Training and Quality Assurance of Ultrasound in Reproductive Medicine: The Role of Simulation

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Affiliations and Conflicts of Interest

- Director, Cardiff University Ultrasound Masters Programme
- President, British Society for Gynaecological Imaging
- Chair, Imaging SIG, European Society for Gynaecological Endoscopy
- Founder, Director and share holder of MedaPhor Ltd., a Cardiff University spin-out company

Modalities of Training – UK experience

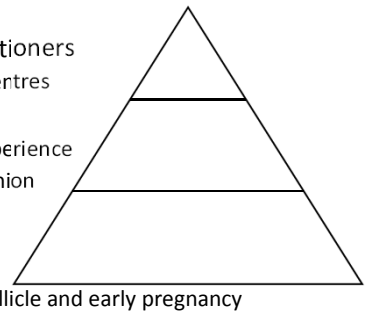
- Structured on the job training from an experienced trainer or mentor
- Formal: face-to-face and short courses or workshops
- Formal: degree courses
- Self-directed learning
- Technology-based e.g. e-learning and/or simulation

Ultrasound Training in the UK

- Evidence for Effectiveness and uptake of skills
  - Non-competency based schemes
    e.g. short theoretical courses – Unknown
  - Short hands-on courses – limited information
  - Competency based schemes – Exit qualification e.g. PgC/PgD or MSc
  - Competency based schemes – OSATS? Impact of frequency of assessments and number of assessors?
  - Conventional approach – apprenticeship?
  - Skills lab and integration of e-learning and simulation in learning process – *Some evidence of benefit is emerging*

Beneficiaries of Training and QA schemes

- Level 3 Practitioners
  - Research centres
- Level 2
  - Years of experience
  - Second opinion
- Level 1
  - Daily clinic scans e.g. baseline, follicle and early pregnancy



RCOG Subfertility and Reproductive Health ATSM

This ATSM is designed to provide more in-depth theoretical and practical training in the management of fertility-related conditions and reproductive endocrinology. It should be undertaken by those trainees who see subfertility forming a significant part of their future consultant role. It is expected that trainees will complete the Intermediate Ultrasound Module in Gynaecology prior to or parallel to completing this ATSM.

Section 3: Endometriosis

Learning outcome: To understand and manage subfertility with reference to endometriosis.

Knowledge criteria	Clinical competence	Professional skills and attitudes	Training support	Evidence and assessment
Understand the anatomy of the abdomen, female genital tract, bladder, ureters and lower bowel	Able to take accurate history and carry out a physical examination, including vaginal-rectal assessment	Sympathy to the symptoms of endometriosis	Appropriate reading material:	Case-based reports and discussions (CbD) to assess application of knowledge
Pathogenesis, epidemiology and classification of endometriosis	Able to perform transvaginal ultrasound scan	Sympathy to the stress related to infertility	NICE guidelines in infertility (www.nice.org.uk)	
Relationship between stages of endometriosis and infertility (defective folliculogenesis, ovulatory dysfunction, distorted pelvic anatomy, altered peritoneal function, autoimmune disorders, impaired implantation)	Able to arrange non-invasive investigations (MRI and USS)	Ability to explain diagnostic and treatment options, risks and benefits, and need for onward referral where appropriate	Journals: *Human Fertility, Human Reproduction, Fertility and Sterility* (www.rcog.org.uk)	Mini-CEX: history and information gathering
Diagnostics for endometriosis, (laparoscopy, MRI, transvaginal ultrasound, immuno-biochemistry)	Able to perform diagnostic laparoscopy	Ability to liaise with other specialists (urologist, general surgeon and radiologist) to optimise patient care and to arrange appropriate referrals to tertiary centres	Regularly attend: gynaecology clinic, infertility clinic, theatre sessions	Mini-CEX: e.g. explanation and planning of the management of endometriosis-associated infertility
	Able to treat early-stage endometriosis (I and II) by laparoscopy	Ability to decide when to operate	Exposure to: ultrasound sessions, assisted conception clinics	OSATS: e.g. pelvic examination, diagnostic laparoscopy, transvaginal ultrasound
	Able to perform laparotomy and laparoscopy for endometrioma		Suitable course relevant to the ATSM	
	Demonstrate competence in setting up laparoscopic equipment, theatre environment, patient positioning, optimisation and recording of images			

Training Course for UK Fertility Practitioners

British Fertility Society
Pelvic Ultrasound Study Day
8-9 June 2011, Copthorne Tara Hotel, London Kensington

