

Ultrasound Training Recommendations for Medical and Surgical Specialties



Faculty of Clinical Radiology
The Royal College of Radiologists

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The Royal College of Radiologists
38 Portland Place
London W1B 1JQ

Telephone 020 7636 4432
Fax 020 7323 3100

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Foreword

The Royal College of Radiologists (RCR) welcomes this document, recognising ultrasound as an evolving technology with wide application throughout medical and surgical practice. Equipment is becoming cheaper, more portable and more widely available, and it is inevitable and appropriate that medical practitioners other than clinical radiologists should seek to develop skills in the performance of ultrasound. The RCR is committed to the development of high quality imaging across the gamut of modalities, and to this end has prepared advice for training in ultrasound across the clinical specialities.

It remains important that ultrasound is seen as part of a co-ordinated imaging service, and this document stresses continued communication with departments of clinical radiology and radiological mentors. The RCR hopes that through the provision of this advice, the access to ultrasound imaging will be significantly improved while maintaining the high quality of imaging services. We acknowledge that for most indications, ultrasound is an outpatient service, however it also contributes to diagnosis and management of patients presenting acutely and to the care of inpatients. It is important that as part of the continued liaison with departments of clinical radiology there is agreed provision for out-of-hours ultrasound imaging.

I would like to thank David Lindsell for his work in leading the production of this advice and the following members of the working party for their contributions and advice.

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Dr Julie Cooke, Jarvis Breast Screening Centre, Guildford
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Dr Michael Weston, St James University Hospital, Leeds

The previous RCR advice *Guidance for the Training in Ultrasound of Medical Non-Radiologists* (BFCR(97)1) is now withdrawn.

Dr Paul Dubbins
Dean
Faculty of Clinical Radiology

1 Introduction

- 1.1 High quality ultrasound services are provided by properly trained and committed practitioners using appropriate quality ultrasound equipment. In the UK, radiologists and sonographic practitioners have traditionally provided such a service from centralised departments of clinical radiology where equipment and manpower can be used cost-effectively.
- 1.2 However, there are increasing demands for ultrasound services to include direct access to facilitate immediate clinical decisions in areas such as 'one-stop' clinics and, potentially, in the newly configured Independent Sector Treatment Centres. Departments of clinical radiology may have difficulty responding to these demands primarily because of the national shortages of radiologists and sonographic practitioners. It is therefore essential that alternative methods of service delivery are considered. These may include the involvement of other professional groups in addition to greater investment in clinical radiology departments.
- 1.3 Medical specialists other than radiologists are increasingly wishing to undertake ultrasound examinations on patients referred to them for their clinical opinion as a direct extension of their clinical examination. This may take place in the outpatient department, on the wards, and in the assessment of emergency patients. Clinicians are also using ultrasound to assist in practical procedures such as central line insertion. Additionally there is a demand by some European training boards to incorporate ultrasound experience into clinical training and accreditation where appropriate.
- 1.4 Radiologists have the skills, experience and commitment to provide guidelines for training of medical non-radiologists and hence influence the quality of service provided for the better. The College believes that this approach, of inter-disciplinary co-operation, serves the interests of patients best.
- 1.5 Training of medical non-radiologists should be adequately funded and planned so that there is no adverse impact on the service provided to patients and the ability of clinical radiology departments to train clinical radiologists and sonographic practitioners.
- 1.6 This document makes recommendations for ultrasound training in the following areas:
 - urological ultrasound
 - gynaecological ultrasound
 - gastrointestinal ultrasound
 - vascular ultrasound
 - breast ultrasound
 - thoracic ultrasound
 - cranial ultrasound in infants
 - focused emergency ultrasound
 - intensive care ultrasound
 - musculoskeletal ultrasound

2 Aims and Principles

- 2.1 The medical use of ultrasound remains highly operator-dependent in spite of advances in technology, and the interests of the patient are best served by the provision of an ultrasound service which offers the maximum clinical benefit and optimal use of resources, i.e., with appropriately trained personnel using equipment of appropriate quality.
- 2.2 All who provide an ultrasound service are ethically and legally vulnerable if they have not been adequately trained. National Health Service (NHS) Trusts in the UK, which provide professional indemnity to practitioners, are unlikely to be able to mount any defence to an action brought against an untrained practitioner. Similarly, the professional defence organisations are unlikely to be successful in mounting a defence against a claim for negligence should an error of diagnosis be made by an untrained practitioner of ultrasound. Advisory guidelines for training in ultrasound provided by the RCR will establish the principles to allow appropriate bodies to provide professional indemnity by setting out training and continuing professional development (CPD) requirements. Trusts, purchasing commissioners and patients should be aware of the requirements for training.
- 2.3 An appropriate level of training in ultrasound is one that allows for the provision of a safe and effective ultrasound service. This may be a purely diagnostic, predominantly interventional, or a clinically focused service. Departments of clinical radiology would normally provide all of these services, but it would be expected that other medical practitioners would deliver only those aspects of ultrasound particularly relevant to their clinical practice. Nonetheless, the training for medical non-radiologists should be to the same standard as those for radiologists, albeit restricted to the relevant and particular area of their clinical expertise. Whereas radiological training provides for the practice of ultrasound across a broad range of medical and surgical specialties, NHS Trusts, purchasing commissioners and patients should be aware of the differences in the comparative depth and breadth of training, and hence ultrasound skills, between trained radiologists and trained medical non-radiologists.
- 2.4 The RCR has worked closely for many years with the Royal College of Obstetricians and Gynaecologists (RCOG) to ensure adequate training in obstetric ultrasound. The joint Diploma in Obstetric Ultrasound is currently being reviewed, and obstetric ultrasound is not covered in this publication. It is also recognised that the RCOG has its own 'special skills training module for ultrasound imaging in the management of gynaecological conditions' and a number of radiologists act as preceptors for this. However a syllabus for gynaecological ultrasound has been included as there may be other groups (e.g., general practitioners) who might wish to train in this area.
- 2.5 The European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) has proposed minimal training requirements for the practice of medical ultrasound in Europe. These are supported by the RCR and the British Medical Ultrasound Society.
- 2.6 Three levels of minimum training requirements are proposed in this document.

2.6.1 Level 1

Practice at this level would usually require the following abilities:

- to perform common examinations safely and accurately
- to recognise and differentiate normal anatomy and pathology
- to diagnose common abnormalities within certain organ systems
- to recognise when a referral for a second opinion is indicated
- to understand the relationship between ultrasound imaging and other diagnostic imaging techniques

Within most medical specialties the training required for this level of practice would be gained during conventional postgraduate specialist training programmes. In the UK this level of training would equate to the end of basic training in ultrasound of radiology specialist registrars (SpRs) in year 3/4 of training. It would also be equivalent to a holder of, for example, the RCOG special skills training module in gynaecological ultrasound imaging.

2.6.2 Level 2

Practice at this level would usually require **most or all** of the following abilities:

- to accept and manage referrals from Level 1 practitioners
- to recognise and correctly diagnose almost all conditions within the relevant organ system and to have sufficient understanding of ultrasound depiction of pathology to optimise the referral of the patient if the condition falls outwith the practitioner's skills
- to perform common non-complex ultrasound guided invasive procedures
- to teach ultrasound to trainees and Level 1 practitioners
- to conduct some research in ultrasound

The training required for this level of practice would be gained during a period of subspecialty training which may either be within or after the completion of a specialist training programme. This would equate to the level of training in radiology at the time of acquiring the CCST, assuming that part of the fifth year of subspecialty training had involved ultrasound.

2.6.3 Level 3

This is an advanced level of practice, which includes **some or all** of the following abilities:

- to accept tertiary referrals from Level 1 and Level 2 practitioners
- to perform specialised ultrasound examinations
- to perform advanced ultrasound-guided invasive procedures
- to conduct substantial research in ultrasound
- to teach ultrasound at all levels
- to be aware of and to pursue developments in ultrasound

In the UK this would equate to a consultant radiologist with a subspecialty practice which includes a significant commitment to ultrasound.

- 2.7 The boundaries between the three levels are difficult to define precisely and the above should only be regarded as a guide to different levels of competence and experience. In the detailed syllabuses attached to this document in Appendices 2–10 an attempt is made to indicate more specifically the type of experience required for each level of training. Training in musculoskeletal ultrasound does not lend itself easily to 'levels' of training and instead a 'modular' approach is recommended (Appendix 11).
- 2.8 The training of medical non-radiologists should foster relationships between radiological and non-radiological medical practitioners so that mutual support continues beyond the initial training period. Ideally a radiologist would continue to act as a mentor for a medical non-radiologist undertaking ultrasound after their training is completed. In addition regular clinico-radiological meetings should continue in order to ensure an integrated approach to any further imaging that may be required.
- 2.9 A system for recording the results of any ultrasound examination in the patients' record is mandatory. The permanent recording of images, where appropriate, is desirable for the purposes of correlative imaging, future comparison and audit.
- 2.10 Knowledge of the appropriate use and integration of other imaging techniques, as well as the clinical and economic impact of ultrasound on the demand for other imaging, should be required.
- 2.11 The requirement to deliver training for medical non-radiologists must acknowledge the time commitment of the trainer and trainee, the provision of funding, the content and practicability of the syllabus and the availability of trainers and training courses. It is essential that there should be no adverse effects on trainees in radiology and sonography. It must be recognised that training requires additional time, space and equipment. Training should be properly costed and funded.
- 2.12 Training should be related to the specialist requirements of the trainee, i.e., training should be modular. Within any one level of training it may be appropriate for a trainee to become proficient in some but not all of the individual modules and only undertake ultrasound practice in this /these areas.

- 2.13 Training should be given in departments which have a multidisciplinary (medical, surgical, radiological etc.) philosophy, an adequate throughput of work, a radiologist or sonographic practitioner with experience and an interest in training in the module required, appropriate equipment and an active audit process. The role of sonographic practitioners in delivering some or all of this modular training should be formally recognised and agreed.
- 2.14 Regular appraisal should take place during the training period. It must be recognised that not all trainees have the aptitude to undertake ultrasound scanning and that, some, despite undergoing training, may not acquire the appropriate skills ever to practise independently. At the end of a period of training a 'competency assessment' form should be completed for each trainee, which will determine the area or areas in which they can practise independently (see Section 3). The responsibility to be adequately trained and to maintain those skills lies with the individual practising ultrasound. An assessment of competence is a reflection on the position at the time the assessment is undertaken and no more. If sonographic practitioners are involved with competence assessment then they should be fully supported in this respect by a responsible radiologist experienced in ultrasound or other ultrasound trained medical practitioner.
- 2.15 Following training, regular and relevant continuing medical education (CME/CPD) should be undertaken and documented. It is the responsibility of the trainee to ensure that their practical skills are maintained by ensuring that regular ultrasound sessions are undertaken and that there is an adequate range of pathology seen in their ultrasound practice.

3 Training Recommendations

Training should consist of both theoretical and practical syllabuses.

3.1 Theoretical training

- 3.1.1 Preliminary theoretical training should cover the physics of ultrasound, levels and sophistication of equipment, image recording, reporting, artefacts and the relevance of other imaging modalities to ultrasound. This element of training may be best delivered by linking with some of the excellent courses run by university departments accredited by the Consortium for the Accreditation of Sonographic Education (CASE).
- 3.1.2 The theoretical syllabus is set out in Appendix 1.

3.2 Practical training

- 3.2.1 A syllabus for each area of ultrasound specialisation structured into the three levels of training has been developed incorporating theoretical training on anatomy and pathology and a practical syllabus listing conditions which should be included in the experience of the trainee (Appendices 2–10). A modular anatomical approach is recommended for musculoskeletal ultrasound (e.g., a trainee may become proficient in shoulder ultrasound alone), as set out in Appendix 11. In other areas of ultrasound specialisation, in appropriate circumstances, a limited anatomical or modular approach may also be acceptable if full competence in that area is demonstrated and future clinical practice is confined to that area alone.
- 3.2.2 Practical experience should be gained under the guidance of a named supervisor trained in ultrasound within a training department. In the context of advice from the RCR, this would normally be in a department of clinical radiology. There may be some areas of ultrasound practice which are not covered by these modules such as intra-operative ultrasound and transcranial Doppler ultrasound. Where required, training modules based on similar principles should be developed for any area of ultrasound practice not covered in this publication.
- 3.2.3 The syllabuses set out in Appendices 2–11 include a competency assessment sheet for training. This should be completed during the course of training as it will help to determine in which areas(s) the trainee can practise independently (see section 2.14).
- 3.2.4 The requirements for the different levels of training are as follows:
 - 3.2.4.1 **Level 1**
 - Different trainees will acquire the necessary skills at different rates and the end-point of the training programme should be judged by an assessment of practical competence.
 - Examinations should encompass the full range of pathological conditions listed in the syllabuses.
 - A logbook listing the number and type of examinations undertaken by the trainee themselves should be kept.
 - An illustrated logbook of specific normal and abnormal findings may be appropriate for some syllabuses.
 - Training should usually be supervised by a Level 2 practitioner. In certain circumstances it may be appropriate to delegate some or most of this supervision to a Level 1 practitioner with at least 2 years' experience of Level 1 practice.
 - 3.2.4.2 **Level 2**
 - This usually requires at least 1 year of experience at Level 1, with the equivalent of at least one session per week.

