European Federation of Societies for Ultrasound in Medicine and Biology

Dear members of EFSUMB

You are probably all aware of the document "Minimum training requirements for the practice of medical ultrasound in Europe". If not the document is available on this website, www.efsumb.org.

After a few years of work EFSUMB Education and Professional Standards Committee has developed guidelines for how the minimum training requirements can be achieved at each level of practice. Structured theoretical and practical training should be followed by competency assessment. In the document that follows you will find a description – for some medical specialties – of the theoretical and practical training that the committee recommends and also competency assessment sheets. We hope you will find that these guidelines from the Education and Professional Standards Committee will be helpful.

We would welcome general comments on these recommendations, suggestions for ways in which they could be improved in the future and suggestions for additional syllabuses. Comments should be submitted by email to: efsumb@efsumb.org

Lil Valentin
Chairman of the EFSUMB Education
and Professional Standards Committee

Minimum training recommendations for the practice of medical ultrasound

1. Introduction

1.1 Many medical specialists 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. Additionally there is a demand by some European Training Boards to incorporate ultrasound experience into clinical training and accreditation where appropriate.

1.2 This document makes recommendations for minimum ultrasound training requirements in the following areas:
- gynaecological ultrasound
- obstetric ultrasound
- gastroenterological ultrasound
- nephro-urological ultrasound
- breast ultrasound
- vascular ultrasound

2. Aims and Principles

2.1 The medical use of ultrasound remains highly operator dependent in spite of advances in technology and the interests of the patient are best served by the provision of an ultrasound service which offers the maximum clinical benefit and optimal use of resources i.e. with appropriately trained personnel using equipment of appropriate quality

2.2 All who provide an ultrasound service are ethically and legally vulnerable if they have not been adequately trained. A defence against a claim for negligence is unlikely to be successful should an error of diagnosis be made by an untrained practitioner of ultrasound.

2.3 An appropriate level of training in ultrasound is one that allows for the provision of a safe and effective ultrasound service. This may be a purely diagnostic, predominantly interventional or a clinically focused service.

2.4 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 (Appendix **1**). These identify three levels of training and expertise. The boundaries between the three levels are difficult to define precisely and should be regarded as a guide to different levels of competence and experience. In the detailed syllabuses appended an attempt is made to indicate more specifically the type of experience required for each level of training

2.5 A system for recording the results of any ultrasound examination in the patients' record is mandatory. The permanent recording of images, where appropriate, is desi-

rable for the purposes of correlative imaging, future comparison and audit.

2.6 Knowledge of the appropriate use and integration of other imaging techniques should be required

2.7 The requirement to deliver training must acknowledge the time commitment of the trainer and trainee, the provision of funding, the content and practicability of the curriculum and the availability of trainers and training courses. It must be recognised that training requires additional time, space and equipment. Training should be properly costed and funded.

2.8 Training should be related to the specialist requirements of the trainee i.e. training should be modular. Within any one level of training it may be appropriate for a trainee to become proficient in some but not all of the individual modules and only undertake ultrasound practice in this/these areas.

2.9 Training should be given in departments which have a multidisciplinary (medical, surgical, radiological etc) philosophy, an adequate throughput of work, a trainer with experience and an interest in training in the module required, appropriate equipment and an active audit process.

2.10 Regular appraisal should take place during the training period. 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 practice independently. 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 that moment in time and no more.

2.11 Following training, regular and relevant continued medical education (CME)/continued professional development (CPD) should be undertaken and documented. It is the responsibility of the trainee to ensure that their practical skills are maintained by ensuring regular ultrasound clinics are undertaken and that there is an adequate range of pathology seen in their ultrasound practice.

3. Training Recommendations

3.1 Training should consist of a theoretical module (Appendix **2**) and practical modules of training (Appendices **3**–**8**)

4. Theoretical Training

4.1 Preliminary theoretical training should cover the physics of ultrasound, levels and sophistication of equipment, image recording, reporting, artefacts and the relevance of other imaging modalities to ultrasound. This element of training may be best achieved by attending formal courses.

4.2 The theoretical module is set out in Appendix **2**.

5. Practical Training

5.1 A curriculum for each module for 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. 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 trainer.

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

Level 1

5.2.1 Different trainees will acquire the necessary skills at different rates and the end-point of the training programme should be judged by an assessment of practical competence.

