



## Opinion

### ISUOG ultrasound training in Oman: evaluating participant long-term retention and effect of repetitive practical courses on ultrasound knowledge and skills

N. VRACHNIS<sup>1,2\*</sup> , T.E. COHEN-OVERBEEK<sup>3</sup> and Collaborators<sup>#</sup>

<sup>1</sup>Third Department of Obstetrics and Gynecology, National and Kapodistrian University of Athens, Medical School, Attikon Hospital, Athens, Greece; <sup>2</sup>Vascular Biology, Molecular and Clinical Sciences Research Institute, St George's University of London, London, UK; <sup>3</sup>Department of Obstetrics and Gynaecology, Division of Obstetrics and Fetal Medicine, Erasmus MC-Sophia Children's Hospital University Medical Center Rotterdam, Rotterdam, The Netherlands

\*Correspondence. (e-mail: nvrachnis@hotmail.com)

#Collaborators are listed at end of article.

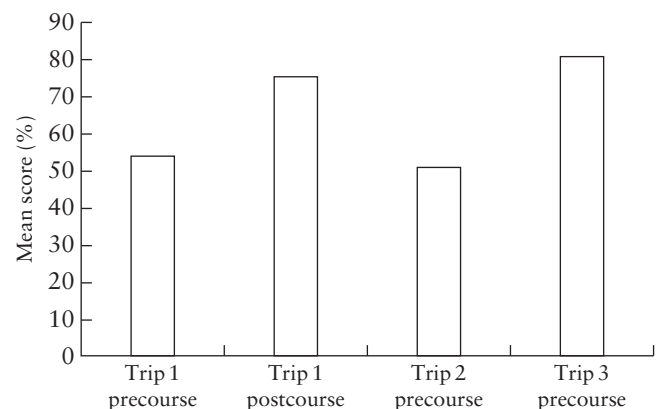
The International Society of Ultrasound in Obstetrics and Gynecology (ISUOG) has a vision, namely, 'that every woman in the world has access to ultrasound, that every scan provider is competent and that the diagnosis of obstetric and gynecologic conditions is effective so that women's health outcomes improve'. Given that effective training in obstetric ultrasound is of paramount importance for the provision of optimal antenatal care, a lack of standardized sonographic training programs results in suboptimal knowledge and skills among healthcare providers in different countries. Moreover, there is often major disparity among local providers: some have had no access to training while others have trained overseas and gained extensive experience. ISUOG runs an Outreach Program whose mission is to 'provide comprehensive and sustainable OBGYN ultrasound education globally, so that every woman can access high-quality ultrasound services to improve health outcomes'. Following established guidelines, ISUOG has developed a theoretical Basic Training Program, which has been validated among both junior residents and specialists in the field<sup>1</sup>.

Short- and long-term retention of theoretical knowledge and practical skills remains a critical issue, with there being strong evidence that clinical knowledge and skills diminish over time in other medical fields<sup>2,3</sup>. Through its Basic Training and Outreach Programs, ISUOG provides a standardized training program that includes a comprehensive theoretical and practical curriculum with the goal of ensuring and enhancing trainee competence. Because these programs are resource-intensive, it is necessary to validate their effectiveness on a long-term basis.

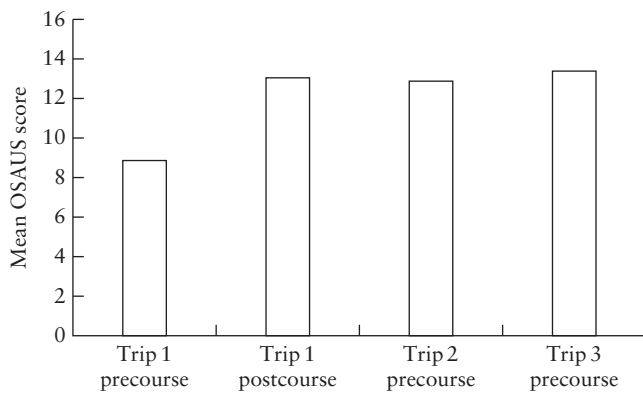
Following up the results of our previous study reporting on the theoretical knowledge and practical skills of

trainees after a 5-day ultrasound training course in Oman coordinated by ISUOG Outreach (Trip 1), we organized consecutive training sessions for 27 trainees from nine regions across Oman, which were delivered during two extra 5-day courses at 5 months (Trip 2) and 14 months (Trip 3) after the initial training Trip 1, and included ongoing educational teaching, interventions and evaluations at the 5- and 14-month timepoints<sup>4,5</sup>. Theoretical knowledge and practical skills attained in Trip 1 were evaluated at the beginning of Trips 2 and 3 to study the actual feasibility of retaining the knowledge and skills, as instructed and taught via this program, on a long-term basis (Tables S1 and S2). At the beginning of Trip 3, a second evaluation was carried out of knowledge and skills that were taught during Trip 2. The complete list of theoretical topics covered during each trip is provided in Table S3.