- A significant further number of examinations should have been undertaken in order to encompass the full range of conditions and procedures encountered in each module.
- A logbook listing the numbers and types of examinations undertaken by the trainee should be maintained.
- An illustrated logbook of specific normal and abnormal findings may be appropriate for some syllabuses.
- Supervision of training should be undertaken by someone who has achieved at least Level 2 competence and has had at least 2 years' experience at that Level.

3.2.4.3 Level 3

- This requires practitioners to spend a significant part of their time undertaking ultrasound examinations, teaching, research and development.
- They will have spent a continuous period of sub-specialist training in which ultrasound will have been a significant component.
- They will be able to perform specialised examinations at the leading edge of ultrasound practice such as the use of intravascular ultrasound contrast agents and the performance of advanced ultrasound-guided invasive procedures.

3.2.5 The syllabuses for each area of ultrasound specialisation are outlined in Appendices 2–11.

4 Continuing Medical Education and Professional Development

- 4.1 The minimum amount of on-going experience in ultrasound as outlined in each syllabus should be maintained.
- 4.2 CME/CPD should be undertaken which incorporates elements of ultrasound practice.
- 4.3 Regular audit of the individual's ultrasound practice should be undertaken to demonstrate that the indications, performance and diagnostic quality of the service are all satisfactory.

Approved by the Board of the Faculty of Clinical Radiology: 2 July 2004

Approved by Council: 23 July 2004

Appendix 1: Recommended Theory Syllabus

This basic theoretical training is a prerequisite to any practical training in ultrasound.

Physics and instrumentation

- The basic components of an ultrasound system.
- Types of transducer and the production of ultrasound, with an emphasis on operator controlled variables.
- Use of ultrasound controls.
- An understanding of the frequencies used in medical ultrasound and the effect on image quality and penetration.
- The interaction of ultrasound with tissue including biological effects.
- The safety of ultrasound and of ultrasound contrast agents.
- The basic principles of real time and Doppler ultrasound including colour flow and power Doppler.
- The recognition and explanation of common artefacts.
- Image recording systems.

Ultrasound techniques

- Patient information and preparation.
- Indications for examinations.
- Relevance of ultrasound to other imaging modalities.
- The influence of ultrasound results on the need for other imaging.
- Scanning techniques including the use of spectral Doppler and colour Doppler.

Administration

- Image recording.
- Image storing and filing.
- Reporting.
- Medico-legal aspects—outlining the responsibility to practise within specific levels of competence and the requirements for training.
- Consent.
- The value and role of departmental protocols.
- The resource implications of ultrasound use.

Appendix 2: Urological Ultrasound

Level 1: Training and Practice

- Practical training should involve at least one ultrasound list per week over a period of 3–6 months, with approximately 5–10 examinations performed by the trainee (under supervision) per session.
- A minimum of 250 examinations should be undertaken. However, different trainees will acquire the necessary skills at different rates, and the end point of the training programme should be judged by an assessment of competencies.
- Examinations should encompass the full range of pathological conditions listed below.
- A logbook listing the types of examinations undertaken should be kept.
- Training should be supervised either by someone who has obtained at least Level 2 competence in urological ultrasound or by a Level 1 practitioner with at least two 2 years' experience of Level 1 practice.
- Trainees should attend an appropriate theoretical course and should read appropriate textbooks and literature.
- During the course of training the competency assessment sheet should be completed as this will determine in which area or areas the trainee can practise independently.

Level 1: Knowledge Base

- Physics and technology, ultrasound techniques and administration (see Appendix 1)
- Sectional and ultrasonic anatomy
 - kidneys
 - ureters
 - other retro-peritoneal structures (adrenals, aorta, i.v.c.)
 - bladder
 - seminal vesicles
 - prostate
 - scrotal contents
 - other pelvic structures (uterus, ovaries, lymph nodes, vessels, bowel)
- Pathology in relation to ultrasound
 - kidneys: congenital anomalies, cysts, tumours (benign and malignant), stones, collecting system dilatation, renal and peri-renal abscesses, trauma, diffuse renal diseases
 - ureters: dilatation, obstruction
 - bladder: tumours, diverticula, wall thickening, calculi, volume estimation
 - prostate: zonal anatomy, infection, hyperplasia, tumours
 - scrotal contents: testicular tumours, cysts, torsion, hydrocele, inflammatory problems, trauma

Level 1: Competencies to be Acquired

- Kidneys
 - To be able to:
 - perform a thorough ultrasound examination of the kidneys in different planes
 - recognise normal renal ultrasonic anatomy and common normal variants
 - measure renal length and assess variation from normality
 - recognise and assess the degree of collecting system dilatation
 - recognise and diagnose simple cysts
 - recognise complex cysts and refer for appropriate further investigation
 - recognise renal tumours and refer for appropriate further investigation
 - recognise and diagnose renal stones
 - recognise peri-renal abnormalities and refer for appropriate further investigation
 - recognise abnormalities which need referral for scanning by a more experienced ultrasonologist and/or further investigation

Appendix 2: Urological Ultrasound *continued*

- Bladder
To be able to:
 - perform a thorough ultrasound examination of the bladder in different planes
 - recognise normal ultrasonic anatomy of the bladder and common normal variants
 - measure bladder volume
 - recognise and diagnose bladder diverticula
 - recognise and assess bladder tumours
 - recognise bladder calculi
 - use colour Doppler to assess ureteric jets
 - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation
- Scrotum
To be able to:
 - perform a thorough ultrasound examination of the scrotal contents in different planes
 - recognise normal ultrasonic anatomy of the testes and epididymi and common normal variants
 - recognise and diagnose epididymal cysts
 - recognise and diagnose varicoceles
 - use Doppler to help differentiate torsion/inflammatory problems
 - recognise and assess intra-scrotal and intra-testicular calcifications
 - recognise and assess testicular tumours
 - recognise inflammatory changes in testes and epididymides
 - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation
- Prostate
To be able to:
 - recognise normal ultrasonic anatomy and common normal variants
 - perform trans-rectal ultrasound
 - measure prostatic volume
 - identify abnormal focal lesions
 - perform a standardised technique of trans-rectal prostatic biopsy
 - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation
- Other
To be able to recognise and, where appropriate, refer for further investigation:
 - normal aorta and aortic aneurysm
 - normal liver and liver masses
 - normal uterus and ovaries and gynaecological masses
- To be able to use ultrasound in the assessment of patients presenting with:
 - haematuria
 - loin pain/renal colic
 - loin mass
 - lower urinary tract symptoms
 - recurrent urinary tract infections
 - supra-pubic mass
 - palpable masses in the scrotum
 - scrotal pain

Level 2: Training and Practice

- Practical training should involve at least 1 year of experience at level 1 with a minimum of one session per week.
- A further 600 examinations should have been undertaken in order to encompass the full range of conditions and procedures referred to below.
- A logbook listing all examinations undertaken should be kept.
- Supervision of training should be undertaken by someone who has achieved at least Level 2 competence in urological ultrasound, has had at least 2 years' experience at that Level, and who would normally be of consultant status.
- A Level 2 practitioner will be able to accept referrals from Level 1 practitioners.

Appendix 2: Urological Ultrasound *continued*

Level 2: Knowledge Base

- Physics and technology
 - in-depth knowledge and understanding of the physics of ultrasound
 - in-depth knowledge and understanding of the technology of ultrasound equipment
- Ultrasound techniques
 - the advanced use of Doppler ultrasound, including spectral, colour and power Doppler
 - the use of ultrasound for guiding interventional procedures
 - further applications of trans-abdominal ultrasound
 - further application of endo-cavity ultrasound (e.g., trans-vaginal ultrasound)
 - intra-operative ultrasound
- Sectional and ultrasonic anatomy
 - the normal renal and pelvic vasculature, including an understanding of the Doppler signals obtained from these vessels
 - more detailed knowledge of structures outside the urinary tract in the abdomen and pelvis
 - ultrasound anatomy of the penis and female genital organs

Level 2: Competencies to be Acquired

- Competencies will have been gained during training for Level 1 practice, and then refined during a period of clinical practice.
- Kidneys, bladder, prostate, scrotal contents
 - To be able to:
 - recognise all pathology affecting the urinary tract and provide an accurate diagnosis in almost all cases
 - recognise abnormalities which are out with his/her experience and refer on appropriately
 - perform ultrasound-guided invasive procedures, including cyst aspiration, abscess drainage, renal biopsy, percutaneous nephrostomy and supra-pubic bladder catheter insertion
 - perform Doppler ultrasound studies relevant to the urinary tract
 - recognise abnormalities elsewhere in the abdomen and pelvis which need referral for scanning by another ultrasonologist and/or further investigation

Level 3: Training and Practice

- A Level 3 practitioner is likely to spend the majority of their time undertaking urological ultrasound, teaching, research and development and will be an 'expert' in this area.
- He/she will have spent a continuous period of specialist training in urological ultrasound.
- He/she will perform specialised examinations at the leading edge of ultrasound practice.
- He/she will accept tertiary referrals from Level 1 and Level 2 practitioners and will perform specialised examinations (e.g., the use of intravascular ultrasound agents in evaluating possible malignancy) as well as performing advanced ultrasound-guided invasive procedures.

Maintenance of Skills: All Levels

- Having been assessed as competent to practise there will be a need for CPD and maintenance of practical skills.
- A specialist registrar will need to continue to perform ultrasound scans throughout the remainder of their training programme. Such further ultrasound practice may be intermittent, but no more than 3 months should elapse without trainees using their ultrasound skills, and at least 100 examinations should be performed per year.
- A medical practitioner performing Level 1 ultrasound should continue to perform at least 250 ultrasound examinations per year on a regular basis, should have regular meetings with radiological colleagues and should have a named radiologist as an 'ultrasound mentor'.
- Practitioners should:
 - include ultrasound in their ongoing CME
 - audit their practice
 - participate in multidisciplinary meetings
 - keep up to date with relevant literature

Approved by the British Association of Urological Surgeons.

Appendix 2: Urological Ultrasound Training Competency Assessment Sheet

| Core Knowledge Base — Level 1 | | Trainee | Trainer | | |
|--|-------------------|-------------------------------------|---------|-------------------|-------|
| Physics and technology | Trainer signature | _____ | _____ | Trainer signature | _____ |
| Practical instrumentation/use of ultrasound controls | Trainer signature | _____ | _____ | Trainer signature | _____ |
| Ultrasound techniques | Trainer signature | _____ | _____ | Trainer signature | _____ |
| | Date | _____ | _____ | Date | _____ |
| | | Administration | | | |
| | | Sectional and ultrasonic anatomy | | | |
| | | Pathology in relation to ultrasound | | | |

Competencies/Skills to be Acquired — Level 1

To be competent to perform/diagnose the following:

Kidneys

- ultrasound examination in different planes
- ultrasonic anatomy and common normal variants
- renal length and variation from normality
- collecting system dilatation
- simple cysts
- complex cysts
- tumours
- stones
- peri-renal abnormalities

Trainer signature

Date

Scrotum

- ultrasound examination in different planes
- ultrasonic anatomy and common normal variants
- epididymal cysts
- varicoceles
- intra-scrotal and intra-testicular calcifications
- tumours
- inflammatory changes in testes and epididymides
- use Doppler to help differentiate torsion/inflammatory problems

Trainer signature

Date

Bladder

- ultrasound examination in different planes
- ultrasonic anatomy and common normal variants
- bladder volume
- diverticula
- tumours
- calculi
- use colour Doppler to assess ureteric jets

Other

- to be able to recognise:
 - normal aorta and aortic aneurysm
 - normal liver and liver masses
 - normal uterus and ovaries and gynaecological masses
- use ultrasound in the assessment of patients presenting with:
 - haematuria
 - loin pain/renal colic
 - loin mass
 - lower urinary tract symptoms
 - recurrent urinary tract infection
 - supra-pubic mass
 - palpable scrotal masses
 - scrotal pain
- know when to refer to a more expert ultrasonologist

