



Ultrasound training recommendations for medical and surgical specialties

Third edition

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Contents

Foreword	3
1. Introduction	4
2. Aims and principles	5
3. Training recommendations	8
4. Continuing professional development	10
Appendix 1. Urological ultrasound	12
Appendix 1. Urological ultrasound training competency assessment sheet	19
Appendix 2. Gynaecological ultrasound	22
Appendix 2. Gynaecological ultrasound competency assessment sheet	30
Appendix 3. Gastrointestinal ultrasound	34
Appendix 3. Gastrointestinal ultrasound competency assessment sheet	40
Appendix 4. Vascular ultrasound	43
Appendix 4. Vascular ultrasound competency assessment sheet	48
Appendix 5. Breast ultrasound	51
Appendix 5. Breast ultrasound competency assessment sheet	56
Appendix 6. Thoracic ultrasound	58
Appendix 6. Thoracic ultrasound competency assessment sheet	62
Appendix 7. Cranial ultrasound	63
Appendix 7. Cranial ultrasound competency assessment sheet	68
Appendix 8. Focused emergency ultrasound	69
Appendix 8. Focused emergency ultrasound competency assessment sheet	74
Appendix 9. Ultrasound training for critical/intensive care	77
Appendix 9. Critical care ultrasound training competency assessment sheet	83
Appendix 10. Head and neck ultrasound	86
Appendix 10. Head and neck ultrasound competency assessment sheet	96
Appendix 11. Musculoskeletal ultrasound	100
Appendix 11. Musculoskeletal ultrasound competency assessment sheet	108
Appendix 12. Recommended theory syllabus	114

Foreword

In 2005, when The Royal College of Radiologists (RCR) produced the first edition of these recommendations, it recognised ultrasound as an evolving technology with wide application throughout medical and surgical practice. Since then, there has been continued growth in the availability of ultrasound and with it an acknowledgement that it plays an ever-increasing role in the diagnosis and management of patients.

In 2014, the College produced an updated second edition of this publication. It was recognised that in the UK, radiologists and sonographic practitioners had traditionally provided such a service from centralised departments, but there was a growing need to provide ultrasound in other settings; for instance, in the community or by the patient's bedside in critical care. The aim of the second edition was to ensure that access to high-quality ultrasound imaging continued to improve and for this to happen, ultrasound must be provided by properly trained and committed practitioners using appropriate quality ultrasound equipment.

Much of the original content remains relevant and unchanged, which is a testament to the work of Rani Thind and the Working Party which produced the first edition. However, practice in this area develops continually and consequently Dr Chris Harvey was asked to review and update the recommendations. I am grateful to him for the changes which he has made for this new edition. The RCR is also indebted to Dr Andrew McQueen, and his colleagues at the British Society of Head and Neck Imaging for drafting the new head and neck appendix which is included in this edition. Dr Andrew Smethurst, Dr Robert Holmes and other members of the Clinical Radiology Professional Standards and Support Board, and the Clinical Radiology Faculty Board, are also thanked for their contributions to this publication.

Richard FitzGerald

Vice-President, Faculty of Clinical Radiology
The Royal College of Radiologists

1. Introduction

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.

Departments of clinical radiology may have difficulty responding to 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.

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. A separate document is aimed at providing guidance for focused ultrasound training.¹

Additionally, there is a demand by some European training boards to incorporate ultrasound experience into clinical training and accreditation where appropriate.

Radiologists have the skills, experience and commitment to provide guidelines for the training of medical non-radiologists and hence influence the quality of service provided for the better. The RCR believes that this approach, of interdisciplinary co-operation, serves best the interests of patients. The RCR strongly believes that it is important that ultrasound training should be of the same high standard for both medical non-radiologists and radiologists. While ultrasound courses and workshops are useful they must be incorporated in to a robust programme of continuous training, supervision, regulation and continuing professional development (CPD) to provide a safe and diagnostic ultrasound service.

Training of medical non-radiologists should be adequately funded and planned so that there is minimal adverse impact on the service provided to patients and the ability of clinical radiology departments to train clinical radiologists and sonographer practitioners.

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
- Head and neck ultrasound
- Musculoskeletal ultrasound.

2. Aims and principles

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; that is, with appropriately trained personnel using equipment of appropriate quality.

All those who provide an ultrasound service are ethically and legally vulnerable if they have not been adequately trained. National Health Service (NHS) trusts and health boards 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 CPD recommendations.¹ Trusts, health boards, purchasing commissioners and patients should be aware of the requirements for training.

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, health boards, 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.

The RCR has worked closely for many years with The Royal College of Obstetricians and Gynaecologists (RCOG) to ensure adequate training in obstetric ultrasound and obstetric ultrasound is not covered in this publication. It is also recognised that the RCOG has its own 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 are other groups (such as general practitioners) who might wish to train in this area.

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.² These are supported by the RCR and the British Medical Ultrasound Society.

Three levels of minimum training requirements are proposed in this document.

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 three or four of training. It would also be equivalent to a holder of, for example, the RCOG special skills training module in gynaecological ultrasound imaging.

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 outside of 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 Certification of Completion of Training (CCT), assuming that part of the fifth year of subspecialty training had involved ultrasound.

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.

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 1–11 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).

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 multidisciplinary team meetings (MDTMs) should continue to ensure an integrated approach to any further imaging that may be required.

A system for recording the results of any ultrasound examination in the patient's record is mandatory. The permanent recording of images, where appropriate, is also mandatory for the purposes of correlative imaging, future comparison and audit. The preferred option is through the hospital radiology information system (RIS)/picture archive and communications systems (PACS) equipment, enabling other clinicians to access the images and report.

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 acquired.

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 minimal 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.

Training should be related to the specialist requirements of the trainee; that is, 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.

Training should be given in departments which have a multidisciplinary (medical, surgical, radiological and so on) philosophy, an adequate throughput of work, a radiologist or Level 2/3 sonographer practitioner with experience and an interest in training in the module required, appropriate equipment and an active audit process. The role of sonographer practitioners in delivering some or all of this modular training should be formally recognised and agreed.

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 another ultrasound Level 2/3 trained medical practitioner.

Following training, regular and relevant 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.

It is important that the ultrasound equipment is adequately serviced and maintained to allow the acquisition of diagnostic images. Parameters that affect performance include scanners, transducers, image quality and quality assurance, safety, equipment replacement and the scanning environment. This area is more fully covered by the RCR guideline Standards for the provision of an ultrasound service.³

3. Training recommendations

Training should consist of both theoretical and practical syllabuses.

Theoretical training

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).

The Radiology-integrated training initiative (R-ITI), a free resource, includes eight sections on theoretical principles.

Other online resources offering theoretical training and guidance include British Medical Ultrasound Society (BMUS), RCR, Radiological Society of North America (RSNA), Sonoworld, Radiopaedia and the Radiology Events and Discrepancies (READ) newsletter.

The theoretical syllabus is set out in Appendix 12.

Practical training

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 1–11). A modular anatomical approach is recommended for musculoskeletal ultrasound (for example, 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.

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 intraoperative 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. Many centres in the UK now offer excellent practical training with the use of simulators allowing the development of ultrasound technical and diagnostic skills prior to or as an adjunct to patient exposure.

The syllabuses set out in Appendices 1–11 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).

The requirements for the different levels of training are as follows:

Level 1

Different trainees will acquire the necessary skills at different rates and the endpoint 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 2/3 practitioner. In certain circumstances it may be appropriate to delegate some or most of this supervision to a Level 1 practitioner with at least two years' experience of Level 1 practice.

Level 2

This usually requires at least one 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 two years' experience at that Level.

Level 3

This requires practitioners to spend a significant part of their time undertaking ultrasound examinations, teaching, research and development.

They will have undertaken 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.

The syllabuses for each area of ultrasound specialisation are outlined in Appendices 1–11.

4. Continuing professional development

The minimum amount of ongoing experience in ultrasound as outlined in each syllabus should be maintained.

CPD should be undertaken which incorporates elements of ultrasound practice. This should be included in the annual appraisal and revalidation process. Trainees should keep detailed log books to document cases, teaching, training and CPD with reflections to build their own US portfolio as part of appraisal and revalidation. Membership of an ultrasound society such as BMUS or other relevant specialty society is strongly encouraged.

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. The audit process should be independent and the format should be in line with RCR recommendations.⁴ Evidence of audit should be available to commissioners of the service if required. Audit templates can be submitted via the RCR's Clinical Radiology AuditLive.⁴ The individual should take part in learning from discrepancy meetings as part of a feedback and learning process.

The individual should keep up to date with the relevant literature.

The individual should attend regular MDTMs and have an ultrasound mentor.

This document was approved by the Board of the Faculty of Clinical Radiology on 23 February 2017.

References

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3. The Royal College of Radiologists and the Society and College of Radiographers. *Standards for the provision of an ultrasound service*. London: The Royal College of Radiologists, 2014. .
4. www.rcr.ac.uk/auditlive (last accessed 19/5/17)
5. Perros P, Boelaert, Colley S K *et al*. Guidelines for the management of thyroid cancer. *Clin Endocrinol (Oxf)* 2014; **81**(Suppl 1): 1–122.

Appendix 1. Urological ultrasound

This curriculum is intended for clinicians who perform diagnostic urological ultrasound and ultrasound-guided urological intervention. At least Level 1 should be obtained by anyone performing unsupervised diagnostic imaging.

Focused training and practice

There are frequent situations arising in clinical practice where rapid bedside assessment using focused ultrasound techniques can help with the assessment of, and treatment planning for, patients. In this situation, rapid ultrasound assessment by a competent non-radiological clinician may be more appropriate than waiting for a formal ultrasound list during normal working hours. Some clinicians may wish to focus on only one skill such as deciding whether the collecting systems/ureters are dilated or not, placing a suprapubic catheter, transrectal ultrasound (TRUS) biopsies and so on. These unitary skills may aid the clinician's practice and greatly improve patient pathways.

Each clinician will have their own requirement for focused training and to accommodate their training requirements, a targeted curriculum and syllabus should be created by local trainers, drawing on appropriate elements of the knowledge base and competencies to be acquired from Levels 1–2, depending on the level of practice expected.

