ISUOG - the propagation of knowledge in ultrasound for the improvement of OB/GYN care worldwide: experience of basic ultrasound training in Oman

Nikolaos Vrachnis (nvrachnis@hotmail.com)
National and Kapodistrian University of Athens Aiginitio Hospital

Aris T. Papageorghiou
St George's NHS Foundation Trust Teaching Hospitals, St George's Medical School

Caterina M. Bilardo
Department of Obstetrics and Prenatal Diagnosis Amsterdam University Medical Centres

Alfred Abuhamad
Department of Obstetrics and Gynecology, Eastern Virginia Medical School

Ann Tabor
Copennhagen University Hospital, Rigshospitalet

Titia E. Cohen-Overbeek
Division of Obstetrics and Prenatal Medicine, Rotterdam

Eleni Xilakis
ISUOG

Flora Mates
ISUOG

Sarah Johnson
ISUOG

Jon Hyett
RPA Women and Babies, Royal Prince Alfred Hospital, Camperdown

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Research article

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Abstract

Objectives The aim of this study is to evaluate and validate the International Society of Ultrasound in Obstetrics and Gynecology (ISUOG)standardized Basic Training curriculum; and the effectiveness of an Outreach teaching and training program delivered in Muscat, Oman. Methods Quantitative assessment to evaluate knowledge and practical skills was administered before and after an ultrasound course for sonologists attending the ISUOG Outreach course, which took place in November, 2017, in Oman. Trainees were selected from each region of the country following a national vetting process conducted by the Oman Ministry of Health. Twenty-eight of the participants were included in the analysis. Pre- and post-training practical and theoretical scores were evaluated and compared. Results Participants achieved statistically significant improvements, by 47% ($p<0.001$), in both theoretical knowledge and practical skills. Specifically, the mean score in the theoretical knowledge test significantly increased from 55.6% (± 14.0%) to 81.6% (± 8.2%), while in the practical test, the mean score increased from 44.6% (± 19.5%) to 65.7% (± 23.0%) ($p<0.001$). Performance was improved post-course among 27/28 participants (96.4%) in the theoretical test (range: 14% to 200%) and among 24/28 (85.7%) trainees in the practical skills test (range: 5% to 217%). Conclusion Application of the ISUOG Basic Training curriculum and Outreach teaching and training course improved the theoretical knowledge and practical skills of local health personnel. These results confirm that the course successfully achieved ISUOG's goal of disseminating knowledge in ultrasound among obstetricians-gynecologists.

Background

Ultrasound relies heavily on the skills of scan providers and effective training is essential to ensure consistently high standards of care. However there is still a lack of standardised training for ultrasound in obstetrics and gynecology [1]. Recent surveys of trainees across the USA and Europe report prevalent variability in availability, quality and methods of training and assessment, both within and across countries [2]. As ultrasound equipment has become more affordable, the use of ultrasound (particularly in low and middle income countries) has also increased. This has raised additional challenges around implementation and personnel capacity and the demand for education and training is greater than ever [3].

The International Society of Ultrasound in Obstetrics and Gynecology (ISUOG) has been recognized, since its establishment in 1991, as a provider of high-quality medical education; it supports individuals and health services in obstetric and gynecological ultrasound. Among other initiatives, ISUOG is developing and providing systematic theoretical and practical training based on its basic training recommendations [4]. In particular, it is expanding educational activities globally through on-site standardized basic training courses; since 2008 ISUOG has run nine such training courses and outreach programs in Haiti, Somaliland, Sudan, Oman, Ghana, Mongolia, Myanmar, PapaNew Guinea and the Lebanon, with the aim of providing on-site education to local health personnel [5]. These training programs are contributing to ISUOG's long term vision 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 [6], [7]. ISUOG is, moreover, carrying out research to validate its educational activity and demonstrate the effectiveness of the range of training programs offered [8].

ISUOG's curriculum development and courses around the world are now sufficiently well established to allow scientific validation of these educational initiatives and determine their effectiveness.

The aim of the study was to evaluate and validate ISUOG's Outreach course.