Trainer signature

Date

Other

- to be able to recognise:
 - normal aorta and aortic aneurysm
 - normal liver and liver masses
 - normal uterus and ovaries and gynaecological masses
- use ultrasound in the assessment of patients presenting with:
 - haematuria
 - loin pain/renal colic
 - loin mass
 - lower urinary tract symptoms
 - recurrent urinary tract infection
 - supra-pubic mass
 - palpable scrotal masses
 - scrotal pain
- know when to refer to a more expert ultrasonologist

Trainer signature

Date

Appendix 2: Urological Ultrasound Training Competency Assessment Sheet *continued*

| | | |
|--------------------------------------|---------|---------|
| Core Knowledge Base — Level 2 | Trainee | Trainer |
|--------------------------------------|---------|---------|

Physics and technology
Ultrasound techniques

| | | |
|-------------------|----------------------------------|-------------------|
| Trainer signature | Sectional and ultrasonic anatomy | Trainer signature |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| | Date | Date |

Competencies/Skills to be Acquired — Level 2

To be competent to perform/recognise the following:

- pathology affecting the urinary tract and provide an accurate diagnosis in almost all cases
- abnormalities which are out with personal experience and refer on appropriately
- ultrasound-guided invasive procedures, including cyst aspiration, abscess drainage, renal biopsy, percutaneous nephrostomy and supra-pubic bladder catheter insertion

| | | |
|-------------------|-------|-------------------|
| Trainer signature | Date | Trainer signature |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| | Date | Date |

- Doppler ultrasound studies relevant to the urinary tract
- abnormalities elsewhere in the abdomen and pelvis which need referral for scanning by another ultrasonologist and/or further investigation

Appendix 3: Gynaecological Ultrasound

Level 1: Training and Practice

- Practical training should involve at least 30 ultrasound sessions within a period of 6 months with approximately 5–10 examinations performed by the trainee (under supervision) per session. However, different trainees will acquire the necessary skills at different rates and the end point of the training programme should be judged by an assessment of competencies.
- Examinations should encompass the full range of pathological conditions listed below.
- A logbook listing the type of examinations undertaken should be kept.
- Training should be supervised either by someone who has obtained at least Level 2 competence in gynaecological ultrasound, or by a Level 1 practitioner with at least 2 years' experience of Level 1 practice.
- Trainees should attend an appropriate theoretical course and should read appropriate textbooks and literature.
- During the course of training the competency assessment sheet should be completed as this will determine in which area or areas the trainee can practise independently.

Level 1: Knowledge Base

- Physics and technology, ultrasound techniques and administration (see Appendix 1)
- The techniques of transabdominal and transvaginal scanning are essential. A full understanding of the issues relating to the performance of intimate examinations and the importance of informed consent for the procedures is emphasised.
- Sectional and ultrasonic anatomy
 - uterus (including physiological changes with age and cycle)
 - ovaries (including physiological changes with age and cycle)
 - cervix and vagina
 - first trimester gestation appearances
 - kidneys
 - bladder and urethra
 - lymph nodes
 - associated structures; omentum and peritoneal fluid
- Pathology in relation to ultrasound
 - uterus: fibroids, adenomyosis, intra-uterine contraceptive devices (IUCDs), endometrial hyperplasia, polyps and tumours
 - ovaries: cysts and their complications, torsion, endometrioma, tumours, inflammation and infection, polycystic and hyperstimulated ovaries
 - fallopian tubes: hydro/pyo-salpinges
 - cervix and vagina: congenital lesions, cysts, tumour, retained foreign bodies
 - first trimester: dating, counting, chorionicity, haemorrhage, signs of non-viability, retained products of conception, ectopic pregnancy
 - kidneys: hydronephrosis, stones, tumour
 - bladder and urethra: tumours, diverticula, wall thickening, calculi, volume estimation, peri-urethral cysts and abscesses
 - other pelvic pathology: lymph nodes, bowel masses, vascular anomalies

Appendix 3: Gynaecological Ultrasound *continued*

Level 1: Competencies to be Acquired

- Early pregnancy
To be able to:
 - date pregnancy
 - recognise signs of non-viability
 - identify multiple pregnancy and chorionicity
 - recognise signs of haemorrhage
 - recognise signs of retained products of conception
 - recognise signs of ectopic pregnancy
- Abnormal vaginal bleeding
To be able to recognise:
 - features of fibroids and their localisation
 - appearances of IUCDs and their localisation
 - normal and abnormal endometrial thickness
 - the features of atrophic and hyperplastic endometrium
 - the features of endometrial polyps
 - when further investigation is required and what to ask for
- Pelvic pain
To be able to recognise:
 - the features of ovarian cyst torsion, rupture or haemorrhage
 - the features of endometrioma
 - appearances of hydrosalpinges
 - the features of pelvic inflammatory disease
 - non-gynaecological causes of pelvic pain
- Pelvic mass
To be able to recognise:
 - typical appearances of uterine and ovarian masses
 - features indicating benign or malignant pathology
 - non-gynaecological causes of a pelvic mass
- Reproductive medicine
To be able to recognise:
 - features of the endometrium at different stages of the menstrual cycle
 - features of the ovary at different stages of the menstrual cycle
 - features of a stimulated and hyperstimulated ovary
 - features of a polycystic ovary
- Kidneys
To be able to:
 - perform a thorough ultrasound examination of the kidneys in different scan planes
 - recognise normal renal ultrasonic anatomy and common normal variants
 - measure renal length and assess variation from normality
 - recognise and assess the degree of collecting system dilatation
 - recognise renal cysts
 - recognise renal tumours
 - recognise renal stones
 - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation

Appendix 3: Gynaecological Ultrasound *continued*

- Bladder
To be able to:
 - perform a thorough ultrasound examination of the bladder in different planes
 - recognise normal ultrasonic anatomy of the bladder and common normal variants
 - measure bladder volume
 - recognise and diagnose bladder diverticula
 - recognise bladder tumours
 - recognise bladder calculi
 - recognise abnormalities which need referral for scanning by a more experienced ultrasonologist and/or further investigation

Level 2: Training and Practice

- Practical training should include at least 1 year of experience at Level 1 with a minimum of the equivalent of one session per week.
- A further 600 examinations should have been undertaken in order to encompass the full range of conditions and procedures referred to below.
- A logbook listing all examinations undertaken should be kept.
- Supervision of training should be undertaken by someone who has achieved at least Level 2 competence in gynaecological ultrasound, has had at least 2 years' experience at that level, and who would normally be of consultant status.
- A Level 2 practitioner will be able to accept referrals from Level 1 practitioners.

Level 2: Knowledge Base

- Physics and technology
 - in-depth knowledge and understanding of the physics of ultrasound
 - in-depth knowledge and understanding of the technology of ultrasound equipment
- Ultrasound techniques
 - the advanced use of Doppler ultrasound, including spectral, colour and power Doppler
 - the use of ultrasound for guiding interventional procedures
 - further applications of trans-abdominal ultrasound
 - further applications of trans-vaginal ultrasound: saline infusion hystero-graphy (SIH), HyCoSy
- Sectional and ultrasonic anatomy
 - The normal pelvic and gynaecological organ vasculature, including an understanding of the Doppler signals obtained from these vessels
 - More detailed knowledge of structures outside the female reproductive tract in the abdomen and pelvis

Level 2: Competencies to be Acquired

- Competencies will have been gained during training for Level 1 practice, and then refined during a period of clinical practice.
- Female reproductive tract
To be able to:
 - recognise and correctly diagnose almost all pathology affecting the female genito-urinary tract
 - perform ultrasound-guided invasive procedures, including ascitic drainage, omental biopsy, pelvic mass biopsy (TA or TV), lymph node aspiration, SIH and HyCoSy
 - perform Doppler ultrasound studies relevant to the uterus and ovaries
 - recognise abnormalities elsewhere in the abdomen and pelvis which need referral for scanning by another ultrasonologist and/or further investigation
 - stage ovarian and uterine tumours

Appendix 3: Gynaecological Ultrasound *continued*

- In addition specifically to be able to recognise and evaluate:
 - causes of an abnormal Doppler waveform.
 - changes associated with precocious puberty, thelarche, adrenarche and virilisation
 - congenital anomalies
 - features of lymph nodes in the inguinal and iliac chains
 - Bartholin's cysts, abscesses and peri-urethral lesions
 - features of haematocolpos
 - features of adenomyosis
 - non-ovarian endometriosis
 - non-gynaecological causes of pelvic pain and how to diagnose appendicitis, inflammatory bowel disease, bowel cancer, hernias, aneurysms and bladder disease
 - different types of complex ovarian masses
 - malignant disease of the omentum, peritoneum and the rest of the abdomen
 - features of pleural effusions
 - common sites and features of tumours that metastasise to the pelvis
 - the principles of oocyte collection by transvaginal ultrasound guided aspiration of follicles

Level 3: Training and Practice

- A Level 3 practitioner is likely to spend the majority of their time undertaking gynaecological ultrasound, teaching, research and development.
- He/she will have spent a continuous period of specialist training in gynaecological ultrasound.
- He/she will accept tertiary referrals from Level 1 and 2 practitioners.
- He/she will perform specialised examinations at the leading edge of ultrasound practice.

Maintenance of Skills: All Levels

- Having been assessed as competent to practise there will be a need for CPD and maintenance of practical skills.
- A specialist registrar will need to continue to perform ultrasound throughout the remainder of his/her training programme. Such further ultrasound practice may be intermittent, but no more than 3 months should elapse without the trainee using his/her scanning skills, and at least 100 scans should be performed per year.
- A medical practitioner performing Level 1 ultrasound should continue to perform at least 250 ultrasound examinations per year on a regular basis, should have regular meetings with radiological colleagues and should have a named radiologist as an 'ultrasound mentor'.
- Practitioners should:
 - include ultrasound in their ongoing CME
 - audit their practice
 - participate in multidisciplinary meetings
 - keep up to date with relevant literature

Appendix 3: Gynaecological Ultrasound Training Competency Assessment Sheet

| Core Knowledge Base — Level 1 | | Trainee | Trainer |
|--|---|---------|-------------------|
| Physics and technology | Trainer signature | Date | Trainer signature |
| Practical instrumentation/use of ultrasound controls | _____ | _____ | _____ |
| Ultrasound techniques | _____ | _____ | _____ |
| | Administration | | |
| | Techniques of transabdominal and transvaginal scanning | | |
| | Issues regarding intimate examinations and informed consent | | |
| | Sectional and ultrasonic anatomy | | |
| | Pathology in relation to ultrasound | | |

Competencies/Skills to be Acquired — Level 1

To be competent to perform/diagnose the following:

| | | | |
|---|-------------------|-------|-------------------|
| Early pregnancy | Trainer signature | Date | Trainer signature |
| • dating pregnancy | _____ | _____ | _____ |
| • signs of non-viability | _____ | _____ | _____ |
| • multiple pregnancy and chorionicity | _____ | _____ | _____ |
| • haemorrhage | _____ | _____ | _____ |
| • retained products of conception | _____ | _____ | _____ |
| • ectopic pregnancy | _____ | _____ | _____ |
| Vaginal bleeding | _____ | _____ | _____ |
| • fibroids and their localisation | _____ | _____ | _____ |
| • IUCDs and their localisation | _____ | _____ | _____ |
| • normal and abnormal endometrial thickness | _____ | _____ | _____ |
| • atrophic and hyperplastic endometrium | _____ | _____ | _____ |
| • endometrial polyps | _____ | _____ | _____ |
| Pelvic pain | _____ | _____ | _____ |
| • ovarian cyst complications | _____ | _____ | _____ |
| • endometriosis | _____ | _____ | _____ |
| • pelvic inflammatory disease | _____ | _____ | _____ |
| • non-gynaecological causes of pain | _____ | _____ | _____ |
| Pelvic mass | _____ | _____ | _____ |
| • identification | _____ | _____ | _____ |
| • organ of origin of mass | _____ | _____ | _____ |
| • benign versus malignant features | _____ | _____ | _____ |
| Reproductive medicine | _____ | _____ | _____ |
| • endometrial changes with menstrual cycle | _____ | _____ | _____ |
| • ovarian changes with menstrual cycle | _____ | _____ | _____ |
| • polycystic ovaries | _____ | _____ | _____ |
| • stimulated and hyperstimulated ovaries | _____ | _____ | _____ |
| Kidneys | _____ | _____ | _____ |
| • ultrasound examination in different scan planes | _____ | _____ | _____ |
| • ultrasonic anatomy and common normal variants | _____ | _____ | _____ |
| • renal length | _____ | _____ | _____ |
| • collecting system dilatation | _____ | _____ | _____ |
| • cysts | _____ | _____ | _____ |
| • tumours | _____ | _____ | _____ |
| • stones | _____ | _____ | _____ |
| Bladder | _____ | _____ | _____ |
| • ultrasound examination in different planes | _____ | _____ | _____ |
| • ultrasonic anatomy and common normal variants | _____ | _____ | _____ |
| • bladder volume | _____ | _____ | _____ |
| • bladder diverticula | _____ | _____ | _____ |
| • tumours | _____ | _____ | _____ |
| • calculi | _____ | _____ | _____ |
| General | _____ | _____ | _____ |
| • know when to refer to a more expert ultrasonologist | _____ | _____ | _____ |