An example syllabus is included in the RCR's focused ultrasound document; for example, suprapubic catheterisation.¹

It is essential that all ultrasound examinations that may have any influence on patient management are performed by individuals who are competent to provide an accurate examination and assessment and that the images and a formal report are recorded on a RIS/PACS system.

Level 1. Knowledge base

- Physics and technology, ultrasound techniques and administration (see Appendix 12)
- Sectional and ultrasonic anatomy
 - Kidneys
 - Ureters
 - Other retroperitoneal structures (adrenals, aorta, inferior vena cava [IVC])
 - 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: infection, hyperplasia, tumours
 - Scrotal contents: testicular tumours, cysts, torsion, hydrocele, inflammatory problems, trauma

Level 1. Training and practice

Practical training should involve at least one ultrasound list per week over a period of three to six months, with approximately five to ten 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 endpoint 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 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. 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.

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 transrectal ultrasound
- Measure prostatic volume
- Identify abnormal focal lesions
- 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
 - Suprapubic mass
 - Palpable masses in the scrotum
 - Scrotal pain.

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 transabdominal ultrasound
 - Further application of endocavity ultrasound (for example, transvaginal and transrectal ultrasound)
 - Intraoperative 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. Training and practice

Practical training should involve at least one 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 two 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. Competencies to be acquired

Competencies will have been gained during training for Level 1 practice, and 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 outside of their experience and refer on appropriately
- Perform ultrasound-guided invasive procedures, including cyst aspiration, abscess drainage, renal biopsy, percutaneous nephrostomy, suprapubic bladder catheter insertion and transrectal prostate biopsies
- 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.

They will have spent a continuous period of specialist training in urological ultrasound. They will perform specialised examinations at the leading edge of ultrasound practice.

They will accept tertiary referrals from Level 1 and Level 2 practitioners and will perform specialised examinations (for example, 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 three 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 CPD which should form part of their annual appraisal and revalidation
- Audit their practice
- Participate in multidisciplinary meetings
- Keep up to date with relevant literature.

Approved by the British Association of Urological Surgeons.

Appendix 1.
Urological ultrasound
training competency
assessment sheet

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
Core knowledge base — Level 1				
Physics and technology			Administration	
Practical instrumentation/use of ultrasound controls			Sectional and ultrasonic anatomy	
Ultrasound techniques			Pathology in relation to ultrasound	
Competencies/skills to be acquired — Level 1				
<i>Kidneys</i>			<i>Scrotum</i>	
Ultrasound examination in different planes			Ultrasound examination in different planes	
Ultrasonic anatomy and common normal variants			Ultrasonic anatomy and common normal variants	
Renal length and variation from normality			Epididymal cysts	
Collecting system dilatation			Varicoceles	
Simple cysts			Intrascrotal and intratesticular calcifications	
Complex cysts			Tumours	
Tumours			Inflammatory changes in testes and epididymides	
Stones			Use Doppler to help differentiate torsion/inflammatory problems	

Trainee:		Trainer:	
	Trainer signature	Date	Trainer signature
Peri-renal abnormalities			<i>Other</i>
<i>Bladder</i>			To be able to recognise normal aorta and aortic aneurysm
Ultrasound examination in different planes			To be able to recognise normal liver and liver masses
Ultrasonic anatomy and common normal variants			To be able to recognise normal uterus and ovaries and gynaecological masses
Bladder volume			Use ultrasound in the assessment of patients presenting with:
Diverticula			– Haematuria
Tumours			– Loin pain/renal colic
Calculi			– Loin mass
Use colour Doppler to assess ureteric jets			– Lower urinary tract symptoms
<i>Prostate</i>			– Recurrent urinary tract infection
Ultrasonic anatomy and common normal variants			– Suprapubic mass
Transrectal ultrasound			– Palpable scrotal masses
Prostatic volume			– Scrotal pain
Abnormal focal lesions			Know when to refer to a more expert ultrasonologist

Trainee:		Trainer:	
	Trainer signature	Date	
			Trainer signature
			Date
Core knowledge base — Level 2			
Physics and technology			Sectional and ultrasonic anatomy
Ultrasound techniques			
Competencies/skills to be acquired — Level 2			
<i>To be competent to perform/recognise the following:</i>			
Pathology affecting the urinary tract and provide an accurate diagnosis in almost all cases			Doppler ultrasound studies relevant to the urinary tract
Abnormalities which are outside of their personal experience and refer on appropriately			Abnormalities elsewhere in the abdomen and pelvis which need referral for scanning by another ultrasonologist and/or further investigation
Ultrasound-guided invasive procedures, including cyst aspiration, abscess drainage, renal biopsy, percutaneous nephrostomy trans-rectal prostate biopsies and suprapubic bladder catheter insertion			

Appendix 2. Gynaecological ultrasound

This curriculum is intended for clinicians who perform diagnostic ultrasound and ultrasound-guided intervention. At least Level 1 should be obtained by anyone performing unsupervised diagnostic imaging.

Focused training and practice

There are frequent situations arising in clinical practice where rapid bedside assessment using focused ultrasound techniques can help with the assessment of, and treatment planning for, patients. In this situation, rapid ultrasound assessment by a competent non-radiological clinician may be more appropriate than waiting for a formal ultrasound list during normal working hours. Some clinicians may wish to focus on only one skill such as recognising the appearances of intrauterine contraceptive device (IUCDs) to aid localisation, or the identification and characterisation of pelvic masses. These unitary skills may aid the clinician's practice and greatly improve patient pathways.

Each clinician will have their own requirement for focused training and to accommodate their training requirements, a targeted curriculum and syllabus should be created by local trainers, drawing on appropriate elements of the knowledge base and competencies to be acquired from Levels 1–2, depending on the level of practice expected.

It is essential that all ultrasound examinations that may have any influence on patient management are performed by individuals who are competent to provide an accurate examination and assessment and that the images and a formal report are recorded on a RIS/PACS system.

Level 1. Knowledge base

- Physics and technology, ultrasound techniques and administration and report writing (see Appendix 12)
- 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 menstrual cycle)
 - Cervix and vagina
 - First trimester gestation appearances

- Bladder and urethra
- Associated structures; omentum and peritoneal fluid
- Pathology in relation to ultrasound
 - Uterus: fibroids, adenomyosis, IUCDs, endometrial hyperplasia, polyps and tumours
 - Ovaries: cysts and their complications, endometrioma, tumours, inflammation and infection, polycystic and hyperstimulated ovaries, torsion
 - Fallopian tubes: hydro/pyo-salpinges
 - Cervix and vagina: congenital lesions, cysts, tumour, retained foreign bodies
 - First trimester: location, viability, biometry, to include fetal number and chorionicity, ectopic pregnancy, signs of non-viability, haemorrhage, retained products of conception
 - Bladder and urethra: volume estimation diverticula, wall thickening, calculi, tumours, peri-urethral cysts and abscesses
 - Other pelvic pathology to recognise deviation from normal, for example, free fluid or masses

Level 1. Training and practice

Practical training should involve at least 30 ultrasound sessions within a period of six months with approximately three to eight examinations performed by the trainee (under supervision) per session. However, different trainees will acquire the necessary skills at different rates and the endpoint of the training programme should be judged by an assessment of competencies to perform and report an ultrasound examination.

Examinations should ideally encompass the full range of pathological conditions listed below.

For some practitioners with Level 1 competencies in only one area of practice, the training and competency assessment in these areas only can be obtained (for example, in the assessment of early pregnancy clinics or postmenopausal patients).

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 two 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. Competencies to be acquired

Early pregnancy

To be able to:

- Define pregnancy locality by ultrasound signs
- Recognise signs of viability/non-viability
- Recognise normal appearances as gestation advances
- Recognise signs of ectopic pregnancy
- Identify multiple pregnancy and chorionicity
- Date pregnancy by crown rump length (CRL)
- Recognise signs of haemorrhage
- Recognise signs of retained products of conception
- Understand the role of ultrasound in the setting of early pregnancy clinical pathways and laboratory findings
- Understand the terms and recognise the ultrasound findings in pregnancies of unknown location and pregnancy of uncertain viability
- Write a structured report of the ultrasound findings.

Abnormal vaginal bleeding

To be able to:

- Recognise normal and abnormal endometrial thickness
- Recognise features of endometrial polyps/carcinoma
- Recognise features of atrophic endometrium
- Recognise features of fibroids and their localisation

- Recognise appearances of IUCDs and their localisation
- Recognise when further investigation is required and what to ask for
- Understand the need for further referral and clinical pathways
- Write a structured report of the ultrasound findings.

Pelvic pain

To be able to:

- Recognise features of ovarian cyst torsion, rupture or haemorrhage
- Recognise features of endometrioma
- Recognise appearances of hydrosalpinges
- Recognise features of pelvic inflammatory disease
- Recognise non-gynaecological causes of pelvic pain
- Understand the need for further referral and clinical pathways
- Write a structured report of the ultrasound findings.

Pelvic mass

To be able to:

- Recognise typical appearances of uterine and ovarian masses
- Recognise features suggesting benign or malignant pathology
- Recognise variations from normal suggesting non-gynaecological causes of a pelvic mass
- Understand the need for further referral and clinical pathways
- Write a structured report of the ultrasound findings.

Reproductive medicine

To be able to:

- Recognise features of the endometrium at different stages of the menstrual cycle

- Recognise features of the ovary at different stages of the menstrual cycle
- Recognise features of a stimulated and hyperstimulated ovary
- Recognise features of a polycystic ovary
- Understand the need for further referral and clinical pathways
- Write a structured report of the ultrasound findings.

Bladder

To be able to:

- Perform an ultrasound examination of the bladder in different planes
- Recognise normal anatomy of the bladder and common normal variants
- Measure bladder volume
- Recognise and diagnose bladder diverticula
- Recognise bladder tumours
- Recognise bladder calculi
- Recognise variations from normal/abnormalities which need referral for scanning by a more experienced ultrasonologist and/or further investigation
- Understand the need for further referral and clinical pathways
- Write a structured report of the ultrasound findings. Practitioners should:
 - Include ultrasound in their ongoing CPD
 - Audit their practice.

