

CoRIPS Research Award 069

Catherine Williams

Awarded £2403.95

A comparison of ultrasound simulation training with clinical teaching to assess whether or not learning is comparable when teaching doctors basic transvaginal gynaecological ultrasound.

Lay Summary

The MedaPhor transvaginal ultrasound simulator will be compared with clinical teaching to assess whether it can adequately teach radiology and obstetric/gynaecology registrars and foundation year 2 doctors the basic components of a transvaginal ultrasound scan. All participants will undertake an initial assessment on the simulator to provide baseline data and allow them to be allocated to either the simulator or clinical teaching group according to their job and scanning ability. They will then undergo ten hours of training in transvaginal ultrasound using the allocated teaching method. All participants will then complete a final assessment incorporating 2 cases on the simulator. Areas assessed will include adequate assessment of anatomy, accuracy of measurements, image quality, correct orientation, time taken to complete and the ability to differentiate between normal and abnormal. The results from both groups will be analysed to establish if the participants have reached a comparable level of ability. All participants will then be allocated to one of three focus groups, where topics covered will include simulator realism, case selection and opinions of simulation training. The key themes identified in the focus groups will be analysed to establish if they can explain the final assessment results.

This project does not propose that achieving a high score in the final assessment directly correlates with being able to perform a good scan on a real patient. It merely aims to identify if the simulator is able to adequately teach some of the basic components that make up a transvaginal scan.

PRINCIPAL AIM OF THE STUDY: To compare the use of the MedaPhor transvaginal (TV) ScanTrainer ultrasound (US) simulator with clinical teaching for teaching radiology and obstetric/gynaecology doctors the basic components of a TV gynaecological US scan.

PRIMARY RESEARCH QUESTION: Is training with the MedaPhor TV ScanTrainer US simulator as good as clinical teaching for teaching radiology and obstetric/gynaecology doctors the basic components of a TV gynaecological US scan?

SECONDARY RESEARCH QUESTION: What were the doctors thoughts and experiences of using the MedaPhor TV ScanTrainer US simulator?

OUTCOMES:

- Establish whether or not training using the MedaPhor TV ScanTrainer US simulator could be a viable alternative to clinical teaching when learning the basic components of a TV US scan.
- Evaluate the MedaPhor TV Scan Trainer US simulator as an US teaching method.

REVIEW OF THE LITERATURE:

US scans form a consistently large percentage of the imaging examinations requested in hospitals due to the safety of the equipment and its easy availability (Monsky et al, 2002, p. 35). Yet, in order to perform a scan the operator must be adept at both the "technical aspects of scanning and the interpretive skills of sonography" (ibid). Consequently, US is considered very operator-dependent and with few doctors attending basic US courses a gap is forming between the techniques available and those able to use them (Salvesen et al, 2010, p.525).

Due to the high demand, a rapid throughput is necessary within an US department and this limits the number of teaching sessions that can be provided to doctors. This has been further exacerbated by the mandatory time restrictions now placed on in-hospital work for speciality trainees, which has limited the time they have available to train in different areas (Gould et al, 2006, p. 215). In addition, it has long since been recognised that where gynaecological US is concerned, sonographers play a substantial role in teaching new doctors (The Royal College of Obstetricians and Gynaecologists, n.d). However, "there is a UK wide shortage of sonographers" (Society and College of Radiographers,

2009) and US departments are struggling to meet government targets such as those laid out in the National Health Service (NHS) Plan (DoH, 2000) and undertake obstetric and vascular screening programmes (NHS Abdominal Aortic Aneurysm screening programme, 2009; National Screening Committee, 2007; NHS Fetal Anomaly Screening Programme, 2010). Consequently, this leaves little time for sonographers to actively participate in training doctors in gynaecological US.

TV US is now the most routinely requested imaging examination for gynaecology referrals (Heer et al, 2004, p. 440). However, due to its invasive nature it is a particularly difficult skill to learn as patients are less willing to tolerate long examination times due to an inexperienced operator (Monsky et al, 2002, p. 35). This in addition to the economic issues stated above has resulted in TV US becoming a difficult area for doctors to learn.