Methods

The study took place alongside an outreach training program in obstetric and gynecologic ultrasound, held from 5th to 9th November, 2017, in Muscat, Oman. We collected information and assessed learning competency, short-term retention, and adaptation to change of practice. Quantitative assessment to evaluate obstetric knowledge and practical skills was administered to sonologists before and after the training programme. The Omani government had previously selected 30 trainees to become trainers in their own regions. Twenty-eight of the trainees attended the course and were included in the analysis. All participants provided written informed consent and were assigned identification numbers to ensure confidentiality. The Ministry of Health of the Sultanate of Oman approved the study.

We administered multiple choice questions, created for this purpose by senior clinicians for ISUOG: Pre- and post-course test questionnaires included 19 pre-course questions and 40 post-course questions that examined knowledge retention across the curriculum. The post-course test included the 19 pre-course questions to allow direct comparison.

The practical component of the program was similarly evaluated using pre-and post-training sets, in accordance to current consensus criteria on how to evaluate ultrasound competence [9]. At the beginning of the practical training session, each trainee was asked to display their current level of ultrasound skills by demonstrating how they would capture and evaluate fetal images and biometric measurements as well as transvaginal gynecological scan images. Trainees were asked to obtain the following images: head and abdominal circumference, femur length, placental localization including distance of placenta from internal cervical os, four-chamber fetal heart view and longitudinal section of uterus, and ovarian morphology in the obstetrical and the transvaginal ultrasound. Subsequently, a theoretical session was held followed by practical training, during which participants were required to practice, among other skills, sliding, rotation, dipping, and angling transducer motions as well as basic machine "knobology". The training course involved a series of hands-on sessions relevant to the three trimesters of pregnancy and included the assessment of fetal lie and presentation, viability, number of fetuses, placenta location, amniotic fluid volume, and fetal biometry. The trainees practiced on volunteer women who provided consent. Each trainee was asked to produce a second copy of the images on the last day of practical training. Pre- and post-training practical scores were evaluated according to the Objective Structured Assessment of Ultrasound Skills (OSAUS) on a scale of 1 to 5: this involves four elements concerning the

images obtained, including applied knowledge of ultrasound equipment, image optimization, systematic examination, and interpretation of images [4].

The collected data were analyzed using MedCalc Statistical Software version 12.7.7 (2013 MedCalc Software bvba, Ostend, Belgium). Quantitative variables were expressed as mean ± standard deviation (SD). The paired t-test was applied to detect differences between pre- and post-course variables after normality verification using the Kolmogorov-Smirnov test. Qualitative variables were expressed as numbers and percentages and proportions were compared with the chi-square or Fisher's exact tests, as appropriate. $P<0.05$ was considered statistically significant.

Results

All trainees taking part in the Oman course were female, as male doctors rarely if ever work in this field in Oman [10], the Oman Medical Specialty Board having recorded no male residents graduating in this specialty between 2006 and 2015. The average age of trainees was 38 years, with a range of 31–47 years. Nine trainees (30%) had been practicing ultrasound for between 5 and 10 years before the course, 11% for 3–5 years and 18% for 0–3 years. The remaining trainees did not specify. The trainees had a range of professional backgrounds, with, indicatively, just over a sixth normally working in family/general medicine, while three were fetal medicine trainees, four specialists in fetal medicine, and two board certified obstetrician-gynecologists. On average, the trainees completed 38 obstetric scans per week (numbers ranging from 1 to 120). Very few trainees had performed gynecological ultrasound scans on a regular basis, if at all. Approximately half of the trainees who responded to the survey had received their ultrasound certificate before the course and five had formal training in the form of the official National Curriculum in Fetal Ultrasound. Only three trainees reported that they were required to keep a log book of ultrasound scans performed, seven reported they were formally evaluated on their ultrasound capabilities, and approximately half reported having previously received simulation-based ultrasound training. A small number of trainees reported having practiced ultrasound for over 5 years despite no formal training and no supervised clinical practice; others had no formal training, though some supervision.