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 transabdominal ultrasound
- Further applications of transvaginal ultrasound: saline infusion hystero-graphy (SIH), hysterosalpingo-contrast-sonography (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 pelvis

Level 2. Training and practice

Practical training should include at least one 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 two 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. Competencies to be acquired

Competencies will have been gained during training for Level 1 practice and refined during a period of clinical practice.

Female reproductive tract

To be able to:

- Recognise and correctly diagnose almost all pathology affecting the female genital tract
- Perform Doppler ultrasound studies relevant to the uterus and ovaries

- Recognise abnormalities elsewhere in the and pelvis which need referral for scanning by another ultrasonologist and/or further investigation.

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 periurethral 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
- The principles of oocyte collection by transvaginal ultrasound-guided aspiration of follicles. Practitioners should:
- Include ultrasound in their ongoing CPD
- Audit their practice.

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.

They will have spent a continuous period of specialist training in gynaecological ultrasound. They will accept tertiary referrals from Level 1 and 2 practitioners.

They 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.

Once trained and assessment of competencies confirmed, the practitioner will need to continue to perform ultrasound throughout the remainder of their training programme. Such further ultrasound practice may be intermittent, but no more than three months should elapse without the trainee using their scanning skills, and competency with evidence of sufficient scanning to maintain these competencies.

All practitioners should work in a team in order to maintain competencies. Practitioners should:

- Include ultrasound in their ongoing CPD which should be included in annual appraisal and revalidation
- Audit their practice
- Participate in multidisciplinary meetings
- Keep up to date with relevant literature.

Appendix 2. Gynaecological ultrasound competency assessment sheet

Trainee:	Trainer:	
	Trainer signature	Date
Core knowledge base — Level 1		
Physics and technology	Administration	
Practical instrumentation/use of ultrasound controls	Sectional and ultrasonic anatomy	
Ultrasound techniques	Pathology in relation to ultrasound	
Techniques of transabdominal and transvaginal scanning	Issues regarding intimate examinations	
Competencies/skills to be acquired — Level 1		
<i>Early pregnancy</i>	<i>Reproductive medicine</i>	
Dating pregnancy	Endometrial changes with menstrual cycles	
Signs of non-viability	Ovarian changes with menstrual cycle	
Multiple pregnancy and chorionicity	Polycystic ovaries	
Haemorrhage	Stimulated and hyperstimulated ovaries	
Retained products of conception	<i>Kidneys</i>	
Ectopic pregnancy	Ultrasound examination in different scan planes	
<i>Vaginal bleeding</i>	Ultrasonic anatomy and common normal variants	

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
Fibroids and their localisation			Renal length	
IUCDs and their localisation			Collecting system dilatation	
Normal and abnormal endometrial thickness			Cysts	
Atrophic and hyperplastic endometrium			Tumours	
Endometrial polyps			Stones	
<i>Pelvic pain</i>			<i>Bladder</i>	
Ovarian cyst complications			Ultrasound examination in different planes	
Endometriosis			Ultrasonic anatomy and common normal variants	
Pelvic inflammatory disease			Bladder volume	
Non-gynaecological causes of pain			Bladder diverticula	
<i>Pelvic mass</i>			Tumours	
Identification			Calculi	
Organ of origin of mass			Ultrasound examination in different planes	
Benign versus malignant features			Ultrasonic anatomy and common normal variants	

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
<i>General</i>				
			Know when to refer to a more expert ultrasonologist	
Core knowledge base – Level 2				
Physics and technology			Sectional and ultrasonic anatomy	
Ultrasound techniques				
<i>Female reproductive tract</i>				
Almost all pathology affecting the female genitourinary tract			Bartholin's cysts, abscesses and periurethral lesions	
Ultrasound-guided invasive procedures, including ascitic drainage, omental biopsy, pelvic mass biopsy (transabdominal or transvaginal), lymph node aspiration, SIH and HyCoSy			Features of haematocolpos	
Doppler ultrasound studies relevant to the uterus and ovaries			Features of adenomyosis	
Abnormalities elsewhere in the abdomen and pelvis which need referral for scanning by another ultrasonologist and/or further investigation			Non-ovarian endometriosis	

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
Stage ovarian and uterine tumours			Non-gynaecological causes of pelvic pain and how to diagnose appendicitis, inflammatory bowel disease, bowel cancer, hernias, aneurysms and bladder disease	
<i>Other</i>			Different types of complex ovarian masses	
Causes of an abnormal Doppler waveform			Malignant disease of the omentum, peritoneum and the rest of the abdomen	
Changes associated with precocious puberty, thelarche, adrenarche and virilisation			Features of pleural effusions	
Congenital anomalies			Common sites and features of tumours that metastasise to the pelvis	
Features of lymph nodes in the inguinal and iliac chains			The principles of oocyte collection by transvaginal ultrasound-guided aspiration of follicles	

Appendix 3. Gastrointestinal ultrasound

This curriculum is intended for clinicians who perform diagnostic gastrointestinal ultrasound and ultrasound-guided intervention. At least Level 1 should be obtained by anyone performing unsupervised diagnostic imaging.

Focused training and practice

There are frequent situations arising in clinical practice where rapid bedside assessment using focused ultrasound techniques can help with the assessment of, and treatment planning for, patients. In this situation, rapid ultrasound assessment by a competent non-radiological clinician may be more appropriate than waiting for a formal ultrasound list during normal working hours. Some clinicians may wish to focus on only one skill such as drainage of ascites and ultrasound-guided liver biopsies. These unitary skills may aid the clinician's practice and greatly improve patient pathways.

Each clinician will have their own requirement for focused training and to accommodate their training requirements, a targeted curriculum and syllabus should be created by local trainers, drawing on appropriate elements of the knowledge base and competencies to be acquired from Levels 1–2, depending on the level of practice expected.

An example syllabus is included in the focused ultrasound document; for example, drainage of ascites and ultrasound-guided liver biopsies.¹

It is essential that all ultrasound examinations that may have any influence on patient management are performed by individuals who are competent to provide an accurate examination and assessment and that the images and a formal report are recorded on a RIS/PACS system.

Level 1. Knowledge base

- Physics and technology, ultrasound techniques and administration (see Appendix 12)
- 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, intrahepatic 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. Training and practice

Practical training should involve at least one ultrasound list per week over three to six months with approximately five to ten 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 endpoint 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 two 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. 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
- Recognise abnormalities of the hepatic and portal venous system, for example, 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 intrahepatic and extrahepatic 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 hydronephrosis
- Recognise normal kidneys, uterus and ovaries
- Recognise renal and gynaecological masses.

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. Training and practice

Practical training should involve at least one 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 two 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. Competencies to be acquired

Competencies will have been gained during training for Level 1 practice and refined during a period of clinical practice. These will include the ability to:

- Perform a comprehensive ultrasound examination of all of the solid organs within the abdomen
- Evaluate the small bowel for focal or diffuse disease
- Evaluate the bowel in inflammatory bowel disease
- Evaluate the large bowel for the presence of diverticular disease, appendicitis and their complications, tumours and obstruction
- Evaluate the peritoneal cavity, its mesenteries, compartments and the omentum for the presence of infective or malignant disease
- Undertake ultrasound-guided drainage of peritoneal fluid collections
- Evaluate the hepatic and portal venous systems using spectral, colour and power Doppler ultrasound
- 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.

They will accept tertiary referrals from Level 1 and 2 practitioners and will perform specialised examinations (eg, 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 their training programme. Such further ultrasound practice may be intermittent, but no more than three months should elapse without the trainee using their 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 CPD which should form part of their annual appraisal and revalidation
- Audit their practice
- Participate in multidisciplinary meetings
- Keep up to date with relevant literature.

Appendix 3. Gastrointestinal ultrasound competency assessment sheet

Trainee:		Trainer:	
	Trainer signature	Date	Trainer signature
Physics and technology			Administration
Practical instrumentation/use of ultrasound controls			Sectional and ultrasonic anatomy
Ultrasound techniques			Pathology in relation to ultrasound
Competencies/skills to be acquired — Level 1			
<i>Liver</i>		<i>Pancreas</i>	
Ultrasound examination in different scan planes			Ultrasound examination in different scan planes
Normal hepatic anatomy and variants			Normal anatomy and variants
Normal and abnormal liver texture			Solid and cystic tumours
Atrophy and hypertrophy			Duct dilatation and stones
Fatty change			Acute and chronic pancreatitis and complications
Cirrhosis			<i>Portal venous system and spleen</i>
Cysts and benign lesions			Splenic size and focal lesions
Malignant lesions			Splenic trauma
Normal hepatic and portal venous anatomy			Portal vein diameter

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
Abnormalities of the portal venous system eg, thrombosis			Cavernous transformation of the portal vein	
Ultrasound-controlled biopsy for the evaluation of parenchymal liver disease			Varices	
<i>Biliary system</i>			<i>Other</i>	
Ultrasound examination in different scan planes			Normal uterus, ovaries, kidneys and aorta	
Normal ultrasonic anatomy and variants			Abdominal aortic aneurysm	
Abnormalities of the gallbladder wall including gall bladder tumours			Hydronephrosis	
Gallbladder stones			Renal and gynaecological masses	
Acute and chronic cholecystitis			Bladder diverticula	
Bile duct dilatation and level of obstruction			<i>General</i>	
<i>Bowel</i>			Know when to refer to a more expert ultrasonologist	
Normal stomach, small and large bowel				
Focal intestinal abnormality				
Small bowel obstruction				

Trainee:		Trainer:	
	Trainer signature	Date	Trainer signature
Competencies/skills to be acquired — Level 2			
Ultrasound examination of all of the solid organs within the abdomen			Bowel tumour
Focal or diffuse small bowel disease			Infective or malignant disease of peritoneum, mesenteries and omentum
<i>Inflammatory bowel disease</i>			Ultrasound-guided drainage of peritoneal fluid collections
Diverticular disease, appendicitis and their complications			The hepatic and portal venous systems using spectral, colour and power Doppler ultrasound
Bowel obstruction			Ultrasound-guided biopsy of focal liver lesions

Appendix 4. Vascular ultrasound

This curriculum is intended for clinicians who perform diagnostic vascular ultrasound and ultrasound-guided intervention. At least Level 1 should be obtained by anyone performing unsupervised diagnostic imaging.