Appendix 3: Gynaecological Ultrasound Training Competency Assessment Sheet *continued*

| | | |
|---------|---------|--|
| Trainee | Trainer | |
|---------|---------|--|

| | | |
|---|----------------------------------|------------|
| Physics and technology Ultrasound techniques | Sectional and ultrasonic anatomy | Date |
| Trainer signature _____ | Trainer signature _____ | Date _____ |

Competencies/Skills to be Acquired — Level 2
To be competent to perform/recognise/diagnose/evaluate the following:

| | Trainer signature | Date | Trainer signature | Date |
|---|-------------------|-------|-------------------|-------|
| Female reproductive tract | | | | |
| • almost all pathology affecting the female genito-urinary tract | _____ | _____ | _____ | _____ |
| • ultrasound-guided invasive procedures, including ascitic drainage, omental biopsy, pelvic mass biopsy (TA or TV), lymph node aspiration, SHI and HyCoSy | _____ | _____ | _____ | _____ |
| • Doppler ultrasound studies relevant to the uterus and ovaries | _____ | _____ | _____ | _____ |
| • abnormalities elsewhere in the abdomen and pelvis which need referral for scanning by another ultrasonologist and/or further investigation | _____ | _____ | _____ | _____ |
| • stage ovarian and uterine tumours | _____ | _____ | _____ | _____ |
| Other | | | | |
| • causes of an abnormal Doppler waveform | _____ | _____ | _____ | _____ |
| • changes associated with precocious puberty, thelarche, adrenarche and virilisation | _____ | _____ | _____ | _____ |
| • congenital anomalies | _____ | _____ | _____ | _____ |
| • features of lymph nodes in the inguinal and iliac chains | _____ | _____ | _____ | _____ |
| • Bartholin's cysts, abscesses and peri-urethral lesions | _____ | _____ | _____ | _____ |
| • features of haematocolpos | _____ | _____ | _____ | _____ |
| • features of adenomyosis | _____ | _____ | _____ | _____ |
| • non-ovarian endometriosis | _____ | _____ | _____ | _____ |
| • non-gynaecological causes of pelvic pain and how to diagnose appendicitis, inflammatory bowel disease, bowel cancer, hernias, aneurysms and bladder disease | _____ | _____ | _____ | _____ |
| • different types of complex ovarian masses | _____ | _____ | _____ | _____ |
| • malignant disease of the omentum, peritoneum and the rest of the abdomen | _____ | _____ | _____ | _____ |
| • features of pleural effusions | _____ | _____ | _____ | _____ |
| • common sites and features of tumours that metastasise to the pelvis | _____ | _____ | _____ | _____ |
| • the principles of oocyte collection by transvaginal ultrasound guided aspiration of follicles | _____ | _____ | _____ | _____ |

Appendix 4: Gastrointestinal Ultrasound

Level 1: Training and Practice

- Practical training should involve at least one ultrasound list per week over 3–6 months with approximately 5–10 examinations performed by the trainee (under supervision) per session. A minimum of 250 examinations should be undertaken. However different trainees will acquire the necessary skills at different rates and the end point of the training programme should be judged by an assessment of competencies.
- Examinations should encompass the full range of pathological conditions listed below.
- A logbook listing the types of examinations undertaken should be kept.
- Training should be supervised either by someone who has obtained at least Level 2 competence in gastrointestinal ultrasound or by a Level 1 practitioner with at least 2 years' experience of Level 1 practice.
- Trainees should attend an appropriate theoretical course and should read appropriate textbooks and literature.
- During the course of training the competency assessment sheet should be completed as this will determine in which area or areas the trainee can practise independently.

Level 1: Knowledge Base

- Physics and technology, ultrasound techniques and administration (see Appendix 1)
- Sectional and ultrasonic anatomy
 - liver
 - gallbladder
 - bile ducts
 - pancreas
 - spleen
 - kidneys
 - other structures (uterus, ovaries, lymph nodes, vessels, bowel)
- Pathology in relation to ultrasound
 - liver: cysts, benign and malignant tumours, metastatic disease, fatty change, cirrhosis
 - biliary system: gallbladder stones, acute and chronic cholecystitis, gallbladder tumours, bile duct obstruction including level of obstruction, intra hepatic duct gas and stones
 - pancreas: pancreatitis, duct stones, duct dilatation, pancreatic tumours
 - portal venous system and spleen: splenic enlargement, portal venous distention, varices, thrombosis, ascites
 - other structures: renal masses and urinary tract obstruction (hydronephrosis), ovarian and uterine masses including cysts, tumours, fibroids and unexpected pregnancy

Level 1: Competencies to be Acquired

- Liver
 - To be able to:
 - perform a thorough ultrasound examination of the liver in different scan planes
 - recognise normal hepatic anatomy and variants
 - recognise normal and abnormal liver texture, such as fatty change, cirrhosis, atrophy and hypertrophy
 - recognise focal lesions, particularly cysts and benign lesions, and be able to detect possible malignant lesions requiring further investigation
 - recognise normal hepatic and portal venous anatomy within the liver

Appendix 4: Gastrointestinal Ultrasound *continued*

- recognise abnormalities of the hepatic and portal venous system e.g., thrombosis
- perform ultrasound controlled biopsy for the evaluation of parenchymal liver disease
- Biliary system
 - To be able to:
 - perform a thorough evaluation of the biliary system
 - recognise normal ultrasonic anatomy of the biliary system and its frequent normal variants
 - recognise abnormalities of the gallbladder wall
 - recognise gallbladder stones
 - recognise features of acute and chronic cholecystitis
 - assess bile duct dilatation at intra hepatic and extra hepatic levels and determine level of obstruction
- Pancreas
 - To be able to:
 - perform a thorough examination of the pancreas recognising normal anatomy
 - recognise the limitations of pancreatic ultrasound because of bowel gas
 - recognise solid and cystic tumours within the head and body of the pancreas
 - recognise pancreatic duct dilatation and pancreatic duct stones
 - recognise the features of acute and chronic pancreatitis and their complications
- Portal venous system and spleen
 - To be able to:
 - evaluate the size of the spleen and recognise focal lesions and evidence of trauma
 - evaluate the portal vein and its diameter and the presence of portal venous thrombosis
 - recognise cavernous transformation of the portal vein and varices
- Bowel
 - To be able to:
 - recognise normal stomach, small and large bowel
 - recognise focal intestinal abnormality and understand the principles of further investigation
 - recognise small bowel obstruction
- Other
 - To be able to:
 - recognise abdominal aortic aneurysm
 - recognise hydronephrosis
 - recognise normal kidneys, uterus and ovaries
 - recognise renal and gynaecological masses

Level 2: Training and Practice

- Practical training should involve at least 1 year of experience at Level 1 with a minimum of one session per week.
- A further 500 examinations should have been undertaken in order to encompass the full range of conditions and procedures listed below.
- A logbook listing all examinations undertaken should be kept.
- Supervision of training should be undertaken by someone who has achieved Level 2 competence in gastrointestinal ultrasound, has had at least 2 years' experience at that level and who would normally be of consultant status.
- A Level 2 practitioner will be able to accept referrals from Level 1 practitioners.

Appendix 4: Gastrointestinal Ultrasound *continued*

Level 2: Knowledge Base

- Sectional and ultrasonic anatomy
 - detailed understanding of intestinal, mesenteric, peritoneal, omental, vascular and retroperitoneal anatomy
- Pathology in relationship to ultrasound
 - an understanding of disease processes which affect the peritoneal cavity, its mesenteries, ligaments and compartments
 - an understanding of the pathways of spread of intraperitoneal and retroperitoneal disease

Level 2: Competencies to be Acquired

- Competencies will have been gained during training for Level 1 practice and then refined during a period of clinical practice.
- Perform a comprehensive ultrasound examination of all of the solid organs within the abdomen.
- Be able to evaluate the small bowel for focal or diffuse disease.
- Be able to evaluate the bowel in inflammatory bowel disease.
- Be able to evaluate the large bowel for the presence of diverticular disease, appendicitis and their complications, tumours and obstruction.
- Be able to evaluate the peritoneal cavity, its mesenteries, compartments and the omentum for the presence of infective or malignant disease.
- Be able to undertake ultrasound-guided drainage of peritoneal fluid collections.
- Be able to evaluate the hepatic and portal venous systems using spectral, colour and power Doppler ultrasound.
- Be able to undertake ultrasound-guided biopsy of focal liver lesions.

Level 3: Training and Practice

- A Level 3 practitioner is likely to spend the majority of their time undertaking gastrointestinal ultrasound, teaching, research and development and will be an 'expert' in this area.
- He/she will accept tertiary referrals from Level 1 and 2 practitioners and will perform specialised examinations (e.g., the use of intravascular ultrasound agents in evaluating focal liver lesions) as well as performing advanced ultrasound-guided invasive procedures.

Maintenance of Skills: All Levels

- Having been assessed as competent to practise there will be a need for CPD and maintenance of practical skills.
- A specialist registrar will need to continue to perform ultrasound throughout the remainder of his/her training programme. Such further ultrasound practice may be intermittent, but no more than 3 months should elapse without the trainee using his/her scanning skills, and at least 100 scans should be performed per year.
- A medical practitioner performing ultrasound at Level 1 should continue to perform at least 250 examinations per year on a regular basis, should have regular meetings with radiological colleagues and should have a named radiologist as an 'ultrasound mentor'.
- Practitioners should:
 - include ultrasound in their ongoing CME
 - audit their practice
 - participate in multidisciplinary meetings
 - keep up to date with relevant literature

Appendix 4: Gastrointestinal Ultrasound Training Competency Assessment Sheet

| | | |
|-------------------|-------------------|------|
| Trainees | Trainer | |
| Trainer signature | Trainer signature | Date |
| Date | Date | Date |

Physics and technology
 Practical instrumentation / use of ultrasound controls
 Ultrasound techniques

Administration
 Sectional and ultrasonic anatomy
 Pathology in relation to ultrasound

Competencies/Skills to be Acquired — Level 1

To be competent to perform / diagnose the following:

- Liver**
- ultrasound examination in different scan planes
 - normal hepatic anatomy and variants
 - normal and abnormal liver texture
 - atrophy and hypertrophy
 - fatty change
 - cirrhosis
 - cysts and benign lesions
 - malignant lesions
 - normal hepatic and portal venous anatomy
 - abnormalities of the portal venous system e.g., thrombosis
 - ultrasound controlled biopsy for the evaluation of parenchymal liver disease
- Biliary system**
- ultrasound examination in different scan planes
 - normal ultrasonic anatomy and variants
 - abnormalities of the gallbladder wall including gall bladder tumours
 - gallbladder stones
 - acute and chronic cholecystitis
 - bile duct dilatation and level of obstruction

- Bowel**
- normal stomach, small and large bowel
 - focal intestinal abnormality
 - small bowel obstruction
- Pancreas**
- ultrasound examination in different scan planes
 - normal anatomy and variants
 - solid and cystic tumours
 - duct dilatation and stones
 - acute and chronic pancreatitis and complications
- Portal venous system and spleen**
- splenic size and focal lesions
 - splenic trauma
 - portal vein diameter
 - cavernous transformation of the portal vein
 - varices
- Other**
- normal uterus, ovaries, kidneys and aorta
 - abdominal aortic aneurysm
 - hydronephrosis
 - renal and gynaecological masses
- General**
- know when to refer to a more expert ultrasonologist

Competencies/Skills to be Acquired — Level 2

To be competent to perform / diagnose / evaluate the following:

- ultrasound examination of all of the solid organs within the abdomen
- focal or diffuse small bowel disease
- inflammatory bowel disease
- diverticular disease, appendicitis and their complications
- bowel obstruction
- bowel tumour

- infective or malignant disease of peritoneum, mesenteries and omentum
- ultrasound-guided drainage of peritoneal fluid collections
- the hepatic and portal venous systems using spectral, colour and power Doppler ultrasound
- ultrasound-guided biopsy of focal liver lesions

Appendix 5: Vascular Ultrasound

Level 1: Training and Practice

- Practical training should involve at least two ultrasound lists per week over a period of no less than 3 months and up to 6 months, with approximately four to six examinations performed by the trainee under supervision per session.
- A minimum of 100 examinations should be undertaken if this is the first practical training module undertaken.
- Examinations should encompass the full range of pathological conditions listed below.
- A logbook listing the types of examinations undertaken should be kept.
- Training should be supervised either by someone who has obtained at least Level 2 competence in vascular ultrasound or by a Level 1 practitioner with at least 2 years' experience of Level 1 practice. This will usually mean that training is carried out in dedicated vascular duplex sessions supervised by an accredited vascular scientist/technologist, specialist sonographer or radiologist.
- Trainees should attend an appropriate theoretical course and should read appropriate textbooks and literature.
- During the course of training the competency assessment sheet should be completed as this will determine in which area or areas the trainee can practise independently.