Programme – Wednesday 8 June 2011

Time	Topic
09.00 – 09.30	Registration
09.30 – 09.45	Welcome, Introduction and Chair
09.45 – 10.45	Image optimisation and machine controls
10.45 – 11.15	**Coffee**
11.15 – 12.00	Normal anatomy and physiology
12.00 – 12.40	Diagnostic ultrasound
12.40 – 12.45	**Close of morning session**
12.45 – 13.30	**Lunch**
13.30 – 14.15	WORKSHOP ONE - Image optimisation
14.15 – 15.00	WORKSHOP TWO - Clinical scenarios
15.00 – 15.15	**Coffee**
15.15 – 16.00	WORKSHOP THREE - Orientation and measurements
16.00	**Close**

British Fertility Society
Pelvic Ultrasound Study Day
8 - 9 June 2011, Copthorne Tara Hotel, London Kensington

Programme – Thursday 9 June 2011

Time	Topic
09.00 – 09.15	Welcome and Chair
09.15 – 10.00	Ultrasound guided procedures in fertility treatments
10.00 – 10.45	Pelvic Pathology
10.45 – 11.15	**Coffee**
11.15 – 12.00	Early pregnancy scanning
12.00 – 12.30	Follicle tracking / Endometrium measuring
12.30 – 12.40	Close of morning session
12.40 – 13.30	**Lunch**
13.30 – 14.15	WORKSHOP ONE - Abdominal scanning
14.15 – 15.00	WORKSHOP TWO - Early pregnancy
15.00 – 15.45	WORKSHOP THREE - Practical scanning for Pelvic Pathology
15.45 – 16.00	**Close of meeting**

Training Course for UK Fertility Practitioners

British Fertility Society
Pelvic Ultrasound Study Day
13-14 June 2013, Copthorne Tara Hotel, London

Preliminary Programme Day 1

Time	Topic
08.30 – 09.30	Registration
09.30 – 09.45	Welcome, Introduction and Chair
09.45 – 10.30	Image optimisation and machine controls.
10.30– 11.15	Normal anatomy and physiology
11.15 – 11.35	Coffee
11.35 – 12.35	Diagnostic Ultrasound
12.35 – 12.45	Close of morning session
12.45 – 13.30	Lunch
13.30 – 16.00	Workshop 1 – Image optimisation Workshop 2 – Orientation and measurements & coffee Workshop 3 – Introduction to abdominal ultrasound
16:00	Close

British Fertility Society
Pelvic Ultrasound Study Day
13-14 June 2013, Copthorne Tara Hotel, London

Preliminary Programme Day 2

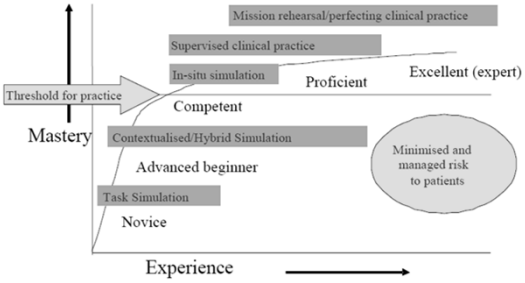
Time	Topic
09.00 – 09.15	Welcome and Chair
09.15 – 10.00	Ultrasound guided procedures in fertility treatments
10.00 – 10.45	Pelvic Pathology
10.45 – 11.15	Coffee
11.15 – 12.00	Early pregnancy scanning
12.00 – 12.30	Follicle Tracking/Endometrium measuring
12.30 – 12.40	Close of morning session
12.40 – 13.30	Lunch
13.30 – 14.15	3D Ultrasound in reproductive medicine
14.15 – 15.00	HyCosy/ Hysterosonography
15.00-15.15	Coffee
15.15-16.00	Applications of Dopla
16.00	Close of meeting

Health Service Education &Training

DH Department of Health

A Framework for Technology Enhanced Learning

Simulation Enhanced Learning



Curran I after Dreyfus HL & Dreyfus HS 1986

What is Blended learning?

- Philosophy; "Learning is a continuous process"
- Combined approach to learning
- Integrated "Blended" use of physical and virtual resources to deliver instruction including all modalities described before

Why Blend?