Focused training and practice

There are frequent situations arising in clinical practice where rapid bedside assessment using focused ultrasound techniques can help with the assessment of, and treatment planning for, patients. In this situation, rapid ultrasound assessment by a competent non-radiological clinician may be more appropriate than waiting for a formal ultrasound list during normal working hours. Some clinicians may wish to focus on only one skill such as to provide ultrasound-guided vascular cannulation. These unitary skills may aid the clinician's practice and greatly improve patient pathways.

Each clinician will have their own requirement for focused training and in order to accommodate their training requirements, a targeted curriculum and syllabus should be created by local trainers, drawing on appropriate elements of the knowledge base and competencies to be acquired from Levels 1–2, depending on the level of practice expected. An example syllabus is included in the focused ultrasound document; for example, ultrasound-guided vascular cannulation.¹

It is essential that ALL ultrasound examinations that may have any influence on patient management are performed by individuals who are competent to provide an accurate examination and assessment and that the images and a formal report are recorded on a RIS/PACS system.

Level 1. Knowledge base

- Physics and technology, ultrasound techniques and administration (see Appendix 12)
- 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. Training and practice

Practical training should involve at least two ultrasound lists per week over a period of no less than three months and up to six 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 two 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. Competencies to be acquired

- To be able to perform continuous wave hand-held Doppler and segmental pressures ankle-brachial pressure index (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
- Diagnose > 50% stenosis (a doubling of peak systolic velocity [PSV] with pulsed Doppler over adjacent segments)
- Recognise common surgical interventions, arteriovenous (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. 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. Training and practice

Practical training should include at least one 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 two years' experience at that level.

Level 2. Competencies to be acquired

Competencies will have been gained during training for Level 1 practice and 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.

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. They will accept tertiary referrals from Level 1 and 2 practitioners.

They should have the capability to make use of developing technologies and ultrasound techniques, develop research and teaching skills and to perform 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 their 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, and a period of re-training is required, it should be agreed and documented with the practitioner, local trainers and assessors.

Practitioners should:

- Include ultrasound in their ongoing CPD which should form part of their in annual appraisal and revalidation
- 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 4. Vascular ultrasound competency assessment sheet

Trainee:		Trainer:	
	Trainer signature	Date	Trainer signature
Core knowledge base –Level 1			
Physics and technology			Administration
Practical instrumentation/use of ultrasound controls			Sectional and ultrasonic anatomy
Ultrasound techniques			Pathology in relation to ultrasound
Competencies/skills to be acquired — Level 1			
<i>Essential principles</i>		<i>Peripheral superficial veins</i>	
Continuous wave (CW) hand-held Doppler and segmental pressures			Recognise normal anatomy and common variants
Caliper measurements of distance and size			Identify sapheno-femoral and sapheno-popliteal junctions
Colour flow and spectral analysis			Diagnose reflux, incompetence, perforators
Velocity measurement and Doppler angle		<i>Abdominal ultrasound</i>	
Peripheral arteries and grafts			Recognise patency and occlusion of aorta
Recognise normal anatomy and common variants			Recognise and size aortic aneurysm
Scan common femoral artery (CFA) to popliteal arteries			<i>Extracranial vessels</i>

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
Recognise patency, occlusion and aneurysm			Recognise normal anatomy and common variants	
Recognise and differentiate 50% stenosis			Recognise patency, occlusion, plaque and stenosis	
Recognise common interventions			Other competencies acquired	
<i>Peripheral deep veins</i>			<i>General</i>	
Recognise normal anatomy and common variants			Know when to refer to a more expert ultrasonologist	
Scan common femoral vein (CFV) to popliteal veins				
Perform compression and augmentation				
Recognise acute above knee deep vein thrombosis (DVT)				
Diagnose and locate reflux				
Core knowledge base – Level 2				
Peripheral arteries and grafts			Transcranial Dopple	
Peripheral deep and superficial veins				

Trainee:		Trainer:	
Trainer signature		Trainer signature	
Date		Date	
Competencies/skills to be acquired - Level 2			
Assessment from iliac to infrapopliteal arteries and veins		Grade degrees of carotid stenosis and plaque type	
Assessment from subclavian to radial and ulnar arteries and veins		Normal variants, aneurysmal dilatation, patency, stenosis and occlusion of major abdominal and iliac vessels	
Patency, occlusion, stenosis, reverse flow and steal in the carotid and vertebral vessels			

Appendix 5. Breast ultrasound

This curriculum is intended for clinicians who perform diagnostic breast ultrasound and ultrasound-guided breast intervention. At least Level 1 should be obtained by anyone performing unsupervised diagnostic breast imaging.

Focused training and practice

There are frequent situations arising in clinical practice where rapid bedside assessment using focused ultrasound techniques can help with the assessment of, and treatment planning for, patients. In this situation, rapid ultrasound assessment by a competent non-radiological clinician may be more appropriate than waiting for a formal ultrasound list during normal working hours. Some clinicians may wish to focus on only one or two skills. These unitary skills may aid the clinician's practice and greatly improve patient pathways.

Each clinician will have their own requirement for focused training and to accommodate their training requirements, a targeted curriculum and syllabus should be created by local trainers, drawing on appropriate elements of the knowledge base and competencies to be acquired from Levels 1–2, depending on the level of practice expected.

It is essential that all ultrasound examinations that may have any influence on patient management are performed by individuals who are competent to provide an accurate examination and assessment and that the images and a formal report are recorded on a RIS/PACS system.

Level 1. Knowledge base

- Physics and technology, ultrasound techniques and administration (see Appendix 12)
- Sectional and ultrasound anatomy
 - Normal anatomy of female and male breast, and patterns of disease spread
 - Changes in ultrasound appearances associated with age, pregnancy and lactation, hormonal status and medication
- Pathology in relation to ultrasound
 - Benign conditions to include: cyst, fibroadenoma, lipoma, fat necrosis, hamartoma, papillary lesions, radial scar/complex sclerosing lesion and gynaecomastia
 - Indeterminate conditions to include: atypical ductal and lobular hyperplasia
 - Malignancy to include: ductal, lobular, inflammatory and other carcinomas
 - Normal and abnormal appearances of axillary lymph nodes
 - Inflammatory breast conditions to include: infection, abscess formation and periductal sepsis

- Iatrogenic appearances to include: breast implants, early and late postoperative changes, seroma, haematoma, radiotherapy changes, fat necrosis, scarring
- Triple assessment
 - Local/national guidelines
 - Clinical findings associated with normal, benign and malignant changes
 - Mammographic interpretation, correlation and co-localisation with ultrasound findings

Level 1. Training and practice

Practical training should involve at least one ultrasound session per week over a period of no less than six months and no more than one year.

A minimum of 100 examinations should be undertaken and a record of these kept.

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, needle biopsy results and surgical histology where appropriate.

The numbers suggested will vary depending how quickly competencies are achieved.

Examinations should include an appropriate range of normal and abnormal cases including palpable and impalpable lesions which should encompass the full range of conditions listed above. They should also include patients presenting to symptomatic clinics, screening assessment clinics and postoperative surgical clinics.

Training should be supervised either by someone who has obtained at least Level 2 competence in breast ultrasound or by a Level 1 practitioner with at least two years' experience of Level 1 practice.

Trainees should be working in line with RCR recommendations.³ The practical experience should ideally be undertaken in conjunction with attendance on a recognised postgraduate course 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. Competencies to be acquired

- An understanding of the strengths, weaknesses and limitations of breast ultrasound
- An understanding of the indications for and the importance of ultrasound in the triple assessment process
- An awareness of the interdependency and significance of mammographic and ultrasound appearances
- The ability to perform a thorough ultrasound examination of the breast and axilla, to recognise normal anatomy and physiological variation as detailed above and to confidently exclude the presence of a sonographic lesion within the breast
- The recognition of established criteria for lesion characterisation
- Identification and discrimination between clearly normal and suspicious axillary lymph nodes
- The ability to write a detailed report of the ultrasound findings with grading, differential diagnosis, conclusion and recommendation for further management
- The recognition of personal limitations and ability to ask for more expert advice if required

Level 2. Knowledge base

Breast imaging

- Knowledge of a range of other imaging studies relevant to breast imaging and their role; for example, breast magnetic resonance (MR), positron emission tomography-computed tomography (PET-CT), tomosynthesis, contrast-enhanced mammography, elastography
- An understanding of principles of evaluation of tumour response to treatment

Pathology in relation to ultrasound

- More detailed understanding of breast disease

Level 2. Training and practice

Practical training should involve at least one year of experience at Level 1. Competencies should be further developed during a period of clinical practice, which will involve at least one session per week with at least ten examinations per week for at least three 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, 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 two years' experience at that level and who would normally be of consultant status.

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 ten guided cyst aspirations of which at least five should be of cysts smaller than 2 cm
- Aspiration of cysts of less than 1 cm diameter
- Guided core biopsies of breast: perform a minimum of ten* guided core biopsies with pathological correlation of core biopsy histology and final pathology (if available)
- Guided fine needle aspiration biopsy (FNAB): perform a minimum of ten* FNABs of solid lesions, with pathological correlation of cytology result and final pathology (if available)
- Guided core biopsy or FNAB of suspicious axillary lymph nodes, in accordance with local guidelines: perform a minimum of ten* guided biopsies with correlation of histology/cytology result and final pathology (if available)
- Perform guided abscess aspiration and drainage
- Perform preoperative guided localisations using skin marking and wire insertion techniques with mammographic corroboration as appropriate
- Perform guided marker insertion before neo-adjuvant chemotherapy
- Evaluation of tumour response to neo-adjuvant treatment
- Evaluation of integrity of breast prostheses
- Ability to accept referrals from Level 1 practitioners

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

Level 3. Knowledge base

- A more detailed understanding of breast imaging and pathology as detailed above including understanding of population screening, risk and prognostic factors as applied to breast cancer.
- Awareness of developments in breast ultrasound including elastography, Doppler and the use of intravascular contrast agents.

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 breast radiologist and will be an 'expert' in this area.

They will accept tertiary referrals from Level 1 and 2 practitioners and will perform specialised examinations as well as performing advanced ultrasound-guided invasive procedures such as vacuum-assisted breast biopsy.