Answers from 28 trainees were included in the analysis. For the theoretical knowledge assessment, 19 questions were answered pre- and post-course. The score (number of correct answers per trainee) ranged from 5 to 14 (26% to 74%) in the pre-course test and from 12 to 18 (63% to 95%) in the post-course evaluation. There was a significant increase in the mean score from 10.6 (± 2.7) to 15.5 (± 1.6) - expressed as a percentage, the mean score increased from 56% (± 14%) to 82% (± 8%) (an increase of 47% (95%CI: 38% to 56%), $p<0.001$). Twenty-seven out of the 28 trainees (96.%) showed some improvement while in one case the performance worsened (Figure 1–2).

In the pre-course test, the majority of trainees (54%) had a <60% score, whereas all trainees (100%) scored >60% post-course (OR = 65.4, 95%CI: 3.6 to 1177.2, $p = 0.005$). Furthermore, in the pre-course test, none (0%) of the trainees scored >75%, whereas this figure was 79% post-course (OR = 197.3, 95%CI: 10.5 to

3691.9, p<0.001). Finally, the post-course score distribution showed a notably smaller dispersion than the pre-course score (coefficient of variation: 25% vs 10%, respectively) (Figure 1).

Pre-course, each question was answered correctly at an average rate of 15.7 ± 6.5 trainees (56% ± 23%). This rose significantly in post-course scores to 22.8 ± 6.1 (82% ± 22%), a mean increase of 47% (95%CI: 33% to 60%, p<0.001). The increase in the number of trainees answering correctly ranged from 6% to 217%. Pre-course, 7/19 questions (36.8%) were answered correctly by trainees, this proportion increasing to 78.9% post-course (OR = 6.4, 95%CI: 1.5 to 27.2, p = 0.012), while only one question (5%) was answered correctly by ≥26 obstetricians pre-course, this increasing to 47% post-course (OR = 16.2, 95%CI: 1.8–147.1, p = 0.013) (Figure 2).

In the practical test, scores ranged from 4 to 19 (20% to 95%) in the pre-course test and from 5 to 20 (25% to 100%) in the post-course evaluation. There was a significant increase in the score from 8.9 (± 3.9) to 13.1 (± 4.6) - expressed as percentages, the mean score increased from 45% (± 19%) to 66% (± 23%). (an increase of 47% (95%CI: 32% to 63%), p<0.001). Twenty-four out of the 28 trainees (86%) improved their performance post-course by a range of 5% to 217%. Half of the trainees (14/28) improved by at least 50%, while four trainees improved by 100% or more. Only two trainees showed a worsening by 20% and 14%, while for two trainees the score remained unchanged after the practical course. In the pre-course test, the majority of the trainees (71%) had a score of <50%, whereas 69% of the trainees scored ≥50% post-course (OR = 5.3, 95%CI: 1.7 to 16.5, p = 0.004). Furthermore, in the post-course test, 64% of the trainees scored ≥60%, whereas this figure was 14% pre-course (OR = 10.8, 95%CI: 2.9 to 40.1, p<0.001) (Figure 3).

Discussion

In this study we evaluated the performance of 28 trainee physicians in Oman with regard to the theoretical knowledge and practical skills acquired in obstetrical and gynecological ultrasound after a 5-day Outreach training course organized by ISUOG Outreach partners together with the Omani government; this was the first national ultrasound training conducted in this country. We showed that the course was associated with a remarkable improvement in post-course scores compared to pre-course, not only for theoretical but also practical components. This highlights the success of the course in fulfilling the training needs, as well as goals of ISUOG.

Our study highlighted that there was significant heterogeneity in experience and inconsistency in prior training at baseline; this further validates our approach as ISUOG's Basic Training program ensures standardized training and ensures that all trainees have experience in both obstetric and gynecological ultrasound. As part of this, ISUOG also initiated the use of log books among trainees in order for each trainee to better record her experience obtained and practice performed throughout the year.

In order to evaluate the efficacy of the course, the performance of the 28 trainees, who answered 19 theoretical questions to determine their original level of knowledge, was analyzed. The content of these questions involved basic theoretical knowledge in obstetrical ultrasound pertinent to fetal anatomy,

biometry, and pathology as well as the techniques for performing fetal ultrasound. After the completion of the theoretical training, physicians were required to answer the same questions again (among other questions). The analysis of the results showed a significant improvement in the level of knowledge of the trainee doctors, on average by 47%.