Level 1: Knowledge Base

- Physics and technology, ultrasound techniques and administration (see Appendix 1)
- To have full working knowledge of the principles, techniques, instrumentation and practical working knowledge of real-time and Doppler ultrasound, and equipment controls. This includes colour flow and power Doppler, colour and pulsed wave, scale, gain, filter, angle correction, electronic steering, invert, sample gating, power output, colour amplitude, velocity measurement, spectral changes and all other parameters required to perform a complete diagnostic vascular duplex study.
- Sectional and ultrasonic anatomy
 - peripheral extremity arteries
 - peripheral extremity veins
 - abdominal vessels
 - extracranial vessels
 - common normal variants
- Pathology in relation to ultrasound
 - peripheral extremity arteries: patency, occlusion, stenosis, aneurysmal dilatation
 - peripheral extremity veins: patency, occlusion, deep venous thrombosis, reflux and incompetence
 - abdominal vessels: patency, occlusion, aneurysmal dilatation of aorta
 - extracranial vessels: patency, occlusion, stenosis
 - appearances and sequelae of common surgical or radiological interventions including angioplasty, stenting, grafts, Miller vein cuffs, dissections, and neointimal hyperplasia

Level 1: Competencies to be Acquired

- To be able to perform continuous wave hand-held Doppler and segmental pressures (ABPI)
- Lower extremity peripheral arteries and grafts
 - To be able to:
 - perform a complete ultrasound examination of the common femoral to popliteal arteries
 - recognise and assess patency, occlusion, stenosis and aneurysmal dilatation, and measure approximate extent of abnormality

Appendix 5: Vascular Ultrasound *continued*

- diagnose > 50% stenosis [a doubling of peak systolic velocity (PSV) with pulsed Doppler over adjacent segments]
- recognise common surgical interventions, arterio-venous (AV) fistulas and pseudoaneurysm formation
- Peripheral veins
Lower extremity deep veins
To be able to:
 - perform a complete ultrasound examination of femoral to popliteal deep veins
 - perform compression and augmentation
 - recognise acute above-knee deep venous thrombosis
 - recognise, diagnose and locate reflux
- Lower extremity superficial veins
To be able to:
 - identify the saphenofemoral and saphenopopliteal junctions
 - recognise and locate clinically relevant venous reflux, incompetence and perforators
 - perform vein mapping and marking
- Abdominal vessels
To be able to:
 - recognise and locate patency and occlusion of the abdominal aorta
 - recognise and size aneurysmal dilatation of the abdominal aorta
- Extracranial vessels
To be able to:
 - recognise and locate patency, occlusion, plaque and stenoses in the carotid vessels

Level 2: Training and Practice

- Practical training should include at least 1 year of experience at Level 1 with continuous ongoing regular ultrasound sessions.
- A logbook of all examinations undertaken should be kept.
- Supervision of training should be undertaken by someone who has achieved at least Level 1 competence in vascular ultrasound and has had at least 2 years' experience at that level.

Level 2: Knowledge Base

- Peripheral arteries and grafts
- Peripheral deep and superficial veins
- Transcranial Doppler ultrasound:
 - ultrasonic anatomy, common normal variants and principles and practice of the technique
 - clinical indications and ultrasonic findings in common clinically relevant abnormalities

Level 2: Competencies to be Acquired

- Competencies will have been gained during training for Level 1 practice and then refined during a period of clinical practice
- To be able to:
 - perform a complete ultrasound scan and identify all abnormalities detailed in Level 1 in the upper and lower extremities, from iliac to infrapopliteal and subclavian to radial and ulnar arteries and veins

Appendix 5: Vascular Ultrasound *continued*

- Extracranial vessels
To be able to:
 - recognise and diagnose patency, occlusion, stenosis, reverse flow and steal in the carotid and vertebral vessels
 - grade degrees of carotid stenosis and plaque type in accordance with local criteria and standards
- Abdominal vessels
To be able to:
 - recognise common normal variants, aneurysmal dilatation, patency, stenosis and occlusion of the major abdominal and iliac vessels, including the mesenteric and renal vessels

Level 3 Training and Practice

- A Level 3 practitioner is likely to spend the majority of their time undertaking vascular ultrasound.
- He/she will accept tertiary referrals from Level 1 and 2 practitioners.
- He/she should have the capability to utilise developing technologies and ultrasound techniques, develop research and teaching skills and the performance of specialised examinations including the use of non-invasive physiological studies, contrast agents, intravascular or intra-operative ultrasound and ultrasound-guided invasive procedures.

Maintenance of Skills: All Levels

- Having been assessed as competent to practise there will be a need for CPD and maintenance of practical skills.
- A trainee should continue to perform ultrasound scans during the remainder of his/her training programme, ideally one session weekly and at least 50 examinations per year.
- A similar minimum ongoing commitment should be required from a trained practitioner. It is recognised that due to training or clinical circumstances such further ultrasound practice may be intermittent. If a significant period has elapsed after the use of such skills, a period of re-training is required which should be agreed and documented with the practitioner, local trainers and assessors.
- Practitioners should:
 - include ultrasound in their ongoing CME
 - audit their practice
 - participate in multidisciplinary meetings
 - keep up to date with relevant literature

The Royal College of Radiologists is grateful to the Vascular Surgical Society of Great Britain and Ireland and the Society of Vascular Technologists who contributed to and approved this section of the document.

Appendix 6: Breast Ultrasound

Level 1: Training and Practice

- Trainees should initially attend an appropriate theoretical course to acquire the core knowledge base as itemised in Appendix 1 and should be familiar with anatomy and pathology of the breast in relation to ultrasound.
- Practical training should involve at least one ultrasound session per week over a period of no less than 6 months and no more than 1 year.
- A minimum of 100 examinations should be undertaken and a record of these kept. However different trainees will acquire the necessary skills at different rates and the end point of the training programme should be judged by an assessment of competencies.
- A logbook of 50 cases should be kept which should record details of the indications for the procedure, the interpretation and a final report. These cases should be supported by correlation with clinical examination and other imaging findings and needle biopsy results and surgical histology where appropriate.
- Examinations should encompass the full range of conditions listed below.
- The cases scanned should include an appropriate range of normal and abnormal cases including palpable and impalpable lesions. They should also include patients presenting to symptomatic clinics, screening assessment clinics and post-operative surgical clinics.
- Mentorship and training should be provided by a practitioner who is expected to be a consultant radiologist or an experienced breast clinician or equivalent qualified practitioner who has reached at least Level 2 competence or with at least 2 years' experience at Level 1.
- The practitioner should be working in line with National Occupational Standards. The practical experience should ideally be undertaken in conjunction with attendance on a recognised postgraduate course, such as that provided by some universities and trainees should read appropriate textbooks and literature.
- During the course of training the competency assessment sheet should be completed as this will determine in which area or areas the trainee can practise independently.

Level 1: Knowledge Base

- Physics and technology, ultrasound techniques and administration (see Appendix 1)
- Sectional and ultrasound anatomy
 - normal anatomy of female and male breast
 - anatomical, physiological and developmental anomalies associated with the breast
 - the changes in ultrasound appearances associated with age, pregnancy and lactation, hormonal status, medication
- Pathology in relation to ultrasound
 - benign conditions including cysts, fibroadenomas, fibroadeno-lipomas, lipomas, haematomas, fat necrosis, hamartomas
 - indeterminate abnormalities including duct papillomas, radial scar
 - malignancy including ductal, lobular, inflammatory and other carcinomas
 - normal and abnormal appearances of axillary lymph nodes
 - inflammatory breast conditions including infection and abscess formation
 - iatrogenic appearances including breast implants, early and late post-operative changes, seromas, haematomas, radiotherapy changes, fat necrosis, scarring

Level 1: Competencies to be Acquired

- To be able to:
 - perform a thorough ultrasound examination of the breast and axilla

Appendix 6: Breast Ultrasound *continued*

- to recognise normal anatomy
- understand the indications for and the importance of ultrasound in the triple assessment process
- understand the strengths, weaknesses and limitations of breast ultrasound
- be aware of the interdependency and significance of mammographic and ultrasound appearances
- be competent in recognising the criteria for lesion characterisation
- confidently exclude the presence of a sonographic lesion within the breast
- write a detailed report of the ultrasound findings with grading, differential diagnosis, conclusion and recommendation for further management
- understand the principle of Doppler ultrasound and its relevance to breast imaging
- recognise personal limitations and ask for more expert advice if required

Level 2: Training and Practice

- Competencies will have been gained during training for Level 1 practice and then refined during a period of clinical practice, which will involve at least one scanning session per week with at least 10 cases on each session for at least 3 months.
- Training for interventional techniques should include observation initially followed by performance of the examination and/or procedure under close supervision. When competence has been acquired then procedures may be undertaken alone but with support close to hand.
- A logbook of diagnostic and interventional procedures performed should be kept with pathological correlation.
- Supervision of training should be undertaken by someone who has achieved Level 2 competence in breast ultrasound and has had at least 2 years' experience at that level.
- The Level 2 practitioner should be competent to accept referrals from Level 1 practitioners.

Level 2: Competencies to be acquired

- Cyst aspiration: initially to perform a minimum of 10 guided cyst aspirations of which at least five should be of cysts smaller than 2 cm.
- Aspirate cysts of less than 1 cm diameter.
- Guided fine needle aspiration biopsy (FNAB): perform a minimum of 10* FNABs of solid lesions, with pathological correlation of cytology result and final pathology (if available).
- If FNA is not performed in the department, to be aware of the uses and limitations of the technique.
- Guided core biopsies: perform a minimum of 10* guided core biopsies with pathological correlation of core biopsy histology and final pathology (if available).
- Perform guided abscess aspiration and drainage.
- Perform pre-operative guided localisations using skin marking and wire insertion techniques.
- Perform guided marker or coil insertion prior to neo-adjuvant chemotherapy.
- Ability to accept referrals from Level 1 practitioners.

Level 3: Training and Practice

- A Level 3 practitioner will be able to accept referrals from Level 1 and Level 2 practitioners and undertake more complex ultrasound examinations.
- He/she will be able to mentor and supervise Level 1 and 2 practitioners.
- He/she will understand and be familiar with vacuum assisted breast biopsy.
- He/she will conduct research.
- He/she will teach breast ultrasound at all levels.
- He/she will be aware of and pursue developments in breast ultrasound including Doppler and the use of intravascular contrast agents.

* Absolute numbers may vary according to the practice of individual breast units and the speed with which the trainee achieves competence.