We observed an expected small decline in the theoretical and practical skills of trainees during the Trip-2 precourse assessment compared with the Trip-1 postcourse assessment (Figures 1 and 2). This decline in both theoretical knowledge and practical skills at the start of Trip 2 was fully restored on the Trip-3 precourse assessment, thus ensuring that the participants had the necessary skill set at the final trip to carry out a basic ultrasound scan in accordance with ISUOG recommendations in real-life settings (Figure S1)<sup>6</sup>. New variables were incorporated in their training during Trip 2, including acquiring the axial transcerebellar plane, acquiring the sagittal plane of the lumbosacral spine, confirmation of a three-vessel cord at the level of the urinary bladder, and



**Figure 1** Bar chart showing mean scores of trainees on 20 theoretical questions assessing retention of ultrasound knowledge in two training courses (Trips 2 and 3) after an initial training course (Trip 1). The results show an expected pattern, in which scores go up between the pre- and postcourse tests for Trip 1 and then decrease in the 5 months between Trips 1 and 2. The mean precourse score for Trip 3 is the highest, as the trainees had reinforced their learning achievement despite the 9 months between Trips 2 and 3. Of note, the specific lectures were delivered once on Trip 1. The same theoretical questions were used for Trips 1–3.



**Figure 2** Bar chart showing mean scores of trainees on assessment of retention of practical ultrasound skills in two training courses (Trips 2 and 3) after an initial training course (Trip 1), using the Objective Structured Assessment of Ultrasound Skills (OSAUS). OSAUS score increased overall between Trips 1 and 3. Precourse scores, which are the most important indicator for retention of skills, increased from Trip 1 to Trip 3. The maximum possible score was 20.

acquiring pulsed umbilical artery blood flow. Practical skills from Trips 1 and 2 were evaluated during the third trip, and the participants' ability to perform the tasks was assessed as being acceptable. Precourse assessment during Trip 3 revealed difficulties only in the practical assessment of the four-chamber view of the fetal heart.

Bearing the above information in mind, it is evident that, while intensive outreach courses may provide essential knowledge in the field of ultrasound in obstetrics and gynecology, the practical skills mastered may deteriorate over time. This was mainly attributed to the fact that some trainees had little opportunity to practice their skills with ongoing scanning after the completion of the first course. In our series, to help overcome this problem and render sustainable the retention of skills, the local health authorities allocated more ultrasound time to trainees and introduced a local mentor scheme to provide trainees with additional support during the 9-month period between the second and third training trips. Furthermore, the assignments and communications in the WhatsApp groups set up between the trainers and the trainees were intensified following the second training trip, thus showing that repeat educational interventions lead to continued improvement in theoretical knowledge and in the practical skill base required for performing quality obstetric and gynecological ultrasound. This is in contrast to a simpler model, based purely on theoretical classroom presentations, in which only 12% of information is retained after 2 weeks<sup>7</sup>. Overall, the precourse theoretical knowledge retention that was achieved at the start of Trip 3 reached 82% (from 54% at the start of Trip 1), and, for the practical skills, retention reached 67% at the start of Trip 3 (from 27% at the start of Trip 1) (Figure S1).

There are a few publications describing the impact of outreach ultrasound training in resource-limited countries<sup>8–10</sup>. While there is evidence of its value in emergency medicine practice, there are no data pertaining to its implementation for training in obstetric and

gynecological imaging<sup>8</sup>. Although current recommendations suggest that at least 100 supervised scans should be performed for a trainee to reach clinical competence, there is evidence that this varies widely between operators<sup>11,12</sup>.

A number of contemporary educational tools are proving to be of added value. Electronic-learning platforms and communication systems may assist in both theoretical and practical training. Ongoing mentorship using a platform that facilitates instant messaging, such as WhatsApp, can cultivate and improve knowledge and skills on a regular basis<sup>12</sup>. Despite this, our experience during this 14-month Phase-1 study in Oman suggests that clinicians still benefit from local 'physical' in-person support to engage in and develop their clinical practice.

Simulation-based learning is also an option from which some trainees may benefit, as it has proven to be effective for training. Simulation may provide a means of preventing a decline in practical skills between formal face-to-face training courses since, in certain contexts, recruiting women for scanning may be difficult (particularly for transvaginal gynecological assessment)<sup>13</sup>. Trainees should have an opportunity from their institution to repeat the specialized psychomotor skill set involved in image acquisition, and simulation can provide an appropriate learning environment for this to be carried out at the pace of the trainee<sup>11</sup>. Simulation-based training is not limited to basic skills, since physicians with advanced sonographic skills can also employ this method of learning to improve their diagnostic abilities for rare fetal anomalies<sup>14–16</sup>. Simulation also has a role in the evaluation of trainee level and/or sustainability of trainees' basic practical skills.