- Extends the reach
  - Health service employers have fixed commitments in workplace and at diverse locations
- Optimises development cost and time
  - Combining different modes e.g. combining virtual collaborative sessions, recorded e-learning, text assignments and audio PowerPoint presentations
- `It works!
  - Stanford University: Higher completion rate
  - University of Tennessee: Faster and better learning at lower cost

Models of Blended Learning - 1

- Skill-driven: Self Directed and Face-2-Face
  - Requirement: regular feedback and support
  - How? Group-learning, teacher-led overview, demonstrate procedures online or F-2-F, online support and set long-term projects
- Attitude-driven: Mixed delivery media to introduce behavioural change
  - Requirement: Risk-free Peer-2-Peer interaction
  - How? Webinars, group projects, role-play Simulations

Models of Blended Learning - 2

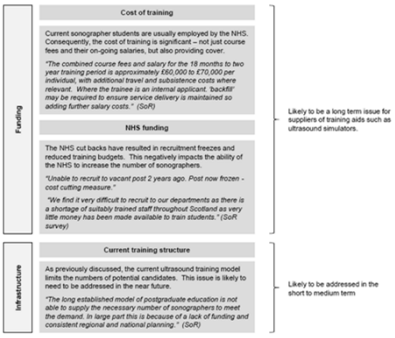
- Competency-driven: Performance support tools plus knowledge, management resources and mentoring to develop workplace competencies
  - Requirement: interacts with experts on the job
  - How? Assign mentors, access to knowledge repository (LMS)

Development of the Blend

- No fixed recipes
- Design your own based on;
  - Experience
  - Observation of "Best Practice" examples
  - Instructional design literature
- Constraints
  - Stability and urgency
  - Touches and cost
  - Learning resource and experience
  - Health Service drivers

Serving the Blend to the NHS

- Health service factors

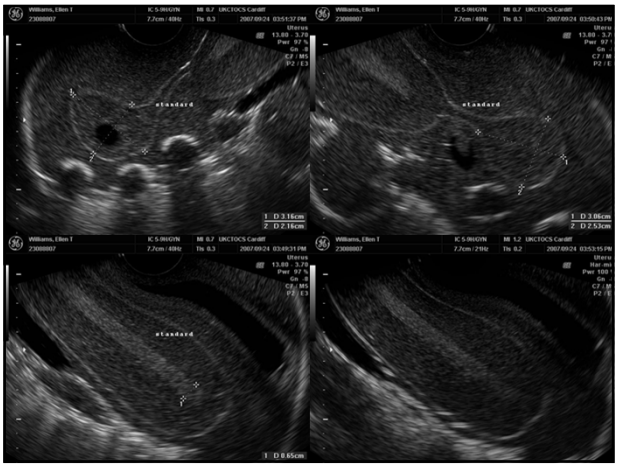


Blended Ultrasound Training Environment components

- Face to face Lectures

- Hands-on with patients
  - Patient recruitment
  - Patient's expectations
  - Intrusive and embarrassing techniques
  - A challenge to organise
  - **Immensely valuable and popular with delegates**
- Practical skills lab training
  - E-learning of the principles of the technique
  - Unlimited practice
  - Small group teaching
  - Realism very limited
- Simulator - Mannequins
  - Extension of the skills lab environment
  - More realism and surprise
  - NO In-built feedback. Need for trainer's presence
  - Useful as a assessment tool and bench-marking

Ultrasound Education on the Web
Narrative and Demonstration of Technique



Physical vs. Virtual Simulators in Ultrasound Training and Education

- Physical Simulators – Tutor required for optimal benefit
  - Machine related skills
  - Image optimisation
  - Eye-hand coordination skills
- Virtual Simulators with NO Haptics and No Feedback – Tutor required
  - Abstract and Procedural tasks
  - Eye-hand coordination
  - Pathology recognition
  - No real feel
- Virtual Simulators with Haptics and Feedback – Tutor NOT required
  - As above PLUS Real Feel &
  - Programmed feed-back metrics and assessment tools

1st European Conference on Simulation in Women's Health
RCOG November 2010

The effectiveness of simulation and e-Learning "Blended Learning Environment" in the acquisition of obstetric and gynaecological ultrasound skill

Amal Al-Salamah & Nazar Amso
Cardiff University School of Medicine

Objectives

- To determine whether trainees' ultrasound skills improve in a short structured US course
- to evaluate the learning outcomes which could be conducted via trainees' assessment

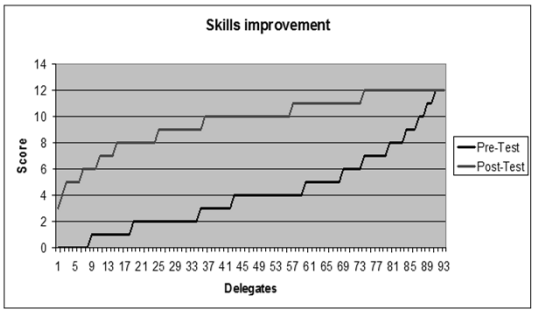
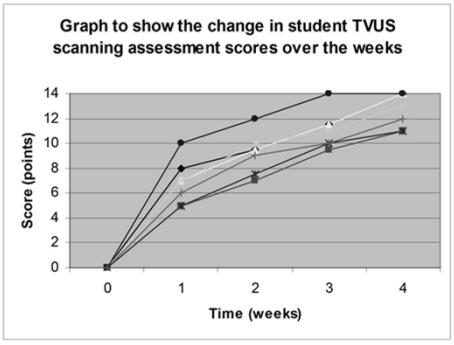