5.2.2 Examinations should encompass the full range of pathological conditions listed in the modules.

5.2.3 A log book listing the number and type of examinations undertaken by the trainee themselves should be kept.

5.2.4 An illustrated log book of specific normal and abnormal findings may be appropriate for some modules.

5.2.5 Training should usually be supervised by a level 2 practitioner. In certain circumstances it may be appropriate to delegate some of this supervision to an experienced level 1 practitioner with at least two years of regular practice.

Level 2

5.2.6 This requires at least one year of experience at level 1, with regular ultrasound clinics.

5.2.7 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.

5.2.8 A log book listing the numbers and types of examinations undertaken by the trainee should be maintained.

5.2.9 An illustrated log book of specific normal and abnormal findings may be appropriate for some modules.

5.2.10 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

5.2.11 This requires a practitioner to spend a significant part of their time undertaking ultrasound examinations or teaching, research and development in the field of ultrasound.

5.3 The syllabus for each practical module is outlined in Appendix **3**–**8**

6. Continuing Medical Education(CME) and Professional Development(CPD)

6.1 The minimum amount of on-going experience in ultrasound as outlined in each syllabus should be maintained.

6.2 CME/CPD should be undertaken which incorporates elements of ultrasound practice.

6.3 Regular audit of the individual's ultrasound practice should be undertaken to demonstrate that the indications, performance and diagnostic quality of the service is satisfactory.

The advice contained in this document draws on the work of the United Kingdom Royal College of Radiologists, its committees and members and Fellows, which resulted in the Publication of 'Ultrasound Training Recommendations for Medical and Surgical Specialties', BFCR(05)2. EFSUMB would wish to acknowledge the contribution of the Royal College of Radiologists and its Fellows

Appendix 1

Minimum Training Requirements for the Practice of Medical Ultrasound in Europe

1. Introduction

1.1 The increasing applications of ultrasound imaging throughout medical practice, together with the increasing availability of cheaper and smaller ultrasound scanners, mean that more medical personnel are using ultrasound equipment to perform and interpret ultrasound scans.

1.2 Ultrasound has an enviable safety record to date. Various bodies, including scientific societies and manufacturers associations have made recommendations concerning the safe and prudent operation of ultrasound equipment, but, unlike imaging equipment, which makes use of ionising radiation [**1**, **2**] there is virtually no national or international regulation of ultrasound usage.

1.3 More than with any other imaging modality, the medical use of ultrasound is highly operator dependent and is fraught with scope for diagnostic error, the potential for which is magnified by the on-going development of more sophisticated equipment with extended applications.

1.4 In order to gain maximum clinical benefit, as well as to achieve optimal use of resources, there is a need for operators of ultrasound equipment to have the appropriate skills for the performance and interpretation of ultrasound examinations.

1.5 EFSUMB, (which is a federation of national ultrasound societies in Europe), has established that, in Europe, there is no standardisation of training requirements for ultrasound practitioners, either between different countries or between different medical disciplines [**3**].

This document is an attempt to stimulate national and pan-European speciality groups to consider training in ultrasound and to work towards the setting of minimum Europe-wide standards for such training.

2. Levels of Practice

2.1 Most national associations and speciality groups will recognise that ultrasound can be practised at different levels.

2.2 However, because of variations in medical systems between countries and variations in the organisation of the different specialities in those countries, it is difficult to strictly define the different levels of practice, and hence the training requirements for each level.

2.3 In the document 'Training in Diagnostic Ultrasound: Essentials, Principles and Standards' [**4**] a WHO Study Group have indicated that ultrasound training needs may be defined according to equipment availability, and suggest three levels of training requirement.

2.4 In Europe, certain countries have pursued the multi-level concept of ultrasound practice, based on clinical experience, ultrasound experience, practical competencies, research record and ability to teach, and are introducing regulated training requirements for each level.

2.5 Whilst it would be unrealistic to expect every speciality group in every European country to agree upon the precise definitions of the levels of practice, abilities for each level may be accepted. Recommendations for the minimum training requirements for each level of practice can then be based on these principles

Level 1

Practice at this level would usually require the following abilities:

a. to perform common examinations safely and accurately
b. to recognise and differentiate normal anatomy and pathology
c. to diagnose common abnormalities within certain organ systems

d. to recognise when referral for a second opinion is indicated

Within most medical specialities, the training requisite to this level of practice would be gained during conventional post-graduate specialist training programmes.

Level 2

Practice at this level would usually require the following abilities:

a. to accept and manage referrals from Level 1 practitioners
b. to recognise and correctly diagnose almost all pathology within the relevant organ system
c. to perform basic, non-complex ultrasound-guided invasive procedures
d. to teach ultrasound to trainees and to Level 1 practitioners
e. to conduct some research in ultrasound

The training requisite to this level of practice would be gained during a period of sub-speciality training, which may either be within or after the completion of a specialist training programme.