Over recent years, the potential of simulation-based medical education to increase the clinical competencies of medical professionals has become increasingly acknowledged (Monsky et al, 2002, p. 35). This was noted in particular in a directive written by the Chief Medical Officer Sir Liam Donaldson in 2009. The use of simulation has proved successful in other industries such as aviation and is already routinely used in medicine for basic clinical skills such as suturing (Donaldson, 2009, p. 51). With a view to extending the use of simulation throughout medical education each royal college was required to appoint a director for simulation training (ibid). As a result, both the Royal College of Radiologists (RCR) and the Royal College of Obstetricians and Gynaecologists (RCOG) are now currently focused on developing their resources in simulation based training (RCR, 2010, p. 2; RCOG, 2009).

“A simulator is a physical object that reproduces, to a greater or lesser degree of realism, a medical procedure that must be learned, and that incorporates a system of metrics that allows progress and learning to be recorded” (Dawson, 2006, p. 19). The development of US simulators with built in virtual examinations have made standardised US training and assessment possible and could represent a new era in US education (Maul et al, 2004, p. 585). Whilst previous research has demonstrated improvements with simulation training in areas such as detecting fetal anomalies using US (ibid), with the constant development of new US simulators more up to date research is required.

In April, 2010 MedaPhor unveiled a new haptic TV US training simulator, which breaks down learning into modules with “easy-to-follow tutorials and assignments” allowing the operator to learn through trial and error (MedGadget, 2010). The use of a force-feedback (haptic) device increases the realism of the simulator and it enables the user to experience “real-time physical feedback of probe manipulation and contact with a patient” (ibid). This product has the potential to revolutionise TV US training by allowing doctors to learn how to perform the basic components of a scan in a safe, non-threatening environment without causing discomfort to a real patient. However, this product is yet to be trialled as a teaching device and with no identifiable previous research solely on the use of an US simulator for teaching TV ultrasound to registrars, this provides a unique research opportunity. This research project aims to assess the usefulness of the MedaPhor TV US simulator in teaching radiology and obstetric and gynaecology doctors the basic components of a TV US scan.

METHODOLOGY:

This research project will utilise a mixed method study design incorporating both quantitative and qualitative data collection elements. Qualitative data will be collected to aid understanding of what it is about the US simulator training that has caused the quantitative results, an approach advocated by Polit and Beck (2006, p. 248). Qualitative and quantitative approaches to research have complementary strengths and weakness and therefore the use of both approaches in this research will enhance the resulting evidence base (ibid, p. 245).

RECRUITMENT STRATEGY:

Study participants will be radiology and obstetric/gynaecology registrars/foundation year 2 (FY2) doctors with limited or no experience in TV US, recruited using convenience sampling. Although it is appreciated that this form of sampling is weak, it is inexpensive and there are not enough doctors within the hospital that fit this criteria to allow for any other form of sampling (Burns and Grove, 2009, p. 354). Although it would have been interesting and relevant to include sonography students in this research, this was not possible as there is only one training within the department at present and they are too experienced in TV US. Exclusion criteria are:

- Involvement in a concurrently running research project as a moderate amount of time commitment to this project is required. Furthermore, involvement in another research project based on US or US training may alter the results of this study.
- Prior qualifications in gynaecological US.
- More than 10 hours of gynaecological scanning experience.

SAMPLE SIZE:

A sample of approximately 18 radiology and obstetric/gynaecology registrars/FY2 doctors will be obtained. The sample size is limited by the number of radiology and obstetric/gynaecology registrars/FY2's trained at any one time within the hospital. Due to the small sample size available this is a pilot study that will provide the basis for further research. As a result it is not necessary to perform a power analysis for this study (Burns and Grove, 2009, p. 357).

DATA COLLECTION:

Part one of the research project will comprise of the quantitative data collection element using a non-equivalent control group pre-test-post-test design. The design used in this project is quasi-experimental as it incorporates manipulation of the independent variable (training method) and use of a control group, but cannot be classed as an experimental design as true randomisation is not incorporated (Polit and Beck, 2006, p.g 180).

After a standardised introduction to the simulator, each participant will undergo a pre-test on it, to allow for the collection of baseline data on their initial scanning ability. The simulator marks their performance and issues a results sheet. The basic components of the TV scan assessed by the simulator as pass/fail are assessment of anatomy, time taken, image quality, correct orientation and accuracy of measurements. The researcher will be present to during the pre-tests to assist with the control panel of the simulator if required. Using the generated results sheet the researcher will award points to each participant, with more points allocated to the more difficult components of the scan passed. The participants will then be separated into strata according to their initial scanning ability and job title and randomly allocated from their strata to either the control group or experimental group. This method of allocation has been chosen to ensure there is appropriate representation of training grade and scanning abilities in each group.