Appendix 6: Breast Ultrasound *continued*

Maintenance of Skills: All Levels

- In order to maintain competence the practitioner should perform at least one ultrasound session per week and a minimum of 150 examinations per year.
- Practitioners should:
 - include ultrasound in their ongoing CME
 - audit their practice
 - participate in multidisciplinary meetings
 - keep up to date with relevant literature

Approved by The RCR Breast Group and the NHS Breast Screening Radiology Quality Assurance Group

Appendix 6: Breast Ultrasound Training Competence Assessment Sheet

| Core Knowledge Base — Level 1 | | Trainee | Trainer |
|--|-------|---------|---------|
| Physics and technology | _____ | _____ | _____ |
| Practical instrumentation /use of ultrasound controls | _____ | _____ | _____ |
| Ultrasound techniques | _____ | _____ | _____ |
| Administration | _____ | _____ | _____ |
| Sectional and ultrasound anatomy | _____ | _____ | _____ |
| Normal anatomy of female and male breast | _____ | _____ | _____ |
| Anatomical, physiological and developmental anomalies associated with the breast | _____ | _____ | _____ |
| The changes in ultrasound appearances associated with age, pregnancy and lactation, hormonal status, medication | _____ | _____ | _____ |
| Pathology in relation to ultrasound | _____ | _____ | _____ |
| Benign breast conditions including cysts, fibroadenomas, fibroadeno-lipomas, lipomas, haematomas, fat necrosis, hamartomas | _____ | _____ | _____ |

| Core Knowledge Base — Level 1 | | Trainee | Trainer |
|---|-------|---------|---------|
| Indeterminate abnormalities including duct papillomas, radial scar | _____ | _____ | _____ |
| Breast malignancy including ductal, lobular, inflammatory and other carcinomas | _____ | _____ | _____ |
| Normal and abnormal appearances of axillary lymph nodes | _____ | _____ | _____ |
| Inflammatory conditions in the breast including infection and abscess formation | _____ | _____ | _____ |
| Iatrogenic changes in the breast, including breast implants, early and late post-operative appearances, seromas, haematomas, radiotherapy changes, fat necrosis, scarring | _____ | _____ | _____ |

| Competencies/Skills to be Acquired — Level 1 | | Trainee | Trainer |
|---|-------|---------|---------|
| To be competent to perform/diagnose the following: | _____ | _____ | _____ |
| ultrasound examination of the breast and axilla | _____ | _____ | _____ |
| normal anatomy of breast and axilla | _____ | _____ | _____ |
| role of ultrasound in the triple assessment process | _____ | _____ | _____ |
| the strengths, weaknesses and limitations of breast ultrasound | _____ | _____ | _____ |
| the interdependency and significance of mammographic and ultrasound appearances | _____ | _____ | _____ |
| criteria for lesion characterisation | _____ | _____ | _____ |
| exclude the presence of a sonographic lesion within the breast | _____ | _____ | _____ |

| Competencies/Skills to be Acquired — Level 1 | | Trainee | Trainer |
|---|-------|---------|---------|
| To be competent to perform/diagnose the following: | _____ | _____ | _____ |
| write a detailed report of the ultrasound findings with grading, differential diagnosis, conclusion and recommendation for further management | _____ | _____ | _____ |
| the principle of Doppler ultrasound and its relevance to breast imaging | _____ | _____ | _____ |
| recognise personal limitations and ask for more expert advice if required | _____ | _____ | _____ |

| Competencies to be Acquired — Level 2 | | Trainee | Trainer |
|--|-------|---------|---------|
| To be competent to perform/diagnose the following: | _____ | _____ | _____ |
| cyst aspiration: initially to perform a minimum of 10 guided cyst aspirations of which at least five should be of cysts smaller than 2 cm | _____ | _____ | _____ |
| aspirate cysts smaller than 1 cm in diameter | _____ | _____ | _____ |
| perform a minimum of 10 FNABs of solid lesions with pathological correlation. If FNA is not standard procedure within the unit then the student should be familiar with the technique and be aware of its uses and limitations | _____ | _____ | _____ |
| perform a minimum of 10 guided core biopsies with pathological correlation | _____ | _____ | _____ |
| perform ultrasound-guided breast abscess aspiration | _____ | _____ | _____ |
| perform ultrasound-guided localisations pre-operatively, using both skin marking and wire insertion techniques | _____ | _____ | _____ |
| perform ultrasound-guided marker or coil insertion prior to neo-adjuvant chemotherapy | _____ | _____ | _____ |
| accept referrals from Level 1 practitioners | _____ | _____ | _____ |

Appendix 7: Thoracic Ultrasound

Level 1: Training and Practice

- Practical training should include:
 - observing 20 thoracic ultrasound examinations
 - performing 10 ultrasound examinations on patients with pleural effusions
 - performing 20 examinations on normal patients
 - performing five thoracocenteses or drain placements using both guided and non-guided techniques
- Examinations should encompass the full range of pathological conditions listed below.
- A logbook listing the types of examinations and procedures undertaken should be kept.
- Training should be supervised either by someone who has obtained at least Level 2 competence in thoracic ultrasound or by a Level 1 practitioner with at least 2 years' experience of Level 1 practice.
- Trainees should attend an appropriate theoretical course and should read appropriate textbooks and literature.
- During the course of training the competency assessment sheet should be completed as this will determine in which area or areas the trainee can practise independently.

Level 1: Knowledge Base

- Physics and technology, ultrasound techniques and administration (see Appendix 1)
- Sectional and ultrasonic anatomy
 - right and left hemidiaphragms
 - heart
 - liver and spleen
 - rib and intercostal spaces
- Pathology in relation to ultrasound
 - pleural effusion
 - pleural thickening
 - consolidated lung
 - paralysed hemidiaphragm
 - pericardial effusion

Level 1: Competencies to be Acquired

- Recognition of normal anatomy of pleura and diaphragm.
- Identification of the heart, liver and spleen.
- Pleural effusion recognition, including the different echogenic patterns.
- Pleural thickening and its differentiation from fluid using colour flow Doppler if appropriate.
- Consolidated lung and its differentiation from effusion.
- Estimation of depth of effusion and its measurement.
- Guided thoracocentesis and drain placement.

Level 2: Training and Practice

- Practical training should involve at least 1 year of experience at Level 1 with a minimum of two examinations performed per week.
- A further 100 examinations should have been undertaken in order to encompass the full range of conditions and procedures referred to above in addition to those listed below.
- A logbook of all examinations undertaken should be kept.

Appendix 7: Thoracic Ultrasound *continued*

- Supervision of training should be by someone who has achieved at least Level 2 competence in thoracic ultrasound, has had at least 2 years' experience at that level, and who would normally be of consultant status.
- A Level 2 practitioner will be able to accept referrals from Level 1 practitioners.

Level 2: Knowledge Base

- Sectional and ultrasonic anatomy
 - a full understanding of thoracic and diaphragmatic anatomy
- Pathology in relation to ultrasound
 - more detailed understanding of pleural disease

Level 2: Competencies to be Acquired

- Competencies will have been gained during training for Level 1 practice, and then refined during a period of practice.
- Ultrasound techniques
 - the advanced use of Doppler ultrasound, including spectral, colour and power Doppler
 - the use of ultrasound for guiding interventional procedures including lung and supraclavicular nodal biopsy

Level 3: Training and Practice

- A Level 3 practitioner is likely to spend the majority of their time undertaking either all aspects of ultrasound, teaching, research and development or be a specialist thoracic radiologist and will be an 'expert' in this area.
- He/she will accept tertiary referrals from Level 1 and 2 practitioners and will perform specialised examinations as well as performing advanced ultrasound-guided invasive procedures.

Maintenance of Skills: All Levels

- Having been assessed as competent to practise there will be a need for CPD and maintenance of practical skills. A chest physician specialist registrar will need to continue to perform ultrasound scans throughout the remainder of the training programme. Such further ultrasound practice may be intermittent, but no more than 3 months should elapse without the trainee using his/her scanning skills.
- In medical practice, a chest physician scanning at Level 1 should perform at least 20 ultrasound examinations per year and have regular meetings with radiological colleagues and should have a named radiologist as an 'ultrasound mentor'.
- Practitioners should:
 - include ultrasound in their ongoing CME
 - audit their practice
 - participate in multidisciplinary meetings
 - keep up to date with relevant literature

Appendix 8: Cranial Ultrasound in Infants

This syllabus is designed to include the whole of cranial ultrasound imaging in infants, not just the ultrasound skills needed on a neonatal intensive care unit. It does not include spinal ultrasound imaging.

Level 1: Training and Practice

- Practical training should involve at least one session per week over a period of no less than 3 months, with approximately five scans per session performed by the trainee (under supervision of an experienced practitioner).
- By the end of Level 1 training the trainee should be able to recognise all major pathologies that need urgent assessment on a neonatal intensive care unit.
- Different trainees will acquire the necessary skills at different rates, and the end point of the training program should be judged by assessment of competencies, rather than by numbers of scans performed alone. As a guide, a minimum of 200 scans should be undertaken if this is the first practical training module undertaken. For those who are already competent at ultrasound in other body areas, then a reduced number of scans may be needed to achieve competency.
- Examinations should encompass all pathological conditions listed below.
- A logbook listing the types of examinations undertaken should be kept.
- An additional portfolio containing an illustrated description of 20 cases with which the trainee has been personally involved is a useful record of performance and achievement and a useful educational aid.
- Training should be supervised either by a practitioner who has obtained at least Level 2 competence in cranial ultrasound, or by a Level 1 practitioner with at least 2 years' experience of Level 1 practice.
- Trainees should attend an appropriate theoretical course and should read appropriate textbooks and literature.
- During the course of training the competency assessment sheet should be completed as this will determine in which area or areas the trainee can practise independently.

Level 1: Knowledge Base

- Physics and technology, ultrasound techniques and administration (see Appendix 1)
- Issues of parental information and consent.
- Sectional and ultrasonic anatomy of the brain:
 - sagittal anatomy
 - coronal anatomy
 - basic trans-axial and near-field scanning
- Pathology in relation to ultrasound:
 - intracranial haemorrhage
 - hypoxic ischaemic change (in full term and premature infants)
 - ventricular dilatation
 - common congenital malformations

Level 1: Competencies to be Acquired

- To be able to:
 - perform a thorough ultrasound examination of the brain in different scan planes
 - recognise normal anatomy and common normal variants
 - recognise varying presentations of pathological processes with gestational and post-natal age
 - measure ventricular size and assess variation from normality
 - assess obstructive hydrocephalus and monitor progression
 - recognise and describe intracranial haemorrhage and assess its extent

Appendix 8: Cranial Ultrasound in Infants *continued*

- recognise common congenital malformations and refer for appropriate further investigation
- recognise when other imaging modalities are more appropriate than ultrasound
- recognise abnormalities which need referral for scanning by a more experienced practitioner and/or further investigation
- To be able to use ultrasound in the assessment of patients presenting with:
 - prematurity
 - fits/apnoea/collapse
 - meningitis
 - hydrocephalus
 - asphyxia (full term and premature)
 - other congenital abnormalities

Level 2: Training and Practice

- Practical training should involve at least 1 year of experience at Level 1 with a minimum of one session per week.
- A significant number of further examinations should have been undertaken sufficient to encompass the full range of conditions and procedures referred to below.
- A logbook of all examinations undertaken should be kept.
- Supervision of training should be by a practitioner who has achieved at least Level 2 competence in cranial ultrasound, has had at least 2 years' experience at that level, and who would normally be of consultant or independent practitioner status.
- A Level 2 practitioner will be able to accept referrals from Level 1 practitioners.

Level 2: Knowledge Base

- Sectional and ultrasonic anatomy
 - the basic use of Doppler ultrasound, including spectral, colour and power Doppler
 - further applications of cranial ultrasound
 - use of trans-axial ultrasound
 - posterior fossa imaging
 - assessment of cerebral perfusion
- Pathology in relation to ultrasound
 - an understanding of the role of ultrasound in the context of cerebral asphyxia, abnormal head circumference, congenital abnormalities, non accidental injury and systemic disease

Level 2: Competencies to be Acquired

- Competencies will have been gained during training for Level 1 practice, and then refined during a period of practice.
- Vascular studies in asphyxia.
- Role of ultrasound in the assessment of abnormal head circumference.
- Recognition of most identifiable congenital brain malformations.
- Further assessment of antenatally suspected anomalies.
- Identification and location of surface collections.
- Appearances of non-accidental injury and the limitations of ultrasound assessment.
- Intra-operative ultrasound as appropriate.
- Infants with systemic disease (e.g., post-operative or paediatric intensive care).

Level 3 Training and Practice

- A Level 3 practitioner is likely to spend a significant proportion of his or her time undertaking cranial ultrasound, teaching, research and development and will be an 'expert' in this area.

Appendix 8: Cranial Ultrasound in Infants *continued*

- He or she will accept tertiary referrals from Level 1 and 2 practitioners and will perform specialised examinations.