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 breast ultrasound throughout the remainder of the training programme. Such further ultrasound practice may be intermittent, but no more than three months should elapse without the trainee using their scanning skills.

In medical practice, a clinician scanning at Level 1 should perform at least one ultrasound session per week and a minimum of 150 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 CPD which should form part of their annual appraisal and revalidation
- Audit their practice
- Participate in multidisciplinary meetings
- Keep up to date with relevant literature.

Approved by the British Society of Breast Radiology.

Appendix 5.
Breast ultrasound
competency
assessment sheet

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
Core knowledge base — Level 1				
Physics and technology			Administration	
Practical instrumentation/use of ultrasound controls			Sectional and ultrasonic anatomy	
Ultrasound techniques			Pathology in relation to ultrasound	
Competencies/skills to be acquired — Level 1				
Understands strengths, weaknesses and limitations of breast ultrasound			Aware of relationship between mammographic and ultrasound appearances	
Recognises established criteria for lesion characterisation			Able to write detailed report with grading, differential diagnosis, conclusion and recommendation for further management	
Understands indications for and importance of ultrasound in triple assessment			Can perform thorough ultrasound examination of breast and axilla, recognise normal anatomy and physiological variation and confidently exclude presence of a sonographic lesion	
Identifies and discriminates between clearly normal and suspicious axillary lymph nodes			Knows when to ask for more expert advice	

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
Competencies/skills to be acquired - Level 2				
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			Perform ultrasound-guided breast abscess aspiration	
Aspirate cysts smaller than 1 cm in diameter			Perform ultrasound-guided localisations preoperatively, using both skin marking and wire insertion techniques	
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 ultrasound-guided marker or coil insertion prior to neo-adjuvant chemotherapy	
Perform a minimum of 10 guided core biopsies with pathological correlation			Accept referrals from Level 1 practitioners	

Appendix 6. Thoracic ultrasound

The curriculum is intended for clinicians who perform diagnostic and therapeutic ultrasound. At least Level 1 should be obtained by anyone performing thoracic scans unsupervised.

Focused training and practice

There are frequent situations arising in clinical practice where rapid bedside assessment using focused ultrasound techniques can help with the assessment of, and treatment planning for, patients. In this situation, rapid ultrasound assessment by a competent non-radiological clinician may be more appropriate than waiting for a formal ultrasound list during normal working hours. Some clinicians may wish to focus on only one skill such as ultrasound-guided drainage of pleural effusions. These unitary skills may aid the clinician's practise and greatly improve patient pathways.

Each clinician will have their own requirement for focused training and in order to accommodate their training requirements, a targeted curriculum and syllabus should be created by local trainers, drawing on appropriate elements of the knowledge base and competencies to be acquired from Levels 1–2, depending on the level of practice expected. An example syllabus is included in the focused ultrasound document for example, ultrasound-guided drainage of pleural effusions.¹

It is essential that ALL ultrasound examinations that may have any influence on patient management are performed by individuals who are competent to provide an accurate examination and assessment and that the images and a formal report are recorded on a RIS/PACS system.

Level 1. Knowledge base

- Physics and technology, ultrasound techniques and administration (see Appendix 12)
- 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. Training and practice

Practical training should include:

- At least one session per week over a period of no less than three months, with approximately five scans per session performed by the trainee (under supervision of an experienced practitioner).

The numbers suggested will vary depending how quickly competencies are achieved. Examinations should encompass the full range of pathological conditions listed above.

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 two 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. 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. 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. Training and practice

Practical training should involve at least one 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.

Supervision of training should be by someone who has achieved at least Level 2 competence in thoracic ultrasound, has had at least two 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. Competencies to be acquired

Competencies will have been gained during training for Level 1 practice, and 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. Knowledge base

It is important that physicians correctly interpret chest x-rays (CXRs) and CT scans used in the decision-making process when managing patients.

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.

They 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 three months should elapse without the trainee using their 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 CPD which should form part of their annual appraisal and revalidation
- Audit their practice
- Participate in multidisciplinary meetings
- Keep up to date with relevant literature.

Appendix 6.
Thoracic ultrasound
competency
assessment sheet

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
Core knowledge base — Level 1				
Physics and technology			Administration	
Practical instrumentation/use of ultrasound controls			Sectional and ultrasonic anatomy	
Ultrasound techniques			Pathology in relation to ultrasound	
Competencies/skills to be acquired — Level 1				
Normal anatomy of pleura and diaphragm			Consolidated lung and its differentiation from effusion	
Identification of heart, liver and spleen			Estimation of depth of effusion and its measurement	
Pleural effusion and different echogenic patterns			Know when to refer to a more expert ultrasonologist	
Pleural thickening and its differentiation from fluid				

Appendix 7. Cranial ultrasound

This curriculum is intended for clinicians who perform cranial ultrasound imaging in infants, not just the ultrasound skills needed on a neonatal intensive care unit. It does not include spinal ultrasound imaging. At least Level 1 should be obtained by anyone performing unsupervised diagnostic imaging.

Focused training and practice

There are frequent situations arising in clinical practice where rapid bedside assessment using focused ultrasound techniques can help with the assessment of, and treatment planning for, patients. In this situation, rapid ultrasound assessment by a competent non-radiological clinician may be more appropriate than waiting for a formal ultrasound list during normal working hours. Some clinicians may wish to focus on only one skill such as the evaluation of suspected intracranial haemorrhage. These unitary skills may aid the clinician's practice and greatly improve patient pathways.

Each clinician will have their own requirement for focused training and to accommodate their training requirements, a targeted curriculum and syllabus should be created by local trainers, drawing on appropriate elements of the knowledge base and competencies to be acquired from Levels 1–2, depending on the level of practice expected.

It is essential that all ultrasound examinations that may have any influence on patient management are performed by individuals who are competent to provide an accurate examination and assessment and that the images and a formal report are recorded on a RIS/PACS system.

Level 1. Knowledge base

- Physics and technology, ultrasound techniques and administration (see Appendix 12)
- Issues of parental information and consent
- Sectional and ultrasonic anatomy of the brain:
 - Sagittal anatomy
 - Coronal anatomy
 - Basic transaxial 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. Training and practice

Practical training should involve at least one session per week over a period of no less than three months, with approximately five scans per session performed by the trainee (under supervision of an experienced practitioner).

The practitioner should be compliant with local procedures for infection control for scanning, especially on the neonatal unit.

By the end of Level 1 training, the trainee should be able to perform and record images from a basic scan demonstrating normal anatomical structures. They should recognise all common pathologies that are seen on a neonatal intensive care unit.

Different trainees will acquire the necessary skills at different rates. The endpoint 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 100 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.

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 two years' experience of Level 1 practice.

Trainees should attend an appropriate theoretical course (including physics of US and instrumentation) 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. 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 postnatal age
- Measure ventricular size and assess variation from normality
- Assess obstructive hydrocephalus and monitor progression
- Recognise and describe intracranial haemorrhage and assess its extent
- Recognise common congenital malformations and refer for appropriate further investigation
- Recognise when other imaging modalities are more appropriate than ultrasound (e.g. MRI or CT)
- Recognise abnormalities which need referral for scanning by a more experienced practitioner and/or further investigation.

To be able to use ultrasound in both the routine and urgent 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 one 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 two 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 transaxial ultrasound
- Posterior fossa imaging
- of cerebral perfusion

Pathology in relation to ultrasound

- Understand of the role of ultrasound in the context of cerebral asphyxia, abnormal head circumference, congenital abnormalities, non-accidental injury and systemic disease and the role of alternative imaging modalities.

Level 2. Competencies to be acquired

Competencies will have been gained during training for Level 1 practice, and 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
- Intraoperative ultrasound as appropriate
- Infants with systemic disease (for example, postoperative 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.

They 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 three 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 scan regularly, 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 CPD
- Audit their practice
- Participate in multidisciplinary meetings
- Keep up to date with relevant literature.

Appendix 7. Cranial ultrasound competency assessment sheet

Trainee:	Trainer:	
	Trainer signature	Date
Core knowledge base — Level 1		
Physics and technology	Administration	
Practical instrumentation/use of ultrasound controls	Sectional and ultrasonic anatomy	
Ultrasound techniques	Pathology in relation to ultrasound	
Infection control		
Competencies/skills to be acquired — Level 1		
Normal US anatomy of the neonatal brain/variants	Image orientation and documentation	
US assessment of intracranial haemorrhage	US assessment of neonatal asphyxia	
US assessment of ventricular dilatation/large head	US assessment of congenital malformations	
US assessment of the premature infant's brain	Know when to refer to a more expert ultrasonologist	
US assessment of the acutely unwell neonate		

Appendix 8. Focused emergency ultrasound

This curriculum is intended for clinicians who perform diagnostic ultrasound and ultrasound-guided intervention. At least Level 1 should be obtained by anyone performing unsupervised diagnostic imaging.

Focused training and practice

There are frequent situations arising in clinical practice where rapid bedside assessment using focused ultrasound techniques can help with the assessment of, and treatment planning for, patients. In this situation, rapid ultrasound assessment by a competent non-radiological clinician may be more appropriate than waiting for a formal ultrasound list during normal working hours. Some clinicians may wish to focus on only one skill such as focused assessment with sonography in trauma (FAST) scanning, or the identification of abdominal aortic aneurysms. These unitary skills may aid the clinician's practice and greatly improve patient pathways.

Each clinician will have their own requirement for focused training and to accommodate their training requirements, a targeted curriculum and syllabus should be created by local trainers, drawing on appropriate elements of the knowledge base and competencies to be acquired from Levels 1–2, depending on the level of practice expected.

It is essential that all ultrasound examinations that may have any influence on patient management are performed by individuals who are competent to provide an accurate examination and assessment and that the images and a formal report are recorded on a RIS/PACS system.

Level 1. Knowledge base

- Physics and technology, ultrasound techniques and administration (see Appendix 12)
- Sectional and ultrasonic anatomy
 - Kidneys
 - Liver
 - Spleen
 - Retroperitoneal structures (aorta, inferior vena cava [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. 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 endpoint 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 ten 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 one year's 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. 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. To be able to use ultrasound in the context assessment of:
 - 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. Knowledge base

- Sectional and ultrasonic anatomy
 - Kidneys
 - Liver
 - Proximal leg veins
 - Heart
 - Musculoskeletal 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. Training and practice

Practical training should involve at least one 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 ten 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 two years' experience at this level.