The scores of the trainees (maximum 19 or 100%) increased on average from 10.6 to 15.5 (56% to 82%). Almost all trainees (27 out of 28) showed improvement in their theoretical knowledge of fetal medicine. In the pre-course test, all trainees showed an apparent deficiency of knowledge regarding the subjects of fetal ultrasound, including proper imaging of the fetal anatomy and fetal biometry, and, as a result, none correctly answered 75% or more of the questions. However, the course was successful in covering this deficit of knowledge, which resulted in the vast majority of the doctors attaining a score of >75% post-course. In a nutshell, the theoretical training led to large increase in the odds of achieving a theoretical score of >75%. Furthermore, before the course the participants gave the appearance of forming a rather disparate group, showing a significant dispersion in the level of their theoretical knowledge. By the end of the training process, however, the participants, overall, gave evidence of having considerably improved their level of knowledge, while their differences in knowledge were remarkably decreased with respect to the theoretical subjects they had been taught.

The results of the practical course evaluation were equally impressive: before practical training, the trainees demonstrated their initial level of ultrasound skill by producing specific images in obstetric and gynecological ultrasound. After its completion the trainees were asked to once again produce the specific images, and their pre- and post-course performance was evaluated based on the OSAUS scoring system. Regarding practical skills, the trainees' score (maximum 20 or 100%) increased on average by 47% (from 45% to 66%) post-course in comparison to pre-course. The vast majority of the trainees (24/28 or 86%) showed improvement in their practical skills.

The learning curve to achieve competence in ultrasonography is long and the learning process is time-consuming, and training is mostly available in centers of expertise. Previous studies have proposed that simulation-based training be considered as an adjunct to basic ultrasonography training [11]. Simulators that are designed to reproduce transvaginal gynecologic ultrasound examination significantly improve the performance of novice doctors, who appear to reach a plateau of expert performance after 4–5 hours of training [12, 13]. Furthermore, the knowledge appears to be retained for up to at least 2 months after clinical training [14].

One limitation of our study is that we only assessed short term retention of information; further work to assess longer term effects is underway. Data concerning trainees' retention of the theoretical background are scarce in the literature and seem to be conflicting [15, 16]. While several methods have been suggested, including live lectures, podcasts, and e-learning activities, none of them has proved to be superior to the old teaching methods [16, 17]. In 2016, Hempel et al demonstrated that the incorporation of an e-learning activity following the completion of a hands-on training session significantly increases knowledge retention and trainees' satisfaction [18]. To this end, WhatsApp groups were established between the

designated trainer and the Omani trainees to ensure continuous communication, which will enable image exchange and questions to be answered in the future.

Conclusion

The findings of our study show that the conduct of basic ultrasound training programs significantly improves both the theoretical and practical skills of trainees. The results of this analysis demonstrate that the basic training course in Oman, like many others previously organized in numerous other countries by ISUOG, successfully achieved the ISUOG goals and gives every appearance of serving its purpose for the propagation of physicians' and midwives' knowledge in ultrasound, with the ultimate goal of improving pregnancy outcomes worldwide. Future research activities should evaluate the retention of skills over time and the successful implementation of ultrasound in prenatal care in order to ensure long-term sustainability of providing quality basic ultrasound examinations to women in low-resource settings.

List Of Abbreviations

ISUOG: International Society of Ultrasound in Obstetrics and Gynecology

SD: standard deviation

OSAUS: Objective Structured Assessment of Ultrasound Skills

Declarations

Ethics approval and consent to participate

All participants provided written informed consent and were assigned identification numbers to ensure confidentiality.

The Ministry of Health of the Sultanate of Oman approved the study.

Consent for publication

Not Applicable

Availability of data and materials

The data that support the findings of this study are available from ISUOG but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of ISUOG.