In addition to demonstrating improvements in knowledge retention and practical skills through repeated intensive training, this study has shown that trainees perform better in basic tasks than in more complex ones. For example, their performance improved less well in assessment of the four-chamber view of the fetal heart and abdominal circumference, and these differences were seen consistently at the start of Trips 2 and 3. This suggests that developing competency in assessment of certain complex structures may take at least one additional episode of training/mentorship beyond a single training week of the outreach program.

In our opinion, one limitation of this style of training that was followed in Oman is that it is resource-intensive and trains relatively small numbers of clinicians at one time. While single intensive outreach programs improve knowledge and practical skills, multiple sessions and mentoring by dedicated trainers is needed for sustainability, progress and long-term retention of knowledge and practical skills. We feel certain that programs such as that presented herein will gradually enable achievement of ISUOG's goals, i.e. access to ultrasound for all women, and in this case Omani women, competence in basic ultrasound among scan providers and effective diagnosis of obstetric and gynecological conditions.

## Acknowledgments

We would like to thank ISUOG, the ISUOG Basic Training Task Force, and the ISUOG Outreach Committee, since this work would not have been possible without their support. The Omani Ministry of Health provided invaluable support and extensive guidance, also without which the course could not have taken place. Dr Mouza Al Salmani, head of the Department of Obstetrics and Gynecology in the Sultan Qaboos Royal Hospital in Muscat, provided the training facility and coordinated volunteer patients, without which, once again, this project would not have been possible. We would also like to thank GE for providing the machines for the course, as well as the ISUOG ambassadors in the region for facilitating and supporting the program.

We are grateful to all those with whom we have had the pleasure of working during this project and duly extend thanks to: Gesù Antonio Báez for coordinating the project, our project adviser Hisham Mirghani, and the ISUOG trainers led by Titia Cohen-Overbeek, Nimrah Abassi, Valeria Angioni, Pauline Schut and Divya Singh who delivered the ISUOG lectures and provided practical training on the ground in Oman.

## Collaborators

A. T. Papageorghiou, Vascular Biology, Molecular and Clinical Sciences Research Institute, St George's University of London, London, UK

V. Pergialiotis, First Department of Obstetrics and Gynecology, National and Kapodistrian University of Athens, Medical School, Alexandra Hospital, Athens, Greece

C. M. Bilardo, Department of Obstetrics and Prenatal Diagnosis, Amsterdam University Medical Centres, Amsterdam, The Netherlands

A. Abuhamad, Department of Obstetrics and Gynecology, Eastern Virginia Medical School, Norfolk, VA, USA

R. S. Abu-Rustum, Department of Obstetrics and Gynecology, University of Florida, Gainesville, FL, USA

L. Hanson, Virginia Beach Obstetrics and Gynecology, Virginia Beach, VA, USA

A. Tabor, Center of Fetal Medicine, Department of Obstetrics, Copenhagen University Hospital, Rigshospitalet, Copenhagen, Denmark

A. Johnson, The Fetal Center, Department of Obstetrics Gynecology and Reproductive Sciences, The University of Texas Health Science Center at Houston, Houston, TX, USA

E. Xilakis, former ISUOG employee  
 F. Mates, former ISUOG employee  
 S. Johnson, former ISUOG employee  
 J. Hyett, RPA Women and Babies, Royal Prince Alfred Hospital, Camperdown, NSW, Australia