A Level 2 practitioner will be able to accept referrals from a Level 1 practitioner.

Level 2. Competencies to be acquired

Competencies will have been gained during training for Level 1 practice, and refined during a period of clinical practice.

- Recognise and correctly make use of 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 a 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 fetal cardiac activity
 - Emergency department obstetric presentations.

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.

They 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 their consultant appointment. Such further ultrasound practice may be intermittent, but no more than three 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 CPD which should form part of their annual appraisal and revalidation
- Audit their practice
- Participate in multidisciplinary meetings
- Keep up to date with relevant literature.

Approved by the Royal College of Emergency Medicine.

Appendix 8. Focused emergency ultrasound competency assessment sheet

Trainee:	Trainer:	
	Trainer signature	Date
Core knowledge base — Level 1		
Physics and technology	Administration	
Practical instrumentation/use of ultrasound controls	Sectional and ultrasonic anatomy	
Ultrasound techniques	Pathology in relation to ultrasound	
Competencies/skills to be acquired — Level 1		
Normal anatomy and variants of kidneys, liver, spleen and aorta	<i>Ultrasound in the assessment of patients presenting with:</i>	
Differences between arteries and veins	Trauma-FAST	
Focused ultrasound to assist in bedside emergency department decisions	AAA screening/detection in symptomatic patients	
The limitations of a scan and ability to explain these limitations to patients/carers	Peri-arrest scenario for PEA/tamponade/effusion	
Recognise patients requiring formal specialist sonographic assessment	Vascular access: internal jugular and femoral vein	
Incorporate ultrasound findings with the rest of the clinical assessment	<i>Pleural and pericardial fluid</i>	
	Free intraperitoneal fluid – use of four-quadrant scan	

Trainee:		Trainer:			
	Trainer signature	Date		Trainer signature	Date
Core knowledge base — Level 2					
<i>Sectional and ultrasonic anatomy</i>			<i>Pathology in relation to ultrasound</i>		
Kidneys			Kidneys: cysts, calyceal dilatation, renal calculi, trauma (free fluid)		
Liver			Liver: cysts, trauma (free fluid)		
Proximal leg veins			Vessels: proximal deep venous thrombosis		
Heart			Cardiac: reduced ventricular function, tamponade, effusion		
Musculoskeletal system			Retroperitoneum: aortic aneurysm, fluid collection		
Pelvic structures (uterus, ovaries, bowel)			Musculoskeletal: fractures, soft tissue collections, foreign body detection		
Competencies/skills to be acquired — Level 2					
Ultrasound-guided invasive procedures (chest drain insertion, suprapubic aspiration/catheterisation, fluid collection drainage)			Detection of foreign bodies and fluid collections within soft tissues		

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
An initial assessment for patients with loin pain/haematuria			Early assessment of symptomatic women in the first trimester of pregnancy after trauma including the assessment of fetal cardiac activity	
A focused assessment of a patient presenting with hypotension			Emergency department obstetric presentations	
Proximal DVT assessment				

Appendix 9. Ultrasound training for critical/ intensive care

This curriculum is intended for clinicians who perform diagnostic ultrasound and ultrasound-guided intervention. At least Level 1 should be obtained by anyone performing unsupervised diagnostic imaging.

Focused training and practice

There are frequent situations arising in clinical practice where rapid bedside assessment using focused ultrasound techniques can help with the assessment of, and treatment planning for, patients. In this situation, rapid ultrasound assessment by a competent non-radiological clinician may be more appropriate than waiting for a formal ultrasound list during normal working hours. Some clinicians may wish to focus on only one skill such as the identification of pleural effusions and their drainage, or the use of ultrasound for central venous access. These unitary skills may aid the clinician's practice and greatly improve patient pathways.

Each clinician will have their own requirement for focused training and to accommodate their training requirements, a targeted curriculum and syllabus should be created by local trainers, drawing on appropriate elements of the knowledge base and competencies to be acquired from Levels 1–2, depending on the level of practice expected.

It is essential that all ultrasound examinations that may have any influence on patient management are performed by individuals who are competent to provide an accurate examination and assessment and that the images and a formal report are recorded on a RIS/PACS system.

Level 1. Knowledge base

- Physics and technology, ultrasound techniques and administration (see Appendix 12)
- 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, for example, thrombosis
- Basic knowledge of Doppler ultrasound principles

Level 1. Training and practice

Practical training should involve carrying out regular ultrasound examinations in the critical care unit or radiology department, with approximately five to ten 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; for example, 25 pleural effusions, 25 vascular line insertions, 25 abnormal abdominal scans. However, different trainees will acquire the necessary skills at different rates and the endpoint 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 ten 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 two 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. 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

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, for example, 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, for example, brachial plexus
- Use ultrasound to guide regional anaesthesia

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
- 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. Training and practice

Practical training should include at least one 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 two 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. Competencies to be acquired

Competencies will have been gained during training for Level 1 practice, and refined during a period of clinical practice.

- Develop further ultrasound skills such as echocardiography, transoesophageal echocardiography and perioperative 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.

They will accept referrals from Level 1 and 2 practitioners and will be actively involved in developing innovative ultrasound applications within critical care.

They will have spent a continuous period of specialist training in critical care ultrasound. They will be able to mentor and supervise Level 1 and 2 practitioners.

They 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 one month elapsing without the trainee using their 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 CPD which should be included in annual appraisal and revalidation
- Audit their practice

- Participate in multidisciplinary team meetings
- Keep up to date with relevant literature.

Appendix 9.
Critical care
ultrasound training
competency
assessment sheet

Trainee:		Trainer:	
	Trainer signature	Date	Trainer signature
Core knowledge base — Level 1			
Physics and technology			Administration
Practical instrumentation/use of ultrasound controls			Sectional and ultrasonic anatomy
Ultrasound techniques			Pathology in relation to ultrasound
Competencies/skills to be acquired — Level 1			
<i>Thorax</i>		Understand likely sites of fluid collection	
Normal aerated lung			Differentiate abdominal from pleural fluid
Pleural effusion			Normal bowel pattern
Differentiate transudate from exudate			Patterns of ileus
Estimate volume of pleural fluid			Bladder distension
Pulmonary consolidation			Normal kidney
Pericardial effusion			Hydronephrosis
Use ultrasound to guide pleural aspiration/drainage			Normal aorta
Identify pulmonary consolidation			Identify and measure aortic aneurysm

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
<i>Vascular</i>			Recognise abdominal signs of cardiac failure	
Basic knowledge of Doppler ultrasound principles			<i>Peripheral neurology</i>	
Differentiate between arteries and veins			Recognise paths of appropriate nerves	
Venous patency			Use ultrasound to guide regional anaesthesia	
Assess veins for cannulation			<i>General</i>	
Use ultrasound to guide venous line insertion			Know when to refer to a more expert ultrasonologist	
<i>Abdomen</i>			Understand likely sites of fluid collection	
Fluid collections				
Core knowledge base — Level 2				
<i>Physics and technology</i>			<i>Sectional and ultrasonic anatomy</i>	
In-depth knowledge and understanding of physics of ultrasound			More detailed recognition and understanding of normal variants with ultrasound	

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
In-depth knowledge and understanding of the technology of ultrasound equipment			<i>Pathology related to ultrasound</i>	
<i>Ultrasound techniques</i>				
Further applications of thoracic, abdominal, vascular and cardiac ultrasound				
Competencies/skills to be acquired — Level 2				
Development of further ultrasound skills such as echocardiography, transoesophageal echocardiography and perioperative monitoring				

Appendix 10. Head and neck ultrasound

This curriculum is intended for clinicians who perform diagnostic head and neck ultrasound and ultrasound-guided head and neck intervention. At least Level 1 should be obtained by anyone performing unsupervised diagnostic imaging.

Focused training and practice

Situations may arise in clinical practice where there is a desire for ultrasound guided tissue sampling of neck masses, performed by a competent non-radiologist. Each trainee will have their own requirement for focused training and in order to accommodate their training requirements, a targeted curriculum and syllabus should be created by local trainers, drawing on appropriate elements of the knowledge base and competencies to be acquired from Levels 1–2, depending of the level of practice expected. Many practitioners will work or may wish to work in a 'neck lump' clinic setting. As such the most common masses encountered will arise from lymph nodes, salivary glands or thyroid; it is envisaged that training will encompass the assessment and investigation of these masses.

A focused training plan to learn and acquire the skills required to perform ultrasound-guided fine needle aspiration (USgFNA) may be developed as part of a Level 1 competency in the appropriate setting for example, an experienced endocrinologist who performs non-image-guided FNA may require a focused programme to learn the skills necessary to change their practice to USgFNA of thyroid masses. Alternatively in a more general context, this skill acquisition may be more appropriate in Level 2 training.

The following programmes can be modified/used according to the training requirements of the individual but serve as a guide to the expected standards and competencies of an individual undergoing training.

It is essential that all ultrasound examinations that may have any influence on patient management are performed by individuals who are competent to provide an accurate examination and assessment and that the images and a formal report are recorded on a RIS/PACS system.

Level 1. Knowledge base

- Physics and technology, ultrasound techniques and administration (see Appendix 12)
- Sectional and ultrasound anatomy
 - Thyroid glands: normal anatomy
 - Major salivary glands: anatomical changes/variants
 - Cervical lymph nodes: normal anatomy, lymph node groups, level classification
 - Major vessels and key muscular landmarks of the neck

- Pathology in relation to ultrasound
 - Thyroid nodule assessment and characterisation: benign/intermediate/suspicious/malignant
 - Benign, low-grade and high-grade salivary gland neoplasia
 - Benign non-neoplastic salivary disease (sialolithiasis, inflammatory)
 - Normal and abnormal appearances of cervical lymph nodes
 - Inflammatory neck conditions to include: infection, abscess formation
 - Venous thrombosis

Level 1. Training and practice

Practical training should involve at least one ultrasound session per week over a period of three to six months, with approximately five to ten examinations performed by the trainee (under supervision) per session.

A minimum of 200 examinations should be undertaken, however different trainees will acquire the necessary skills at different rates, and the endpoint of the training programme should be judged by the trainer's assessment of competency and case mix.