Maintenance of Skills: All Levels

- Having been assessed as competent to practice at Level 1, there will be a need for maintenance of practical skills, by continuing to perform regular ultrasound and update skills. Such further ultrasound practice may be intermittent, but no more than 3 months should elapse without the trainee using their ultrasound skills, and sufficient examinations should be performed per year to maintain competency.
- In independent practice, a medical practitioner scanning at Level 1 should continue to perform at least 100 examinations per year, should have regular meetings with imaging colleagues and should have a designated ultrasound practitioner of Level 2 experience or above designated as their mentor.
- Practitioners should:
 - include ultrasound in their ongoing CME
 - audit their practice
 - participate in multidisciplinary meetings
 - keep up to date with relevant literature

Appendix 9: Focused Emergency Ultrasound

Level 1: Training and Practice

- Practical training should involve regular emergency department or radiology department ultrasound, with approximately five examinations performed by the trainee (under supervision) per week.
- Approximately 50 examinations should be undertaken if this is the first practical training module. A clinician working in emergency medicine will need to devote sufficient time to gain Level 1 competence. This may be as much as one session per week but is unlikely to be in dedicated blocks of time. However, different trainees will acquire the necessary skills at different rates, and the key end point of the training programme should be judged by an assessment of competencies.
- Examinations should concentrate on the core clinical indications of trauma, aortic aneurysm and vascular access where there are benefits of an early focused ultrasound scan in the Emergency Department or acute assessment area.
- A logbook listing the types of examinations undertaken should be kept.
- An additional pictorial record containing an illustrated description of 10 cases in which the trainee has been personally involved may be collected and is a useful confirmation of experience when moving between departments.
- Training should be supervised either by someone who has obtained at least Level 2 competence in focused emergency ultrasound, or by a Level 1 practitioner with at least 1 years' experience of Level 1 practice.
- Trainees should attend an appropriate theoretical course and should be familiar with the published literature on focused emergency ultrasound.
- During the course of training the competency assessment sheet should be completed as this will determine in which area or areas the trainee can practise independently.

Level 1: Knowledge Base

- Physics and technology, ultrasound techniques and administration (see Appendix 1)
- Sectional and ultrasonic anatomy
 - kidneys
 - liver
 - spleen
 - retro-peritoneal structures (aorta, IVC)
 - vessels: internal jugular veins, carotid arteries, femoral veins and arteries
- Pathology in relation to ultrasound
 - kidneys: trauma/free fluid
 - liver and spleen: trauma/free fluid
 - retroperitoneal: presence or absence of abdominal aortic aneurysm (AAA)
 - vessels: vascular access
 - cardiac scan: trauma/pericardial tamponade, pericardial effusions, asystole

Level 1: Competencies to be Acquired

- To be able to:
 - recognise normal anatomy
 - use focused ultrasound to assist in bedside emergency department decisions
 - recognise the limitations of a scan and be able to explain these limitations to patients/carers
 - recognise patients requiring formal specialist sonographic assessment
 - incorporate ultrasound findings with the rest of the clinical assessment

Appendix 9: Focused Emergency Ultrasound *continued*

- To be able to use ultrasound in the context assessment of:
 - focused assessment by sonography for trauma (FAST)
 - AAA screening/detection in symptomatic patients
 - peri-arrest scenario for pulseless electrical activity (PEA)/tamponade/effusion
 - vascular access
 - pleural and pericardial fluid

Level 2: Training and Practice

- Practical training should involve at least 1 year of experience at Level 1 with an average of three to five scans/week.
- A further 150–200 examinations should have been undertaken in order to encompass most of the conditions and procedures listed. A practitioner may develop competencies in some but not all of these areas.
- A logbook of all examinations undertaken should be kept.
- A further pictorial logbook should also be kept detailing 10 cases examined by the trainee which may be useful as a record when moving between departments.
- Supervision of training should be undertaken by someone who has achieved at least Level 2 competence in focused emergency ultrasound and who has had at least 2 years' experience at this level.
- A Level 2 practitioner will be able to accept referrals from a Level 1 practitioner.

Level 2: Knowledge Base

- Sectional and ultrasonic anatomy
 - kidneys
 - liver
 - proximal leg veins
 - heart
 - musculo-skeletal system
 - pelvic structures (uterus, ovaries, bowel)
- Pathology in relation to ultrasound
 - kidneys: cysts, calyceal dilatation, renal calculi, trauma (free fluid)
 - liver: cysts, trauma (free fluid)
 - vessels: proximal deep venous thrombosis
 - cardiac: reduced ventricular function, tamponade, effusion
 - retroperitoneum: aortic aneurysm, fluid collection
 - musculoskeletal: fractures, soft tissue collections, foreign body detection

Level 2: Competencies to be Acquired

- Competencies will have been gained during training for Level 1 practice, and then refined during a period of clinical practice.
- Recognise and correctly utilise ultrasound within the emergency department and be able to perform at least three of the following:
 - ultrasound-guided invasive procedures (chest drain insertion, suprapubic aspiration/catheterisation, fluid collection drainage)
 - an initial assessment for patients with loin pain/haematuria
 - a focused assessment of patient presenting with hypotension
 - proximal DVT assessment
 - detection of foreign bodies and fluid collections within soft tissues
 - early assessment of symptomatic women in the first trimester of pregnancy post trauma including assessment of foetal cardiac activity
 - Emergency Department obstetric presentations

Appendix 9: Focused Emergency Ultrasound *continued*

Level 3: Training and Practice

- A Level 3 practitioner is likely to spend a significant proportion of their time undertaking emergency ultrasound, teaching, research and development and will be an 'expert' in this area.
- He/she will accept referrals from Level 1 and 2 practitioners and will perform the spectrum of examinations indicated above. This will include developing the role for innovative ultrasound practice within Emergency Care.

Maintenance of Skills: All Levels

- Having been assessed as competent to practise there will be a need for CPD and maintenance of practical skills.
- An emergency trainee will need to continue to perform ultrasound scans throughout the remainder of the training programme and into his/her consultant appointment. Such further ultrasound practice may be intermittent, but no more than 3 months should elapse without the trainee using his scanning skills, and at least 50 scans should be performed per year.
- All practitioners should have regular meetings within the department to ensure appropriate focused emergency ultrasound use. The department lead for ultrasound practice will have regular contact with radiological colleagues and should have a named radiologist as an 'ultrasound mentor'.
- Practitioners should:
 - include ultrasound in their ongoing CME
 - audit their practice
 - participate in multidisciplinary meetings
 - keep up to date with relevant literature

Approved by the Faculty of Accident and Emergency Medicine

Appendix 10: Ultrasound Training for Critical/Intensive Care

Level 1: Training and Practice

- Practical training should involve carrying out regular ultrasound examinations in the critical care unit or radiology department, with approximately 5–10 examinations performed by the trainee (under supervision) per week.
- A minimum number of examinations in each specific area of interest should be undertaken if this is the first practical training module undertaken, e.g., 25 pleural effusions, 25 vascular line insertions, 25 abnormal abdominal scans. However different trainees will acquire the necessary skills at different rates and the end point of the training programme should be judged by an assessment of competencies.
- Examinations should encompass the full range of pathological conditions and practical procedures listed below.
- A logbook listing the types of examinations undertaken should be kept.
- An additional logbook containing an illustrated description of 10 cases in which the trainee has been personally involved may be a useful adjunct particularly if moving between different units.
- Training should be supervised either by someone who has obtained at least Level 2 competence in critical care ultrasound themselves, or by a Level 1 practitioner with at least 2 years' experience of level 1 practice.
- Trainees should attend an appropriate theoretical course and should be familiar with the published literature.
- During the course of training the competency assessment sheet should be completed as this will determine in which area or areas the trainee can practise independently.

Level 1: Knowledge Base

- Physics and technology, ultrasound techniques and administration (see Appendix 1)
- Sectional and ultrasonic anatomy
 - thorax
 - abdomen, retroperitoneal and peritoneal spaces
 - abdominal aorta
 - urinary tract
 - peripheral vascular anatomy
 - peripheral neurological anatomy
- Pathology in relation to ultrasound
 - thorax: pleural disease, patterns and causes of pulmonary consolidation, pericardial disease.
 - abdomen: fluid collections, gastrointestinal ileus, acute urinary tract pathology, aortic aneurysms
 - vascular: venous disease, e.g., thrombosis
- Basic knowledge of Doppler ultrasound principles

Level 1: Competencies to be Acquired

- General
 - recognise normal anatomy
 - use ultrasound to assist in critical care decisions and interventional procedures
 - recognise limitations of technique and own knowledge base
 - recognise patients requiring formal specialist sonographic assessment

Appendix 10: Ultrasound Training for Critical/Intensive Care *continued*

- Thorax
 - pleural disease
 - identify and assess pleural effusions: transudate, exudates, volume estimation
 - use ultrasound to guide pleural aspiration/drainage
 - pulmonary
 - identify pulmonary consolidation
 - distinguish abnormal lung from pleural diseases
 - pericardial
 - identify significant pericardial effusions prior to formal echocardiographic assessment
- Abdomen
 - fluid collections
 - identify and assess abdominal and pelvic fluid collections
 - differentiate subphrenic from pleural fluid
 - distension
 - identify cause of abdominal distension, e.g., fluid, small bowel ileus, bladder distension, masses
- Urinary tract
 - identify cause of acute renal impairment, specifically hydronephrosis
 - identify significant bladder distension
- Vascular
 - identify and measure abdominal aortic aneurysm
 - recognise abdominal features secondary to cardiac failure
- Peripheral vascular
 - differentiate between arteries and veins
 - assess veins for vascular access
 - identify suitable neck veins and their patency
 - use ultrasound to guide line insertions
- Peripheral neurology
 - identify paths of appropriate peripheral nerves, e.g., brachial plexus
 - use ultrasound to guide regional anaesthesia

Level 2: Training and Practice

- Practical training should include at least 1 year of experience at Level 1 with a minimum of one session or equivalent per week.
- A further 300 examinations should have been undertaken in order to encompass the full range of conditions and procedures.
- A logbook listing all examinations undertaken should be kept.
- A further illustrated logbook should be kept detailing 20 cases examined by the trainee which may be useful to document further progression of training.
- Supervision of training should be undertaken by someone who has achieved at least Level 2 competence in critical care ultrasound, has had at least 2 years' experience at that level and would normally be of consultant status.
- A Level 2 practitioner will be able to accept referral from Level 1 practitioners.

Level 2: Knowledge Base

- Physics and technology
 - in-depth knowledge and understanding of physics of ultrasound
 - in-depth knowledge and understanding of the technology of ultrasound equipment

Appendix 10: Ultrasound Training for Critical/Intensive Care *continued*

- Ultrasound techniques
 - further applications of thoracic, abdominal, vascular and cardiac ultrasound
- Sectional and ultrasonic anatomy
 - more detailed recognition and understanding of normal variants with ultrasound
- Pathology related to ultrasound

Level 2: Competencies to be Acquired

- Competencies will have been gained during training for Level 1 practice, and then refined during a period of clinical practice.
- Develop further ultrasound skills such as echocardiography, transoesophageal echocardiography and peri-operative monitoring.

Level 3: Training and Practice

- A Level 3 practitioner is likely to spend the majority of their time undertaking ultrasound examinations, teaching, research and development, and will be regarded as an 'expert' in this area.
- He/she will accept referrals from Level 1 and 2 practitioners and will be actively involved in developing innovative ultrasound applications within critical care.
- He/she will have spent a continuous period of specialist training in critical care ultrasound.
- He/she will be able to mentor and supervise Level 1 and 2 practitioners.
- He/she will be aware of and pursue developments in critical care ultrasound including Doppler and the use of intravascular contrast agents.

Maintenance of Skills: All Levels

- Having been assessed as competent to practise there will be a need for CPD and maintenance of practical skills.
- A trainee should continue to practise ultrasound throughout their training with no more than 1 month elapsing without the trainee using his/her ultrasound scanning skills.
- In medical practice, a critical care physician performing ultrasound at Level 1 should continue to perform at least 100 examinations per year, should have regular meetings with radiological colleagues and should have a named radiologist or experienced sonographic practitioner as an 'ultrasound mentor'
- Practitioners should:
 - include ultrasound in their ongoing CME
 - audit their practice
 - participate in multidisciplinary team meetings
 - keep up to date with relevant literature

Appendix 11: Musculoskeletal Ultrasound

Musculoskeletal ultrasound comprises a wide range of examinations and pathologies. It is unlikely that any practitioner will cover the full range. A modular approach that meets the needs of an individual's clinical practice is therefore likely to be appropriate and 'levels' of competence are not stipulated in this section.

Training and Practice

- Practical training should involve at least one ultrasound list per week for 3–6 months with approximately 10 examinations performed by the trainee under supervision per session.
- A minimum of 250 examinations should be undertaken. However, trainees acquire the necessary skills at different rates and some examinations (e.g., shoulder ultrasound) take considerably longer than others for trainees to acquire proficiency. The end point of the training programme should be judged by an assessment of competencies.
- A logbook listing the types and numbers of examinations undertaken should be kept.
- Training should be supervised by an experienced musculo-skeletal sonologist.
- Trainees should attend an appropriate theoretical course and should read appropriate textbooks and literature.
- During the course of training the competency assessment sheet should be completed as this will determine in which area or areas the trainee can practise independently.