Competing interests

The authors declare that they have no competing interests

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Authors’ contributions

NV conceptualized the study, developed the proposal, conducted the statistical analyses, wrote the report, participated in overall supervision of the project and revision of the report.

AP conceptualized the study, wrote the report, participated in overall supervision of the project and revision of the report.

CB conceptualized the study, assisted in writing and editing the final report.

AA conceptualized the study,assisted in writing and editing the final report.

AT conceptualized the study, assisted in writing and editing the final report.

TCO coordinated the project, completed initial data entry and analysis, assisted in writing and editing the final report.

EX conceptualized the study, coordinated the project, completed initial data entry and analysis, assisted in writing and editing the final report.

FM coordinated the project, completed initial data entry and analysis, conducted the statistical analyses, assisted in writing and editing the final report.

SJ conceptualized the study, coordinated the project, wrote the report, participated in overall supervision of the project and revision of the report.

JH conceptualized the study, developed the proposal, wrote the report, participated in overall supervision of the project and revision of the report

All authors read and approved the final manuscript.

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Figures

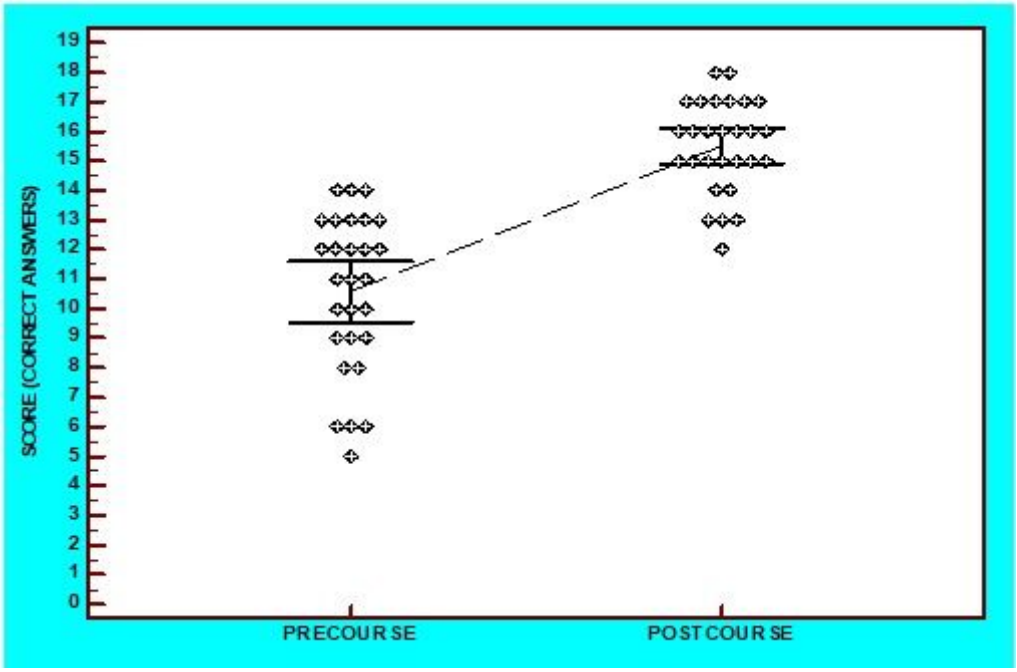

Figure 1

Dots-plot diagram with mean and 95%CI of pre- and post-theoretical course score

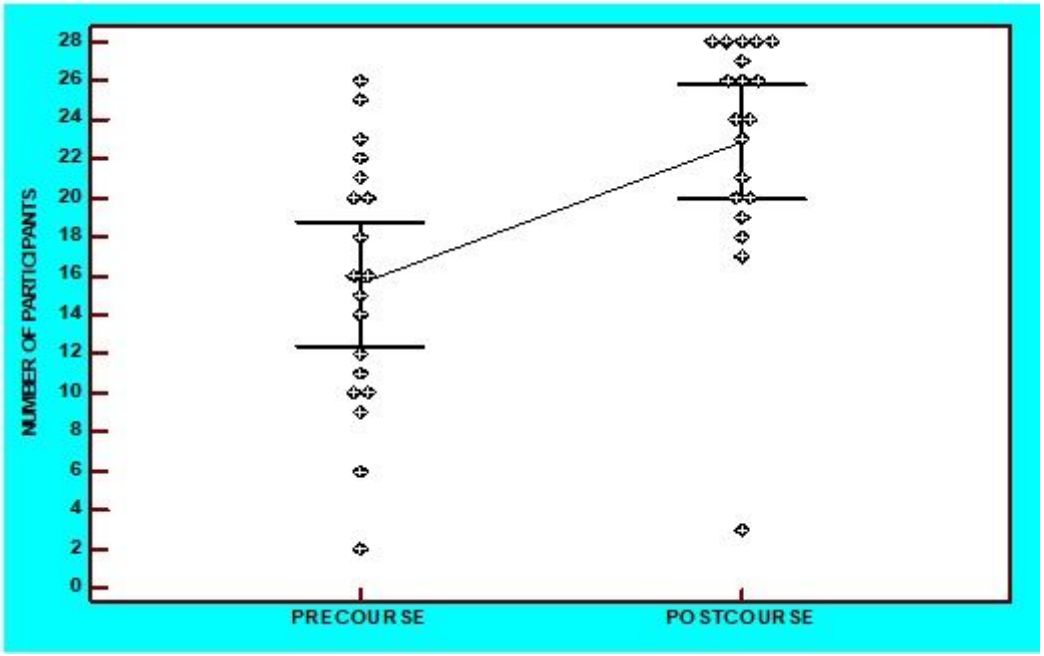

Figure 2

Dots-plot diagram with mean and 95%CI of the pre- and post-theoretical course comparison of questions by the number of trainees who answered correctly.

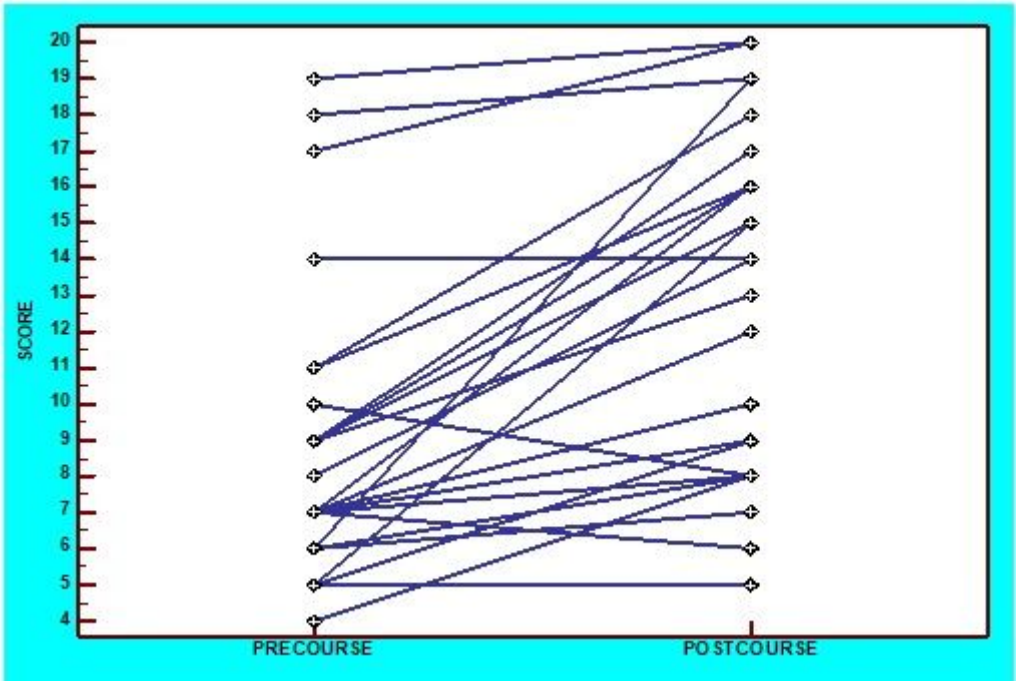

Figure 3

Dot and line diagram of the comparison of pre- and post-practical course scores