Level 3

This is an advanced level of practice, which involves the following abilities:

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

3. Minimum Training Requirements

3.1 For each level of ultrasound practice, national and/or European speciality groups should formulate a detailed syllabus with comprehensive recommendations for necessary amounts of practical experience (target numbers).

3.2 Syllabuses should include, at the appropriate level, theoretical knowledge of:

- ultrasound physics
- safety of ultrasound and contrast agents
- ultrasound instrumentation
- scanning techniques
- ultrasound artefacts
- anatomy (of the relevant body systems)
- pathology (of the relevant body systems)
- ultrasound findings in the normal condition
- ultrasound findings in pathological conditions
- scan interpretation

- indications for ultrasound and inter-relationship with other imaging modalities
- ultrasound-guided procedures

3.3 Recommendations should include an indication of the minimum numbers of scans, which should be performed (at the appropriate level) as:

- supervised scanning
- independent scanning, with review by a designated trainer

3.4 Training programmes should include recommendations and/or regulations for evaluinterpretive skills. In each country and/or speciality there should be a recognised competent authority with responsibility for the evaluation of training, using whatever methods are felt to be appropriate in that country and/or speciality. Similarly, methods for, and the implications of, accreditation of individuals who have completed training programmes will vary, and it is essential that there should be recognition of the necessity for limiting the use of ultrasound to suitably trained individuals.

3.5 Continuing professional education and development is essential for any individual practising ultrasound. Training recommendations and/or regulations should include consideration of minimum scanning practice in order to maintain skills and minimum levels of educational activities in order for individuals to remain up-to-date in the rapidly developing field of medical ultrasound.

4. Sonographers

4.1 Sonographers are healthcare professionals without a medical degree who use ultrasound for medical purposes in some specialities in some European countries.

4.2 In virtually all countries and medical specialities in Europe where sonographers currently practice, there are comprehensive training programmes for sonographers which require high standards of knowledge and practical scanning skills, and they are strictly regulated with well developed schemes for the evaluation and accreditation of the trainees.

4.3 It is possible that the practice of ultrasound by sonographers will increase and will be introduced into more countries over the next few years. It is therefore important that consideration be given to the setting up of suitable training programmes in order to ensure that the sonographers are properly trained for their job.

5. Conclusions

5.1 The medical use of ultrasound can be practised at different levels

5.2 Those physicians and sonographers practising ultrasound should be properly trained for the appropriate level of practice.

5.3 There should be mechanisms in place to evaluate the theoretical knowledge and practical skills of ultrasound trainees.

5.4 National and European speciality associations are urged to subscribe to these concepts, and to recommend and supervise the theoretical and practical training that is requisite for the various levels of ultrasound practice.

References

1. Council Directive 97 / 43 / Euratom of 30 June 1997. The Medical Exposures Directive (1997) Official Journal 180:22-27
2. Department of Health (2000) Ionising Radiation (Medical Exposure) Regulations IS 1999/3232. Norwich: Stationery Office
3. Training and accreditation: A report from the EFSUMB Education and Professional Standards Committee. EFSUMB Newsletter 2000: 14; 20.
4. Training in Diagnostic Ultrasound: Essentials, Principles and Standards: Report of WHO Study Group 1998. WHO technical report series: 875

Footnote

This document has been prepared by the EFSUMB Education and Professional Standards Committee, and has been approved by the EFSUMB Executive Bureau. As part of the consultation process, this committee organised a Workshop at the Euroson Congress, which was held in Edinburgh, Scotland on Thursday 13th December 2001, to which representatives of different medical specialties in Europe were invited to contribute.

Members of EFSUMB Education and Professional Standards Committee

Dr Lil Valentin (Sweden) – Chairman
Dr Henry Irving (UK) – Secretary
Prof David H Evans (UK)
Prof Jochen Hackeloer (Germany)
Prof Kurt Jäger (Switzerland)
Dr Pentii Lohela (Finland)
Dr Ioan Sporea (Romania)

Contributors to Edinburgh Workshop

Prof. Dr. med. Uli Hoffmann, Representative of the International Union of Angiology
Dr George R Sutherland, Chairman of the Echocardiography working group 7 of the European Society of Cardiology
Prof. Juriy Wladimiroff, Education committee member of the International Society of Ultrasound in Obstetrics and Gynecology
Prof. Rolf W. Günther, President of the European Association of Radiology
Prof. Carlo Trombetta, President of the Italian Society of Urological Imaging and the coordinator of the European Society of Urological Imaging
Dr Ioan Sporea, replaced Prof. Rapaccini as representative of European Gastroenterologists
Prof. Michel Claudon, President of EFSUMB

Appendix 2

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.
- An understanding of the frequencies used in medical ultrasound and the effect on image quality and penetration.
- The interaction of ultrasound with tissue including biological effects.
- The safety of ultrasound and of ultrasound contrast agents.
- The basic principles of real time and Doppler ultrasound including colour flow and power Doppler.
- The recognition and explanation of common artefacts
- Image recording systems.