Clinical teachings lists (where appointment times are lengthened and trainees learn to scan on real patients) are the current method of learning TV US within our hospital. Therefore each participant of the control group will undergo ten hours of gynaecology clinical teaching lists with a qualified sonographer. The same sonographer will teach all members of the control group. The experimental group will undergo ten hours of training in TV US on the simulator. No other US training will be provided to either group.

On completion of their ten hours training each participant will undergo a post-test assessment which comprises of two standardised TV examinations on the simulator. One of these examinations will be a normal scan which will assess whether they can perform the basic components of a TV scan (case 1) and the other examination will incorporate pathology and will be used to assess if they can differentiate between normal and abnormal (case 2). It is appreciated that the experimental group may have a slight advantage for the post-test due to their familiarity with the simulator. It was not possible to develop a post-test that was both standardised and unbiased towards one of the groups and therefore this will be taken into consideration when analysing the results. Ethically, undertaking the post-test on the simulator was preferable to each participant performing a TV scan on the same real patient. To minimise this advantage both of the post-test examinations will be unavailable to the experimental group for use during their training. In addition to this all participants may ask for assistance with the simulator control panel during the post-test without being penalised.

For post-test case 1, the simulator will mark the participants on their ability to adequately assess the anatomy and the time taken to complete the scan. Participants will be asked to store images of certain measurements and each of these will be marked by the researcher and another qualified sonographer as a pass/fail on image quality, accuracy of measurements and correct orientation. Both assessors will be blinded as to which training group the participants were in. Unfortunately due to the limitations of the simulator it is not possible for these areas to be marked by the simulator on this case. Prior to the post-test the assessors will undertake case 1 and the measurements taken by both will be used to set the acceptable range for accuracy (average \pm 10%). For post-test case 2, the participants scan the following areas and state whether they are abnormal or normal - uterus, right adnexa, left adnexa and pouch of douglas. The simulator awards a point for each correct answer. A score from the combined results of cases 1 and 2 will be calculated for each participant, again with additional weighting of points given to the more difficult scan components that were passed.

One month after completion of the quantitative data collection period (when all participants will have returned to conventional US training and thus all have experience of learning using real patients) the participants will be allocated to one of three focus groups. Both the control and experimental groups will be equally represented in each focus group in order to incite debate. This will result in 6 people per group in keeping with recommendations from Holloway and Wheeler (2010, p. 129). Each focus group will last approximately 1 hour and will be recorded on a dictaphone by the researcher. Topics for discussion will include simulator realism, image quality, case selection and opinions of simulation based US training.

A focus group was chosen to obtain qualitative data as opposed to a face-to-face interview or questionnaire for a number of different reasons. Whilst a questionnaire would have been cheaper and less time consuming to conduct, this was decided against as the response rate is frequently low and the questions may be misinterpreted or not fully completed (Polit and Beck, 2006, p. 296). A further alternative method considered was that of face-to-face interviews, which would be easier to arrange as opposed to finding a suitable time for a whole group of people to meet, although this would require an increase in the time release from scanning duties required by the researcher. It is also possible as the researcher, to be able to have more control over the topics discussed in an interview in comparison with a focus group (Holloway and Wheeler, 2010, p. 103). However, it was felt that the data collected would be enhanced through less control over the flow of topics and by allowing participants to react to the statements of others and debate with them, as suggested by Polit and Beck (2004, p. 343).

DATA ANALYSIS:

The pre-test scores are used only to aid with dividing participants into strata according to their initial scanning ability. The quantitative data from the post-tests will be analysed using inferential statistics to compare the differences between the two groups in scores for image quality, orientation, accuracy of measurements, time taken, ability to differentiate between normal/abnormal and overall post-test score. Due to the small sample size, the results of the inferential statistics will only be used to infer trends as opposed to drawing definite conclusions about the data as it is appreciated that the risk of making a Type II error is high. All data collected from the post-test will be interval data and therefore SPSS will be used to perform independent T-tests. The quantitative results will also be used to perform a power analysis in order to calculate the sample size needed in further research to obtain significant results.