Figure 2: overall workshops skill improvement of all delegates scores in pre- test and post-test

Summary

- **Structured short courses**
  - Blended approach allows unlimited practice before patient scanning
  - Structured assessment check list is a valid too to determine improvement
  - Essential to determine base-line skills before training in order to demonstrate improvement of skills
  - All training grades and categories showed significant improvement
  - Questionnaire showed significant satisfaction after training (data not shown)
- **Limitations**
  - Long term benefit has not been determined
  - No comparison with conventional training

Peer-education Pilot: Cardiff (2009)



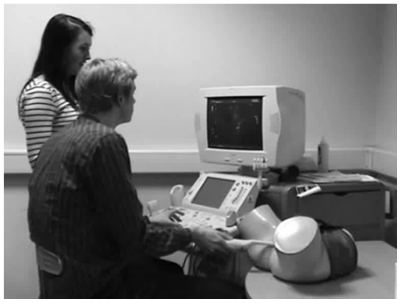
Summary

- Peer education is a valid educational tool
- Structured training with frequent assessments and feedback improves skills level
- Skills may be attained in a relatively short period

Comparison of Two Methods of Teaching Ultrasound Scanning to Medical Students

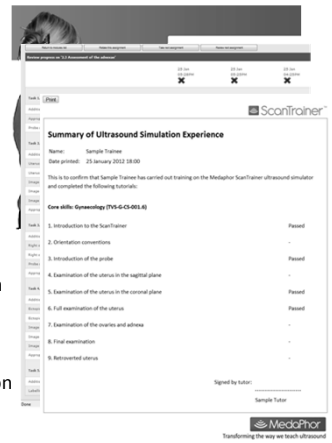
Holly Morgan & Nazar Amso
Cardiff University School of Medicine
June 2010

Mannequin

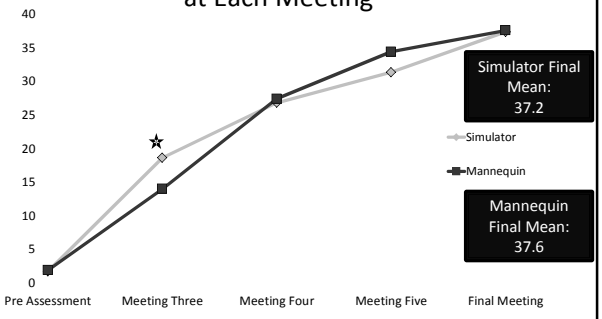


Components of a virtual simulator?

1. Force feed-back "haptic" device
2. Simulated "clever" ultrasound probe
3. Virtual anatomy and interactive probe
4. Simultaneous hand movement and real-time ultrasound image depiction
5. Computer-generated feedback on trainee's performance
6. Measurable skills acquisition
7. End-of-session report



Simulator



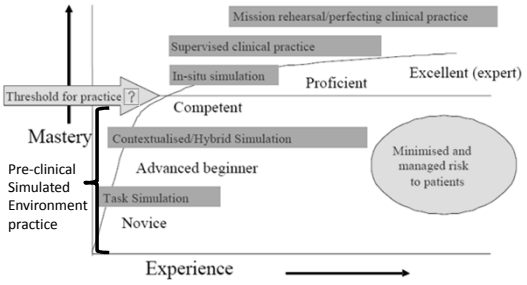
Discussion

- Mannequin
  - One to one- trainee to trainer
  - Good understanding of the basic principles
  - No detailed feedback
  - Minimal benefit without supervisor
- Simulator
  - Modules are curriculum driven
  - Accuracy needed to pass modules
  - Training in one's own time
  - Only intermittent supervision needed
  - Virtual anatomy to guide

Advantages

- A direct comparison
- Groups were randomised
- All participants from the same year therefore had very similar baseline knowledge
- Large amount of data collected
- Highlighted some small issues

Simulation Enhanced Learning



Curran I after Dreyfus HL & Dreyfus HS 1986

Questions?

