North America, Inc, San Diego, CA) transvaginal simulator task trainer. Each team member was given a unique standardized case scenario. Each scenario consisted of a clinical vignette, a transvaginal scan, and 5 multiple-choice questions. Nonscanning teammates were allowed to speak and verbally cue, but no other assistance was allowed in image acquisition. Points were awarded based on the cumulative score for the 3 cases and the total time taken for case completion.

Sono Blindfold Challenge

This station incorporated Vimedix simulators (CAE Healthcare, Sarasota, FL). Teams were given a clinical scenario and needed to scan simultaneously in a head-to-head race format. One member was blindfolded and mute. The other 2 team members verbally guided the sonographer to correct placement and orientation of the probe so that the image could be acquired. Teams were awarded points if they correctly acquired and interpreted the image before the other team.

Table 2. Round 2 Events and Skills Assessed

Station	Image Acquisition	Image Interpretation	Incorporation Into Medical Decision-Making	Procedural Performance	Communication	Teamwork
Is There Any Body There?	•	•		•	•	•
Mission: Impossible Scan	•	•		•	•	•
Toxic Patient Simulation	•	•	•	•	•	•
Can You Match That?	•	•		•	•	
A Pain in the Back	•			•		
I'm Not Dead Yet!	•	•	•	•	•	•
Stump the Chump	•	•		•		
It's Neck and Neck	•	•		•	•	•
It Takes a Very Steady Hand	•	•	•	•	•	
Sono Blindfold Challenge	•	•	•	•	•	•

Round 3

In Round 3, the 2 top-performing teams from Round 2 competed in a game show–style format. Real-time scores were tabulated and projected onto a large screen, which maximized audience engagement. The event was judged by 1 SGOC member in 2012 and by a panel of 3 SGOC members in 2013.

In 2012, Round 3 consisted of 3 segments: Picture Board, Rapid Fire, and Instant Recall. The scores for each segment were cumulative. Teams were not penalized for incorrect answers.

Picture Board

Teams started by taking turns choosing from a numbered grid projected onto a screen. Each number was associated with a video clip demonstrating normal anatomy, pathology, or an ultrasound finding (eg, artifact). The team then answered a question pertaining to diagnosis or management. If the team answered incorrectly, the other team had an opportunity to steal the points by answering the question correctly.

Rapid Fire

Each of the 3 competitors from both teams had 45 seconds in which to answer as many ultrasound-related questions as possible.

Instant Recall

In the final segment, short ultrasound videos were shown to both teams simultaneously. At the end of the video, questions pertaining to that particular video were posed to test the teams' ability to interpret ultrasound scans, evaluate subtle findings, and recall technical and anatomic details. The two teams buzzed in to answer these questions. In all 3 segments, correct answers were explained after the competitors had a chance to answer.

In 2013, Round 3 consisted of 2 segments: Literature Quiz, and Scan-Off.

Literature Quiz

The first event was a question-and-answer series based on 4 articles, which were sent to all SonoGames participants in the weeks preceding the event. The articles were selected by the SGOC based on the quality of the article, rigor in methodology, and importance of conclusions. Questions were asked, and teams buzzed in. If a team answered incorrectly, the opposing team had an opportunity to confer before answering the question. A total point score was recorded at the conclusion of this first event.

Scan-Off

For the second event, the teams alternated scanning a human model. After a case scenario was presented, a preselected member of one team approached the model and performed a focused scan that addressed the clinical scenario. Two separate ultrasound machines were connected to projectors, and the audience was able to follow the real-time scanning. Verbal coaching and cues by the sonographer's teammates and the audience were allowed. The sonographer had 30 seconds to obtain the requested image and would freeze the image at the point that he or she deemed most technically adequate. The competing team, blinded to the other team's scan, then performed the same exercise using the same scenario. The judges chose the superior ultrasound image.

Improving the Games: Year 1 to 2

The SGOC identified strengths and weaknesses of the games from its inception year and applied these to improve the event for the second year. A postevent survey evaluation was e-mailed to all resident team members and attending team captains. Additionally, a debriefing meeting was held to discuss areas of improvement.

In the first year, there were some technical difficulties with the audience response software that occurred just before the event and caused a 15-minute delay. To avoid this problem in the second year, we tested and retested all of the software and audiovisual equipment the prior evening and had backup software and response cards available.

It was felt that the competitive nature of the event was very successful at generating interest and excitement for point-of-care ultrasound education. The largest change from the first to second year was the doubling of teams advancing to Round 2. It was largely felt that the cut of 38 teams to only 5 was too drastic. By creating 2 parallel tracks and doubling the number of judges and moderators at each station, we were able to accommodate 10 teams in the second year.

Moderators, Scoring, and Judges

Emergency ultrasound faculty volunteers and members of the AEUS Board of Directors acted as judges, time keepers, additional moderators, photographers, crowd controllers, and registration table personnel. When possible, faculty captains of SonoGames teams were not eligible to serve as judges. If they were selected as judges, they did not judge their own teams. All volunteers were required to attend an information session the evening before the event.

Awards and Prizes

SonoGames medals were awarded to all teams that advanced to Round 2. The award for the champions of the SonoGames was to take home the SonoCup and have the team name permanently engraved on the base of the trophy. The winning team was also awarded a plaque commemorating this victory.

Teams were encouraged to choose creative names and to dress in costume. In 2013, certificates were awarded to the best in each category. Encouragement of such creativity promoted the fun and lighthearted spirit of the event and built further team solidarity.

Sponsorship and Working With Industry

For the 2012 SonoGames, ultrasound equipment and simulation companies were contacted for educational support without sponsorship. For the 2013 SonoGames, event organizers determined that the AEUS and the emergency ultrasound mission would greatly benefit from grant support in the form of industry sponsorship. While the simulation companies continued to provide educational support without sponsorship, all ultrasound equipment companies were contacted to solicit financial support for the event in addition to equipment support. Sponsorship levels were discussed, as well as the benefit to the company in terms of a broad exposure to hundreds of ultrasound-trained emergency medicine residents and faculty. Company logos were placed on the event program, the website, and the event T-shirts, and space for signage was provided. The generosity of these companies was integral to the event's success.

Limitations

We acknowledge that there are certain limitations in the administrative methods and/or formats in the educational activity, as these may not be validated methods for testing ultrasound skills. First, educational questions used in Round 1 were peer reviewed by members of the SGOC but were not validated. The process of validating questions involves disseminating them to a wide group of test takers in advance. In this particular case, we decided that dissemination of questions before the event could provide an unfair advantage to teams with access to the questions. For similar reasons, we chose not to use questions from previously developed question banks (ie, the American College of Emergency Physicians website). Instead of formal validation, a peer-review process was used—all SGOC members had an opportunity to review questions before the event for accuracy, consistency, and clarity. The lack of a formal validation process for Round 2 and Round 3 tasks was unlikely to affect the fairness of the event, since teams were scored only against each other and not against an absolute benchmark. In this way, an unfair question or task would have affected all teams equally, and the relative scores would remain largely unchanged.

Summary

Resident education and competency assessment in point-of-care ultrasound is an Accreditation Council for Graduate Medical Education requirement for emergency medical educators.[5] The AEUS SonoGames has created a 4-hour medical education activity that was organized to motivate the learner through a competitive, game-style platform. The overall goal of the event was to bring together physicians in training from all over the country to promote ultrasound education. In the future, SonoGames could include medical students, resident physicians from other countries, or an expanded format to accommodate more teams.

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