Examinations should encompass the full range of pathological conditions listed below.

A logbook should be kept listing the examinations performed by the trainee.

Training should be supervised by someone who has obtained at least Level 2 competence in head and neck ultrasound. Mentorship and training should be provided by a practitioner who is expected to be a Consultant radiologist or an experienced non-radiologist who has reached Level 2 competency and who holds at least one year's experience at Level 1 or above.

Additional learning resources should be considered to support clinical training; these include attendance at a theoretical and practical head and neck ultrasound course, appropriate textbooks, literature and the Radiology integrated training initiative (R-ITI) e-learning packages.

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. Competencies to be acquired

General

- Recognise relationship of ultrasound to alternative head and neck imaging modalities
- Accurately issue reports on US examinations performed
- Be aware of own limits and recognise when to refer for a Level 2 opinion

Thyroid

To be able to:

- Perform a thorough ultrasound examination of the thyroid gland in different planes
- Understand the 2014 British Thyroid Association U scoring system for assessment and characterisation of thyroid nodules (that is, U1–U5) and the indications for specialist referral⁵
- Recognise normal ultrasonic anatomy and common normal variants (U1)
- Recognise the features of confidently benign (U2) nodules
- Recognise the features of indeterminate (U3) nodules
- Recognise the features of suspicious (U4) nodules
- Recognise the features of malignant (U5) nodules
- Recognise thyroid abnormalities that require referral to or discussion with a Level 2 head and neck practitioner
- Identify when USgFNA or core biopsy is required.

Major salivary glands

To be able to:

- Perform a thorough ultrasound examination of the parotid, submandibular and sublingual salivary glands in different planes
- Recognise normal ultrasonic anatomy and common normal variants
- Recognise the features of salivary calculi and obstructive sialectasis/sialadenitis
- Identify the limitations of US in the assessment of calculi/salivary obstruction
- Recognise the features of a benign salivary neoplasm

- Recognise when a salivary mass does not have typical features of benignity
- Recognise salivary abnormalities that require referral to or discussion with a Level 2 head and neck practitioner
- Identify when USgFNA or core biopsy is required.

Cervical lymph nodes

To be able to:

- Understand the anatomical boundaries of the main cervical lymph node groups
- Perform a comprehensive ultrasound examination of lymph node groups I–VI
- Recognise the normal ultrasonic architecture of cervical lymph nodes
- Recognise typical features of reactive lymphadenopathy
- Recognise abnormal ultrasonic architecture and key ultrasonic features favouring malignant lymphadenopathy
- Recognise cervical lymph node abnormalities that require referral to or discussion with a Level 2 head and neck practitioner
- Identify when USgFNA or core biopsy is required.

Major vessels of the neck

To be able to:

- Recognise normal ultrasonic anatomy and common normal variants
- Recognise the features of venous thrombosis.

Level 2: Knowledge base

- Administration
- Patient and image data acquisition and storage: awareness of governance issues
- Sectional and ultrasound anatomy
 - Detailed understanding of cervical anatomy including:
- Superficial muscles of the head and neck
- Lymph node territories/groups

- Salivary variants
- Key muscles/landmarks
 - Iatrogenic: anatomical changes following surgical resection of primary tumour and neck node dissection
- Ultrasound techniques
 - USgFNA* and ultrasound-guided core needle biopsy (USgCNB)

*Ultrasound guided FNA may have been acquired as a Level I competency for specific focused training

Pathology in relation to ultrasound

- Benign thyroid pathology: haemorrhagic/cystic degeneration, thyroiditis, ectopic thyroid
- Malignant thyroid pathology: differentiated thyroid carcinoma, poorly differentiated and anaplastic thyroid carcinoma, lymphoma, metastasis
- Parathyroid: adenoma
- Major salivary glands: size and position of salivary ductal calculi, ranula/sialocele, auto-immune sialadenitis, lymphoepithelial cysts, benign and malignant salivary tumours, intra-parotid lymphadenopathy
- Cervical lymph nodes: normal versus abnormal nodal architecture, features of extracapsular disease spread, lymphadenitis, suppurative lymphadenopathy and abscess formation
- Iatrogenic: post surgical neck appearances, stitch granuloma, post radiation changes in the neck
- Miscellaneous: Congenital neck abnormalities, sebaceous cysts, benign nerve sheath tumours

Level 2: Training and practice

Practical training would typically follow one year of experience at Level 1 with a minimum of one session per week. Competencies should be further developed during a period of clinical practice, which will involve at least one session per week for a further three to six months.

Training should be supervised by someone who has obtained at least Level 2 competence in head and neck ultrasound (the trainer would be expected to have two years experience at that level).

A minimum of 200–250 examinations should be undertaken, however, different trainees will acquire the necessary skills at different rates, and the endpoint of the training programme should be judged by assessment of competencies.

For ultrasound guided tissue sampling of neck masses, a logbook should record each interventional procedure with documentation of the procedure performed, any potential complication and the pathological outcome. Sample adequacy rates for USgFNA and USgCNB should be recorded and assessed. Training of USgFNA and/or USgCNB should be supervised by someone with at least Level 2 competence in head and neck ultrasound with at least two years' experience of ultrasound guided neck intervention.

Training for biopsy techniques should include initial observation of the trainer performing the procedure, followed by development of needle placement skills using a phantom model. Once phantom training has been undertaken proficiently, the trainee will then perform USgFNA on neck masses under direct supervision. When competence has been acquired, a progression to indirect supervision would be expected. Documentation showing performance of typically 20 procedures performed safely and with adequate tissue sampling (under both direct and indirect supervision) should reflect appropriate training. It is advisable that a direct observation of practical skills (DOPS) style proforma be used as an objective assessment tool during training. The trainee and trainer can use this to help identify the trainee's development needs, guide the training plan and be included in the trainee's individual portfolio. Core biopsy skills may be developed at Level 2 training or be deemed to be more appropriate to Level 3 training; a similar training and assessment programme would be envisaged. In most circumstances, however, it would be expected that there is a natural progression from acquisition of USgFNA skills initially with subsequent progression to USgCNB.

Biopsy skills may be acquired in a focused area for example, thyroid or may be more generalised in scope. Training programmes will need to be modified/designed accordingly. The practicalities and issues behind patient consent for biopsy and the process of consent should be included in any training programme and assessed accordingly. A clear understanding of the potential contraindications to biopsy and local policy in regard to biopsy in patients undergoing anti-coagulation therapy is mandatory.

Examinations should encompass a typical range of pathological conditions as listed below.

Additional learning resources should be considered to support clinical training; these include attendance at a head and neck ultrasound course (involving practical training in US guided techniques), appropriate textbooks, literature and R-ITI e-learning packages. 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 2: Competencies to be acquired

General

- Assess the appropriateness of head and neck ultrasound requests
- Appropriately categorise and prioritise requests for head and neck ultrasound

- Accurately issue reports on US examinations performed
- Recognise comparative accuracy of ultrasound to alternative head and neck imaging modalities
- Recognise when to proceed to other imaging modalities following head and neck ultrasound
- Understand the principles of US guided biopsy techniques for example, parallelism and so on.
- An audit (ideally concerning personal clinical practice or a related topic) presentation at a departmental/directorate audit meeting (to be delivered on completion of training)
- Regular attendance at local, relevant multidisciplinary team meetings (for example, head and neck oncology, thyroid, and so on)

Thyroid

To be able to:

- Use the 2014 British Thyroid Association U scoring system to stratify thyroid nodules and appropriately select nodules for USgFNA⁵
- Identify regional nodal metastases in patients with thyroid malignancy per lymph node group
- Recognise the features of focal and diffuse thyroiditis
- Recognise thyroid abnormalities that require further investigation with other imaging modalities.

Parathyroid

To be able to:

- Recognise the typical sonographic features of parathyroid adenoma.

Major salivary glands

To be able to:

- Identify salivary neoplasms and recognise high-grade malignant features
- Identify and report anatomical features for surgical planning of parotid masses (for example, relationship to neurovascular structures, deep lobe involvement, and so on)
- Identify specific features of sialolithiasis relating to salivary management (stone position, size, mobility)
- Recognise the features of ranulae
- Recognise the features of sialadenitis including auto-immune sialadenitis (Sjögren's syndrome)

- Recognise salivary abnormalities that require further investigation with other imaging modalities.

Cervical lymph nodes

To be able to:

- Understand the anatomical boundaries/demarcation of the lymph node groups and their implications on patient management
- Recognise the key features of malignant lymphadenopathy, including extracapsular spread and invasion of adjacent structures
- Appropriately identify and select abnormal lymph nodes for USgFNA or USgCNB
- Recognise the common cervical masses that mimic lymph node masses, for example, branchial cleft cysts and nerve sheath tumours
- Recognise cervical lymph node abnormalities that require further investigation with other imaging modalities.

Major vessels of the neck

To be able to:

- Recognise abnormalities of the carotid space, for example, nerve sheath tumours.

Iatrogenic

To be able to:

- Recognise the expected features following neck nodal dissection (radical, modified radical, selective)
- Recognise the expected features following reconstructive neck surgery (for example, free flap)
- Recognise the expected features following neck irradiation.

Miscellaneous

To be able to:

- Recognise congenital neck cysts (thyroglossal duct, branchial cleft)
- Identify sebaceous cyst
- Recognise benign neurogenic masses
- Identify and recognise spread of sepsis within cervical spaces.

Ultrasound techniques

To be able to:

- Accurately perform USgFNA of neck masses with competent sample preparation
- Perform approximately 20–30 procedures with documentation of adequacy of sampling and possible complication rates
- Lesions should be both large (greater than 2 cm) and small (less than 2 cm)
- Obtain <15% inadequacy rate for USgFNA of neck masses
- Demonstrate an awareness of the practicalities of US guidance, in the various potential approaches to cervical masses.
- Safely perform USgCNB for common thyroid, salivary and nodal pathology
- Perform and (document accordingly) approximately 20–30 core biopsies (directly/indirectly supervised)
- Demonstrate awareness of issues regarding consent and of potential contra-indications to biopsy and the ability to obtain consent.