Knowledge Base

- Physics and technology, ultrasound techniques and administration (see Appendix 1)
- Sectional and ultrasonic anatomy
 - shoulder
 - elbow
 - wrist/hand
 - groin
 - hip
 - thigh
 - knee
 - lower leg
 - ankle/foot
 - other (e.g., infant spine, brachial plexus)
- Pathology in relation to ultrasound
 - shoulder: rotator cuff tendinosis, partial- and complete thickness tears and calcification; joint and bursal effusion; long head of biceps tendinosis, rupture and subluxation; paralabral cyst
 - elbow: tendinosis of common flexor/extensor origins; tendinosis and rupture of triceps and distal biceps tendons; effusion; loose bodies; ulnar nerve entrapment; bursae
 - wrist/hand: tendon tears and tenosynovitis; carpal tunnel syndrome; space occupying lesions; pulley injuries; arthropathy
 - groin: hernias; tendinosis and tendon tears
 - hip: developmental dysplasia of the hip (DDH); effusion (children, adults, prosthetic joints); bursae; snapping hip; tendinosis and tendon tears
 - thigh: muscle contusion and tears; tendinosis and tendon tears
 - knee: effusion; bursae (including ruptured Baker's cyst); meniscal cysts; collateral ligament sprains; patellar tendon tendinosis and rupture
 - lower leg: muscle contusion and tears, muscle herniae
 - ankle/foot: tendinosis and tears of achilles, posterior tibial and peroneal tendons; tenosynovitis;

Appendix 11: Musculoskeletal Ultrasound *continued*

- ankle effusion and loose bodies; plantar fasciitis; Morton's neuroma; other space occupying lesions; arthropathy
- soft tissue masses
- brachial plexus: injuries and tumours
- spine: dysraphism and tethered cord in neonates

Competencies to be Acquired

- Other diagnostic techniques
 - be aware of alternative diagnostic methods including clinical examination and imaging techniques
 - recognise comparative accuracy of alternative techniques
 - recognise when to proceed to other imaging examinations following ultrasound examination
- Shoulder
 - To be able to:
 - perform a thorough ultrasound examination of the shoulder in different planes
 - recognise normal ultrasonic anatomy and common normal variants
 - recognise and be aware of difficulties in distinguishing accurately between tendinosis/ partial-thickness/ complete-thickness tears of the rotator cuff
 - recognise rotator cuff calcification
 - recognise tendinosis, rupture and subluxation of the long head of biceps tendon
 - recognise effusions of the shoulder joint and subdeltoid bursa
 - recognise paralabral cyst
 - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation
- Elbow
 - To be able to:
 - perform a thorough ultrasound examination of the elbow in different planes
 - recognise normal ultrasonic anatomy and common normal variants
 - recognise tendinosis of the common flexor/ extensor origins
 - recognise tendinosis/ partial/ complete rupture of the triceps and distal biceps tendons
 - recognise joint effusions and loose bodies
 - recognise ulnar nerve entrapment
 - recognise olecranon bursitis
 - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation
- Wrist/hand
 - To be able to:
 - perform a thorough ultrasound examination in different planes
 - recognise normal ultrasonic anatomy and common normal variants including accessory muscles
 - recognise de Quervain's tenosynovitis
 - recognise effusions in other tendons sheaths
 - recognise tendonitis, partial and complete tendon tears and identify retracted tendon
 - recognise features of carpal tunnel syndrome and entrapment in Guyon's canal
 - recognise ganglia and distinguish them from solid space occupying lesions
 - recognise inflammatory arthropathy
 - recognise pulley injuries
 - recognise foreign bodies and FB reactions
 - recognise ligament injuries
 - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation

Appendix 11: Musculoskeletal Ultrasound *continued*

- Groin
To be able to:
 - perform a thorough ultrasound examination in different planes
 - recognise normal ultrasonic anatomy and common normal variants
 - recognise inguinal and femoral hernias
 - recognise strains of the rectus abdominis and adductor muscles
 - recognise abnormalities which need referral for scanning by a more experienced ultrasonologist and/or further investigation
- Hip
To be able to:
 - perform a thorough ultrasound examination in different planes
 - recognise normal ultrasonic anatomy and common normal variants
 - assess the neonatal hip and recognise DDH
 - recognise joint effusions in children, adults and prosthetic joints
 - recognise iliopsoas bursa and distinguish from solid masses
 - recognise causes of snapping hip such as iliopsoas, tensor fascia lata and rectus femoris tendons
 - recognise tendinosis and tendon tears e.g., of hamstrings, glutei
 - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation
- Thigh
To be able to:
 - perform a thorough ultrasound examination in different planes
 - recognise normal ultrasonic anatomy and common normal variants
 - recognise contusions and tears of the quadriceps and hamstring muscles
 - recognise tendinosis and partial and complete tears of the hamstring and quadriceps tendons
 - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation
- Knee
To be able to:
 - perform a thorough ultrasound examination in different planes
 - recognise normal ultrasonic anatomy and common normal variants
 - recognise joint effusion
 - recognise ganglia and bursae, including ruptured Baker's cyst
 - recognise meniscal cysts and associated meniscal tears
 - recognise sprains of collateral ligaments
 - recognise tendinosis and tears of patellar tendon
 - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation
- Lower leg
To be able to:
 - perform a thorough ultrasound examination of the lower leg in different planes
 - recognise normal ultrasonic anatomy and common normal variants
 - recognise muscle contusions and tears
 - recognise muscle herniae
- Ankle/foot
To be able to:
 - perform a thorough ultrasound examination in different planes
 - recognise normal ultrasonic anatomy and common normal variants including accessory muscles
 - recognise tendinosis and tears of achilles, posterior tibial and peroneal tendons

Appendix 11: Musculoskeletal Ultrasound *continued*

- recognise joint effusions and loose bodies
- recognise plantar fasciitis
- recognise Morton’s neuroma
- recognise ganglia and distinguish them from solid space occupying lesions
- recognise arthropathy
- recognise ankle ligament injuries
- recognise foreign bodies and foreign body reactions
- recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation
- Soft tissue masses
 - To be able to:
 - recognise solid, cystic and indeterminate masses
 - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation
- Brachial plexus
 - To be able to:
 - recognise brachial plexus injuries and tumours
 - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation
- Spine
 - To be able to:
 - recognise spinal dysraphism and tethered cord in neonates
 - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation
- Technique
 - To be able to:
 - perform Doppler ultrasound examinations relevant to the MSK system, including spectral, colour and power Doppler
- Interventional
 - To be able to:
 - Perform ultrasound-guided invasive procedures including joint and cyst aspiration and injection; abscess drainage; biopsy of soft tissue masses and synovium; therapeutic injections

Maintenance of Skills

- Having been assessed as competent to practise there will be a need for CPD and maintenance of practical skills.
- A specialist registrar will need to continue to perform ultrasound scans throughout the remainder of their training programme.
- Such further ultrasound practice may be intermittent but no more than 3 months should elapse without the trainee using his/her ultrasound skills and at least 100 examinations should be performed per year.
- A medical practitioner should perform at least 200 examinations per year on a regular basis, should have regular meetings with radiological colleagues and should have a named radiologist as an ‘ultrasound mentor’.
- Practitioners should:
 - include ultrasound in their ongoing CME
 - audit their practice
 - participate in multidisciplinary meetings
 - keep up to date with relevant literature

Approved by the British Society of Skeletal Radiology

Appendix 11: Musculoskeletal Ultrasound Training Competency Assessment Sheet

| Core Knowledge Base | | Trainee | Trainer |
|---|---|-------------------------|-------------------------|
| <ul style="list-style-type: none"> Physics and technology Practical instrumentation / use of ultrasound controls Ultrasound techniques | Administration Sectional and ultrasonic anatomy Pathology in relation to ultrasound | _____ _____ _____ | _____ _____ _____ |
| | Date | Trainer signature | Date |
| | _____ | _____ | _____ |
| | _____ | _____ | _____ |
| | _____ | _____ | _____ |

Competencies/Skills to be Acquired

To be competent to perform / diagnose the following:

| | Trainer signature | Date | Trainer signature | Date |
|---|-------------------|-------|-------------------|-------|
| Shoulder | _____ | _____ | _____ | _____ |
| <ul style="list-style-type: none"> ultrasound examination in different planes normal anatomy and variants rotator cuff tendinosis, tears and calcification tendinosis, rupture and subluxation of long head of biceps tendon effusions of shoulder joint and subdeltoid bursa paralabral cyst aspiration of joint or bursal effusion aspiration of focus of calcification therapeutic / diagnostic injection in bursa or joint | _____ | _____ | _____ | _____ |
| Elbow | _____ | _____ | _____ | _____ |
| <ul style="list-style-type: none"> ultrasound examination in different planes normal anatomy and variants tendinosis or rupture of common flexor/ extensor origins or biceps/triceps tendons joint effusion and loose bodies ulnar nerve entrapment olecranon bursitis aspiration of joint or bursal effusion therapeutic/ diagnostic injection of joint | _____ | _____ | _____ | _____ |
| Wrist/hand | _____ | _____ | _____ | _____ |
| <ul style="list-style-type: none"> ultrasound examination in different planes normal anatomy and variants de Quervain's tenosynovitis effusions in tendon sheaths tendinosis and tendon ruptures carpal tunnel syndrome and ulnar nerve entrapment ganglia and distinguish them from solid space occupying lesions inflammatory arthropathy | _____ | _____ | _____ | _____ |
| Hip | _____ | _____ | _____ | _____ |
| <ul style="list-style-type: none"> ultrasound examination in different planes normal anatomy and variants at different ages DDH joint effusions iliopsoas bursa causes of snapping hip tendinosis and tears of glutei and hamstrings joint aspiration and therapeutic injections bursal aspiration and therapeutic injection | _____ | _____ | _____ | _____ |
| Thigh | _____ | _____ | _____ | _____ |
| <ul style="list-style-type: none"> ultrasound examination in different planes normal anatomy and variants contusions and tears of the quadriceps and hamstring muscles and tendons aspiration of thigh haematoma | _____ | _____ | _____ | _____ |
| Groin | _____ | _____ | _____ | _____ |
| <ul style="list-style-type: none"> ultrasound examination in different planes normal anatomy and variants inguinal and femoral hernias strains of rectus abdominis and adductor muscles therapeutic injections | _____ | _____ | _____ | _____ |
| Pulley injuries | _____ | _____ | _____ | _____ |
| <ul style="list-style-type: none"> ligament injuries foreign bodies and reactive changes ligament injuries aspiration and therapeutic injections of joints and tendon sheaths | _____ | _____ | _____ | _____ |

Appendix 11: Musculoskeletal Ultrasound Training Competency Assessment Sheet *continued*

| | Trainer signature | Date | Trainer signature | Date |
|---|-------------------|-------|-------------------|-------|
| Knee <ul style="list-style-type: none"> ultrasound examination in different planes normal anatomy and variants joint effusion Baker's cyst and ruptured Baker's cyst ganglia/other bursae/meniscal cyst sprains of collateral ligaments tendinosis and tears of patellar tendon | _____ | _____ | _____ | _____ |
| Lower leg <ul style="list-style-type: none"> ultrasound examination in different planes normal anatomy and variants muscle contusions and tears muscle herniae | _____ | _____ | _____ | _____ |
| Ankle/foot <ul style="list-style-type: none"> ultrasound examination in different planes normal anatomy and variants tendinosis and tears of tendo Achilles, posterior tibial and peroneal tendons joint effusions and loose bodies plantar fasciitis Morton's neuroma ganglia arthropathy ankle ligament injuries foreign bodies joint aspiration and therapeutic injection injection of plantar fasciitis and Morton's neuroma | _____ | _____ | _____ | _____ |
| Soft tissue masses <ul style="list-style-type: none"> solid, cystic and indeterminate masses need for appropriate additional imaging examinations appropriate aspiration and biopsy | _____ | _____ | _____ | _____ |
| Brachial plexus <ul style="list-style-type: none"> normal anatomy and variants injuries and tumours | _____ | _____ | _____ | _____ |
| Spine <ul style="list-style-type: none"> normal neonatal anatomy spinal dysraphism and tethered cord | _____ | _____ | _____ | _____ |
| Technique <ul style="list-style-type: none"> Doppler ultrasound examinations relevant to MSK system | _____ | _____ | _____ | _____ |
| Interventional <ul style="list-style-type: none"> joint and cyst aspiration and injection abscess aspiration and drainage biopsy of soft tissue masses synovial biopsy therapeutic injections | _____ | _____ | _____ | _____ |
| General <ul style="list-style-type: none"> know when to refer to a more expert ultrasonologist | _____ | _____ | _____ | _____ |

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