- Is there evidence that US skills of fertility practitioners improve in a short US course?
  - With or without hands-on element?
- Should fertility practitioners have a basic ultrasound qualification?
- Do they maintain their skills in clinical practice?
- What is the evidence for continuing development and maintenance of skills?
- Is there a role for National or European standards to practice?
- Is there a role for revalidation??

Inter and Intra Observer Variation

- Spandorfer (1998)
  - ET was measured in 63 patients and results compared
  - Intra-observer variation < inter-observer variation
- Bredella (2000)
  - Inter-observer variability related to experience with variability being lower between experienced users compared to in-experienced
- Hertzberg (2005)
  - No correlation between performance and experience

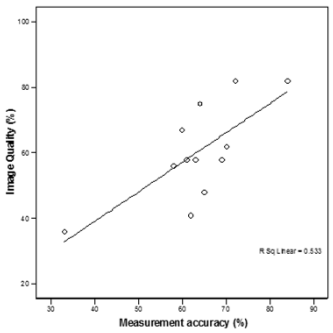
Measurement Accuracy

- Herman (1998)
  - Assessed magnification on calliper placement
  - Better reproducibility as magnification increased
- Bredella (2000)
  - Showed inadequate depth settings caused inaccurate measurements
- Breitkopf (2005)
  - Found greater measurement errors in less experienced users e.g. incorrect image plane and calliper placement
- Gerris (2013)
  - “Shrinking Follicle Syndrome”

Image Quality

- Bredella (2000)
  - Assessed value of QA programme: gain, focus
  - QA programme ensures high-quality images and leads to improvement in performance
- Levine (2008)
  - Assessed factors affecting image quality such as training, experience, speciality
  - Found sonographers specialising in women’s imaging performed best

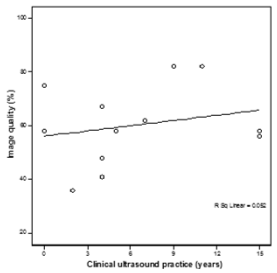
D'Angelo et al: Results

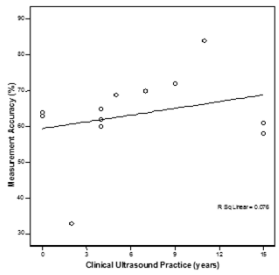


- +ve correlation
- as Image-Quality improves so does the accuracy of measurement and vice versa.

D'Angelo et al: Results

No significant correlation





What does all of this mean?

- Training schemes should;
  - Have clear objectives
  - Be competency based to ensure high standard of training among all practitioners
- Maintenance and improvement of skills is critical through;
  - Enrolment on CPD and QA programmes
  - Regular audit of practice
- Professional bodies/Societies have a duty to ensure high standards of practice through formal guidelines and policies

What Should Ultrasound Guidelines For Doctors/ Midwife/Nurse Sonographers in ART Include?

- Statement of Intent and purpose of guideline
- Professional Guidelines to include;
  - Continuing Professional Development and participation in a recognised CPD programme
  - Follow National or Professional Code of Professional Conduct for doctors/midwifery/nurse sonographers
  - Follow Local clinical governance guidelines
- Clinical care pathways and "what if?" and "what to do?" scenarios for suspected abnormal findings

What Should Ultrasound Guidelines For Doctors/ Midwife/Nurse Sonographers in ART Include?

- Guidelines/Policy for;
  - General information giving before and after the scan include policy on intimate examinations
  - Verbal consent to undertake procedures, image storage/archiving, data handling and possible use for secondary "teaching and training" purposes
  - Cleaning/disinfecting of ultrasound probe
  - Ultrasound machine safety testing, maintenance and software/hardware update

What Should Ultrasound Guidelines For Doctors/ Midwife/Nurse Sonographers in ART Include?

- Standard Reporting Guideline to;
  - Defining what a report is
  - Understanding the medico-legal implications of the report
  - Criteria that must be fulfilled by a midwife/nurse in order to be able to complete a report
  - Take part in a quality assurance and audit exercise
  - Follow local protocols on acquisition, archiving and use of ultrasound data
  - Understand and follow current National legislation on data protection and freedom of information

What Should Ultrasound Guidelines For Doctors/ Midwife/Nurse Sonographers in ART Include?

- Ergonomic Practice Guidelines
  - Prevention and management of work related MSK disorders and repetitive stress injury
  - Managing obese patients (Health and Safety)
  - Ultrasound examination timing
- Practice Specific Professional Bodies Guidelines
  - Gynaecological US examination guidelines (BSGI)
  - Ultrasound examination of postmenopausal women (United Kingdom Collaborative Trial for Ovarian Cancer Screening (UKCTOCS) trial)
  - Early pregnancy assessment guidelines

Thank You for Your Attention