Level 3: Knowledge base

- A more detailed understanding of head and neck imaging and pathology as detailed above, including understanding of head and neck oncology, thyroid oncology, current and developing surgical practice, head and neck radiotherapy and complex, non-ultrasound imaging techniques
- Awareness of developments in head and neck ultrasound, including elastography and novel high-resolution techniques (for example, intra-oral, intra-operative)

Level 3: Training and practice

A Level 3 practitioner is likely to spend the majority of their time undertaking head and neck imaging (with a significant ultrasound component), teaching, research and development and will be an 'expert' in this area.

They will accept tertiary referrals from Level 1 and 2 practitioners and will perform specialised examinations (for example, high-resolution staging of laryngeal tumours) as well as performing advanced ultrasound-guided invasive procedures. They can/are likely to be involved in mentorship, teaching and training of Level 1 and Level 2 practitioners

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 clinician performing head and neck ultrasound should have a regular ultrasound commitment (at least one session per week) with all images and reports recorded on PACS/RIS.

Practitioners should:

- Include ultrasound in their ongoing CPD which should form part of their annual appraisal and revalidation
- Audit their interventional work (all USgFNA and USgCNB procedures)
- Participate in multidisciplinary meetings
- Keep up to date with relevant literature.

Appendix 10. Head and neck ultrasound competency assessment sheet

Trainee:		Trainer:	
	Trainer signature	Date	Trainer signature
Core knowledge base — Level 1			
Physics and technology			Administration
Practical instrumentation/use of ultrasound controls			Sectional and ultrasonic anatomy
Ultrasound techniques			Pathology in relation to ultrasound
Competencies/skills to be acquired — Level 1			
<i>Thyroid</i>		<i>Cervical lymph nodes</i>	
Ultrasound examination in different scan planes			Ultrasound anatomy of lymph node groups I–VI
Understand the 2014 BTA U scoring system for thyroid nodules			Normal appearance of cervical lymph nodes
Benign nodules (U2)			Benign lymphadenopathy
Indeterminate nodules (U3)			Malignant lymphadenopathy
Suspicious nodules (U4)			<i>Major vessels of the neck</i>
Malignant nodules (U5)			Ultrasound anatomy
<i>Major salivary glands</i>			Venous thrombosis

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
Ultrasound examination in different scan planes			<i>Miscellaneous</i>	
Salivary calculi and sialadenitis			Clear and well-structured, written ultrasound reports	
Benign salivary neoplasm				
Malignant salivary neoplasm				
Core knowledge base – Level 2				
Sectional and ultrasound anatomy			Pathology in relation to ultrasound	
Ultrasound guided tissue sampling techniques/principles			Patient/image/report administration	
Competencies/skills to be acquired – Level 2				
<i>To be competent to perform/recognise/diagnose/evaluate the following:</i>				
<i>Thyroid</i>			<i>Cervical lymph nodes</i>	
BTA U scoring & selection of nodule for USgFNA			Ultrasound anatomy of lymph node groups including: occipital, bucco-facial and parotid lymph nodes	
Focal and diffuse thyroiditis			Malignant lymphadenopathy – specific ultrasound features	

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
<i>Parathyroid</i>			Lymphadenitis (infective, inflammatory)	
Parathyroid adenoma			Appropriate selection of USgFNA and USgCNB for nodal pathology	
<i>Major salivary glands</i>			<i>Major vessels of the neck</i>	
High-grade salivary malignancy			Carotid space masses (for example, paraganglioma, schwannoma)	
Parotid lesion characterisation for surgical planning			<i>Iatrogenic</i>	
Sialolithiasis characterisation			Post neck dissection appearances	
Ranula			Post reconstructive surgery appearances	
Sialadenitis /Sjögren's syndrome			Post radiotherapy appearances	
<i>Ultrasound techniques</i>			<i>Miscellaneous</i>	
Safe and accurate USgFNA performance			Thyroglossal duct cyst	
Observation of technique			Second branchial cleft cyst	

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
Directly supervised USgFNA (minimum 20 cases)			Sebaceous cyst	
Indirectly supervised USgFNA (minimum 20 cases)			Lipoma	
Safe and accurate USgCNB performance			Vascular malformation	
Observation of technique			Benign neurogenic mass	
Directly supervised USgCNB (minimum 20 cases)			Spread of sepsis involving cervical fascial spaces	
Indirectly supervised USgCNB (minimum 20 cases)				

Appendix 11. Musculoskeletal ultrasound

This curriculum is intended for clinicians who perform diagnostic ultrasound and ultrasound-guided musculoskeletal intervention. At least Level 1 should be obtained by anyone performing unsupervised diagnostic imaging.

Focused training and practice

There are frequent situations arising in clinical practice where rapid bedside assessment using focused ultrasound techniques can help with the assessment of, and treatment planning for, patients. In this situation, rapid ultrasound assessment by a competent non-radiological clinician may be more appropriate than waiting for a formal ultrasound list during normal working hours. These unitary skills may aid the clinician's practice and greatly improve patient pathways.

Each clinician will have their own requirement for focused training and to accommodate their training requirements, a targeted curriculum and syllabus should be created by local trainers, drawing on appropriate elements of the knowledge base and competencies to be acquired, depending on the level of practice expected.

It is essential that all ultrasound examinations that may have any influence on patient management are performed by individuals who are competent to provide an accurate examination and assessment and that the images and a formal report are recorded on a RIS/PACS system.

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.

Knowledge base

- Physics and technology, ultrasound techniques and administration (see Appendix 12)
- Sectional and ultrasonic anatomy
 - Shoulder
 - Elbow
 - Wrist/hand
 - Groin
 - Hip
 - Thigh

- Knee
- Lower leg
- Ankle/foot
- Other (for example, 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; 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

Training and practice

Practical training should involve at least one ultrasound list per week for three to six months with approximately ten 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 (for example, 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 musculoskeletal 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.

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 (FB) and FB reactions
- Recognise ligament injuries
- Recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation.

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, for example, 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 quadriceps 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

Third edition

- 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 (FBs) and FB 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 three months should elapse without the trainee using their 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 CPD which should be included in annual appraisal and revalidation
- 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 competency assessment sheet

Trainee:	Trainer:	
	Trainer signature	Date
Core knowledge base — Level 1		
Physics and technology	Administration	
Practical instrumentation/use of ultrasound controls	Sectional and ultrasonic anatomy	
Ultrasound techniques	Pathology in relation to ultrasound	
Competencies/skills to be acquired — Level 1		
<i>Shoulder</i>	<i>Wrist/hand cont</i>	
Ultrasound examination in different planes	Pulley injuries	
Normal anatomy and variants	Ligament injuries	
Rotator cuff tendinosis, tears and calcification	Foreign bodies and reactive changes	
Tendinosis, rupture and subluxation of long head of biceps tendon	Ligament injuries	
Effusions of shoulder joint and subdeltoid bursa	Aspiration and therapeutic injections of joints and tendon sheaths	
Paralabral cyst	<i>Groin</i>	
Aspiration of joint or bursal effusion	Ultrasound examination in different planes	
Aspiration of focus of calcification	Normal anatomy and variants	

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
Therapeutic/diagnostic injection in bursa and joint			Inguinal and femoral hernias	
<i>Elbow</i>			Strains of rectus abdominis and adductor muscles	
Ultrasound examination in different planes			Therapeutic injections	
Normal anatomy and variants			<i>Hip</i>	
Tendinosis or rupture of common flexor/extensor origins or biceps/triceps tendons			Ultrasound examination in different planes	
Joint effusion and loose bodies			Normal anatomy and variants at different ages	
Ulnar nerve entrapment			DDH	
Olecranon bursitis			Joint effusions	
Aspiration of joint and bursal effusion			Iliopsoas bursa	
Therapeutic/diagnostic injection of joint			Causes of snapping hip	
<i>Wrist/hand</i>			Tendinosis and tears of glutei and hamstrings	
Ultrasound examination in different planes			Joint aspiration and therapeutic injections	

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
Normal anatomy and variants			Bursal aspiration and therapeutic injection	
de Quervain's tenosynovitis			<i>Thigh</i>	
Effusions in tendon sheaths			Ultrasound examination in different planes	
Tendinosis and tendon ruptures			Normal anatomy and variants	
Carpal tunnel syndrome and ulnar nerve entrapment			Contusions and tears of the quadriceps and hamstring	
Ganglia and distinguish them from solid space-occupying lesions			Muscles and tendons	
Inflammatory arthropathy			Aspiration of thigh haematoma	
Competencies/skills to be acquired — Level 1				
<i>Knee</i>		<i>Soft tissue masses</i>		
Ultrasound examination in different planes			Solid, cystic and indeterminate masses	
Normal anatomy and variants			Need for appropriate additional imaging examinations	
Joint effusion			Appropriate aspiration and biopsy	
Baker's cyst and ruptured Baker's cyst			Brachial plexus	
Ganglia/other bursae/meniscal cyst			Normal anatomy and variants	

Trainee:		Trainer:		
	Trainer signature	Date	Trainer signature	Date
Sprains of collateral ligaments			Injuries and tumours	
Tendinosis and tears of patellar tendon			<i>Spine</i>	
<i>Lower leg</i>			Normal neonatal anatomy	
Ultrasound examination in different planes			Spinal dysraphism and tethered cord	
Normal anatomy and variants			Technique	
Muscle contusions and tears			Doppler ultrasound examinations relevant to MSK system	
Muscle herniae			Interventional	
<i>Ankle/foot</i>			Joint and cyst aspiration and injection	
Ultrasound examination in different planes			Abscess aspiration and drainage	
Normal anatomy and variants			Biopsy of soft tissue masses	
Tendinosis and tears of tendon Achilles, posterior tibial and peroneal tendons			Synovial biopsy	
Joint effusions and loose bodies			Therapeutic injections	
Plantar fasciitis			<i>General</i>	
Morton's neuroma			Know when to refer to a more expert ultrasonologist	

Trainee:	Trainer:	
	Trainer signature	Date
Ganglia		
Arthropathy		
Ankle ligament injuries		
Foreign bodies		
Joint aspiration and therapeutic injection		
Injection of plantar fasciitis and Morton's neuroma		

Appendix 12.
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 and report recording
 - Image and report storing and filing (PACS/RIS)
 - Image 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.
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