## REFERENCES

- Hillerup NE, Tabor A, Konge L, Savran MM, Tolsgaard MG. Validity of ISUOG basic training test. *Ultrasound Obstet Gynecol* 2018; 52: 279–280.
- Au K, Lam D, Garg N, Chau A, Dzwonek A, Walker B, Tremblay L, Boet S, Bould MD. Improving skills retention after advanced structured resuscitation training: A systematic review of randomized controlled trials. *Resuscitation* 2019; 138: 284–296.
- Tolsgaard MG, Rasmussen MB, Tappert C, Sundler M, Sorensen JL, Ottesen B, Ringsted C, Tabor A. Which factors are associated with trainees' confidence in performing obstetric and gynecological ultrasound examinations? *Ultrasound Obstet Gynecol* 2014; 43: 444–451.
- Vrachnis N, Papageorghiou AT, Bilardo CM, Abuhamad A, Tabor A, Cohen-Overbeek TE, Xilakis E, Mates F, Johnson SP, Hyett J. International Society of Obstetrics and Gynecology (ISUOG) - the propagation of knowledge in ultrasound for the improvement of OB/GYN care worldwide: experience of basic ultrasound training in Oman. *BMC Medical Education* 2019; 19: 434.
- Vrachnis N, Papageorghiou AT, Bilardo CM, Abuhamad A, Tabor A, Cohen-Overbeek TE, Vlachadis N, Xilakis E, Johnson S, Hyett J. OP04.06: ISUOG Basic Ultrasound training in Oman: knowledge transfer in ultrasound for the improvement of obstetric and gynecological care worldwide. *Ultrasound Obstet Gynecol* 2018; 52 (Suppl 1): 76.
- ISUOG Education Committee recommendations for basic training in obstetric and gynecological ultrasound. *Ultrasound Obstet Gynecol* 2014; 43: 113–116.
- Hempel D, Stenger T, Campo Dell'Orto M, Stenger D, Seibel A, Rohrig S, Heringer F, Walcher F, Breikreutz R. Analysis of trainees' memory after classroom presentations of didactical ultrasound courses. *Crit Ultrasound J* 2014; 6: 10.
- LaGrone LN, Sadasivam V, Kushner AL, Groen RS. A review of training opportunities for ultrasonography in low and middle income countries. *Trop Med Int Health* 2012; 17: 808–819.
- Goldenberg RL, Nathan RO, Swanson D, Saleem S, Mirza W, Esamai F, Muyodi D, Garcés AL, Figueroa L, Chomba E, Chiwala M, Mwenechanya M, Tshetu A, Lokangako A, Bolamba VL, Moore JL, Franklin H, Swanson J, Liechty EA, Bose CL, Krebs NF, Michael Hambidge K, Carlo WA, Kanaiza N, Naqvi F, Pineda IS, Lopez-Gomez W, Hamsumonde D, Harrison MS, Koso-Thomas M, Miodovnik M, Wallace DD, McClure EM. Routine antenatal ultrasound in low- and middle-income countries: first look - a cluster randomised trial. *BJOG* 2018; 125: 1591–1599.
- Osei-Ampofo M, Tafoya MJ, Tafoya CA, Oteng RA, Ali H, Becker TK. Skill and knowledge retention after training in cardiopulmonary ultrasound in Ghana: an impact assessment of bedside ultrasound training in a resource-limited setting. *Emerg Med J* 2018; 35: 704–707.
- Dyre L, Norgaard LN, Tabor A, Madsen ME, Sorensen JL, Ringsted C, Tolsgaard M. Collecting Validity Evidence for the Assessment of Mastery Learning in Simulation-Based Ultrasound Training. *Ultraschall Med* 2016; 37: 386–392.
- Tolsgaard MG, Chalouhi GE. Use of ultrasound simulators for assessment of trainee competence: trendy toys or valuable instruments? *Ultrasound Obstet Gynecol* 2018; 52: 424–426.
- Madsen ME, Konge L, Norgaard LN, Tabor A, Ringsted C, Klemmensen AK, Ottesen B, Tolsgaard MG. Assessment of performance measures and learning curves for use of a virtual-reality ultrasound simulator in transvaginal ultrasound examination. *Ultrasound Obstet Gynecol* 2014; 44: 693–699.
- Jacobsen ME, Andersen MJ, Hansen CO, Konge L. Testing basic competency in knee arthroscopy using a virtual reality simulator: exploring validity and reliability. *J Bone Joint Surg Am* 2015; 97: 775–781.
- Maul H, Scharf A, Baier P, Wustemann M, Gunter HH, Gebauer G, Sohn C. Ultrasound simulators: experience with the SonoTrainer and comparative review of other training systems. *Ultrasound Obstet Gynecol* 2004; 24: 581–585.
- Ostergaard ML, Nielsen KR, Albrecht-Beste E, Konge L, Nielsen MB. Development of a reliable simulation-based test for diagnostic abdominal ultrasound with a pass/fail standard usable for mastery learning. *Eur Radiol* 2018; 28: 51–57.

## SUPPORTING INFORMATION ON THE INTERNET

The following supporting information may be found in the online version of this article:



**Figure S1** Bar charts showing the number of features achieved by trainees for each image/plane in the respective practical skills assessments in two training courses (Trips 2 and 3) after an initial training course (Trip 1). Comparing the precourse assessments, the mean number of features achieved increased for all images used between Trips 1 and 3. The mean number of features achieved post-Trip 1 and pre-Trip 2 decreased; this is a predictable finding given the elapsed time; however, there was a steady improvement for the precourse assessments at each trip compared with the previous one.

**Table S1** Flowchart of the 14-month practical evaluation scheme

**Table S2** Practical training assessment using the Objective Structured Assessment of Ultrasound Skills (OSAUS) score

**Table S3** ISUOG Oman Outreach project theoretical presentations