The qualitative data collected at the focus groups will be transcribed and analysed using theme analysis to identify the main themes arising from the discussions. This analysis will then be correlated with the statistical data to help explain the quantitative results.

RELIABILITY:

As each component of the pre-test is marked by the simulator on whether it is a pass or fail, this test is objective, free from bias and thus reliable. Points are only awarded by the researcher for passed components. This is also true of all of case 2 of the post-test and the assessing anatomy and time taken sections of case 1.

For case 1 of the post-test the stored images of the measurements will be marked by both the researcher and another qualified sonographer for accuracy, image quality, and correct orientation. Interrater reliability will be calculated to ensure consistency in scoring and in accordance with the advice of Langdridge and Hagger-Johnson (2009, p. 81) an interrater reliability coefficient of 0.8 or above will be deemed acceptable.

VALIDITY:

The use of blinding for the post-tests results in increased internal validity and minimises researcher bias (Burns and Grove, 2009, p. 270). Greater confidence in the validity of the results is also possible due to the mixed method study design (Polit and Beck, 2006, p. 245).

A list of the scan components of the pre-test and post-test marked by both the simulator and the assessors will be sent to three experts in US training to assess the content validity of each assessment. A content validity index (CVI) will be calculated and in accordance with advice given by Polit and Beck (2004, p. 422) a CVI of at least 0.80 will be sought. Furthermore, each expert will be asked to grade each marked component as either a basic, intermediate or advanced US skill. The consensus will be used for each component and the number of points awarded for a pass will be weighted according to difficulty of task.

A pilot test of post-test case 1 will be conducted on three qualified sonographers to allow the reliability and validity of the marking sheet used by the assessors for scoring accuracy of measurements, orientation and image quality.

ETHICAL IMPLICATIONS

Ethical approval has been sought from the LREC and NRES and deemed unnecessary. Ethical approval has been granted by the School of Community and Health Sciences at City University, London. Please see attached forms.

A detailed information sheet regarding the project will be given to all potential participants. A signed consent form will be obtained from all participants before the project commences. A copy will be given to the participant and the other copy will be kept by the researcher. Both this and all data collected through the course of the project will be kept by the researcher for 10 years and then destroyed in accordance with local hospital protocol.

All data collected will be confidential and the participants will not be referred to by name on any of the data. Each participant will be allocated a code to which only the researcher has the key. The electronic data will be password protected and the hard copy kept in a lockable file. In accordance with hospital policy verbal permission for the examination to be undertaken by a trainee will be sought from all patients in the control groups teaching lists.

POTENTIAL IMPACT OF STUDY:

- Aid development of a structured introduction to TV US scanning that enables trainees to learn the basic components required.
- Ease pressure on imaging departments to provide US training time and reduce the number of teaching lists required.
- Allow US trainees to practice their TV US skills in a safe environment.
- Enhance the patient's experience of this examination when undertaken by a trainee.
- Improve trainees' abilities in TV US scanning and thus ease pressure on limited number of sonographers.
- Improve the out of hours gynaecology US service.
- Positively change the way that US training is delivered.

DISSEMINATION STRATEGY:

A written summary of the results along with a letter of thanks will be given to all participants. Oral presentations of the results will be given to both the radiology and obstetrics and gynaecology departments within the hospital. A written manuscript of the research project will be submitted for peer review to *Ultrasound*, *Synergy* and *Ultrasound in Obstetrics and Gynaecology* journals. In addition, a poster presentation summarising the research project and its results will be submitted for presentation at the British Medical Ultrasound Society Conference (BMUS) in 2012. Applications will also be made to relevant conferences to present the research project findings. If successful in this funding bid the final report will be published on the Society of Radiographers website.

References:

- Burns, N. & Grove, S. K. (2009). *The Practice of Nursing Research: Appraisal, Synthesis, and Generation of Evidence*. 6th ed. St Louis: Elsevier Saunders.
- Dawson, S. (2006). Procedural Simulation: A Primer. *Radiology*. 241(1) October: 17-25.
- Department of Health. (2000). *The NHS Plan: A plan for investment, a plan for reform*. London: HMSO.
- Donaldson, L. (2009). 150 years of the Annual Report of the Chief Medical Officer: On the State of Public Health 2008. London: Department of Health.
- Gould, D. A., Reekers, J. A., Kessel, D. O., Chalmers, N. C., Sapoval, M., Patel, A. A., Becker, G. J., Lee, M. J. & Stockx, L. (2006). Simulation Devices in Interventional Radiology: Validation Pending. *Journal of Vascular and Interventional Radiology*. 17(2) February: 215-216.
- Heer, I. M., Middendorf, K., Muller-Egloff, S., Dugas, M. & Strauss, A. Ultrasound Training: The Virtual Patient. *Ultrasound in Obstetrics & Gynecology*. 24(4) September: 440-444.
- Holloway, I. & Wheeler, S. (2010). *Qualitative Research in Nursing and Healthcare*. 3rd ed. Chichester: Wiley-Blackwell.
- Langdridge, D. & Hagger-Johnson, G. (2009). *Introduction to Research Methods and Data Analysis in Psychology*. Essex: Pearson Education Limited.
- Maul, H., Scharf, A., Baier, P., Wustemann, M., Gunter, H. H., Gebauer, G. & Sohn, C. (2004). Ultrasound Simulators: experience with the SonoTrainer and comparative review of other training systems. *Ultrasound in Obstetrics & Gynecology*. 24(5) October: 581-585.
- MedGadget. (2010). Transvaginal Haptic Ultrasound Simulator Unveiled [Online]. Available: http://www.medgadget.com/archives/2010/04/transvaginal_haptic_ultrasound_simulator_unveiled.html [Accessed 7 March 2011].
- Monsky, W. L., Levine, D., Mehta, T, S., Kane, R. A., Ziv, A., Kennedy, B. & Nisenbaum, H. (2002). Using a Sonographic Simulator to Assess Residents Before Overnight Call. *American Journal of Roentgenology*. 178(1): 35-39.
- National Health Service Fetal Anomaly Screening Programme. (2010). *NHS Fetal Anomaly Screening Programme: 18+0 to 20+6 Weeks Fetal Anomaly Scan National Standards and Guidance for England* [Online] <http://fetalanomaly.screening.nhs.uk/standardsandpolicies> (Accessed 7 December 2010).
- National Screening Committee (2007). *Antenatal Screening – Working Standards for Down's Syndrome Screening 2007* [Online]. <http://fetalanomaly.screening.nhs.uk/standardsandpolicies> (Accessed 7 December 2010).
- NHS Abdominal Aortic Aneurysm Screening Programme (2009). URL: <http://aaa.screening.nhs.uk/> . [Accessed 7 December 2010].
- Polit, D. F. & Beck, C. T. (2004). *Nursing Research: Principles and Methods*. 7th ed. Philadelphia: Lippincott, Williams & Wilkins.
- Polit, D. F. & Beck, C. T. (2006). *Essentials of Nursing Research: Methods, Appraisal, and Utilization*. 6th ed. Philadelphia: Lippincott, Williams & Wilkins.
- Royal College of Obstetricians and Gynaecologists (n.d). *Joint Statement on Ultrasound Training* [Online]. Available: <http://www.rcog.org.uk/education-and-exams/curriculum/ultrasound/joint-statement-ultrasound-training> [Accessed 7 March 2011].
- Salvesen, K. A., Lees, C. & Tutschek, B. (2010). Basic European training in obstetrics and gynecology: where are we and where do we go from here? *Ultrasound in Obstetrics & Gynecology*. 36(5) November: 525-529.
- The Royal College of Obstetricians and Gynaecologists. (2009). *RCOG Release: RCOG appoints new Director of Simulation* [Online]. Available: <http://www.rcog.org.uk/news/rcog-release-rcog-appoints-new-director-simulation> [Accessed 7 March 2011].

The Royal College of Obstetricians and Gynaecologists. (2010). Module 4: Intermediate: Ultrasound in gynaecology [Online]. Available: http://www.rcog.org.uk/files/rcog-corp/uploaded-files/ED_US_Module_4_Int_Gynae.pdf [Accessed 7 March 2011].

The Royal College of Radiologists. (2010). Simulation in Radiology. London: The Royal College of Radiologists.

The Royal College of Radiologists. (2011). Radiology Direct Observation of Procedural Skills (Rad-DOPS) [Online]. Available: <http://www.rcr.ac.uk/docs/radiology/other/Rad-DOPS%20v4.0.pdf> [Accessed 7 March 2011].

The Society and College of Radiographers. (2009). Developing and Growing the Sonographer Workforce: Education and Training Needs. London: SCoR.