Ultrasound Techniques

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

Administration

- Image recording.
- Image storing and filing.
- Reporting.
- Medico-legal aspects – outlining the responsibility to practice within specific levels of competence and the requirements for training
- Consent
- The value and role of departmental protocols in determining the appropriate use of ultrasound

Appendix 3

Gynaecological Ultrasound

This curriculum is intended for clinicians who perform diagnostic gynecological ultrasound scans. It includes standards for theoretical knowledge and practical skills. It is recommended that all gynaecologists obtain Level 1 competence, preferably during their specialist training.

Level 1

- It is recommended that trainees should perform a minimum of 300 examinations under supervision. However different trainees will acquire the necessary skills at different rates and the end point of the training programme should be judged by an assessment of competencies
- Examinations should encompass the full range of pathological conditions listed below
- A log book listing the types of examinations undertaken should be kept
- An illustrated log book of 20 documented cases should be kept. This should include uterine fibroids, corpus luteum cysts and different types of abnormal early pregnancy
- Training should usually be supervised by a level 2 practitioner. In certain circumstances it may be appropriate to delegate some of this supervision to an experienced level 1 practitioner with at least two years of regular practical experience.
- The training should include an appropriate theoretical course (see below) followed by a theoretical examination and the trainee should read appropriate textbooks and literature
- To maintain level 1 status the practitioner should perform at least 300 examinations each year
- During the course of training the competency assessment sheet should be completed as this will determine in which area or areas the trainee can practise independently

Level 1 Knowledge Base and Recommended Contents of Level 1 Theoretical Course

A minimum of 20 hours theoretical teaching is required preferably at the beginning of the training period. This should include:

- Physics and Technology, Ultrasound Techniques and Administration (see Appendix **2**)
- Normal gynaecological ultrasound findings in non-pregnant women
- Normal ultrasound findings in early pregnancy (4–12 gestational weeks)
- Ultrasound based management of early pregnancy complications
- Common abnormal ultrasound findings in the uterus, e.g. fibroids and their most important differential diagnoses (e.g., sarcomas, adenomyosis, and uterine malformations)
- Ultrasound based management of pre- and post-menopausal bleeding (measurement of endometrial thickness, saline infusion sonography, etc)
- Common abnormal ultrasound findings in the adnexae, e.g. corpus luteum cysts, endometriomas, dermoid cysts, hydrosalpinges, para-ovarian cysts, peritoneal inclusion cysts, abscesses.
- Ultrasound characteristics of benign and malignant pelvic masses.
- Management of incidentally detected ovarian cysts in postmenopausal women.

Level 1 Competencies to be acquired

At the end of training the trainee should be able to:

- Perform a systematic examination of the pelvic organs, both transvaginally and transabdominally
- Obtain optimal images of the uterus and adnexa
- Obtain accurate measurements of the uterus, endometrium and ovaries
- Recognize physiological changes in the uterus and ovaries during the normal menstrual cycle.
- Locate an intrauterine contraceptive device in the uterus.
- Discriminate between normal and abnormal ultrasound findings in a non-pregnant woman
- Recognize, measure and locate uterine fibroids
- Detect an intrauterine gestational sac of at least 5 mm in mean diameter
- Detect heart activity in an embryo of at least 10 mm in crown-rump-length.
- Correctly use ultrasound to manage early pregnancy complications (miscarriage and tubal pregnancy)

Level 2

- The training requisite to this level of practice would be gained during a period of sub-speciality training, which may either be within or after the completion of a specialist training programme.
- Competencies will have been acquired during training for level 1 practice which will then be refined by performing a minimum of 30 clinic sessions at a centre where supervision by someone with level 2 competence is available.
- Typically a level 2 practitioner will have undertaken at least 2000 gynaecological ultrasound examinations
- A log book should be kept documenting 50 cases which amongst other conditions should include the following
  - uterine pathology, benign and malignant
  - ovarian pathology, benign and malignant
  - tubal pathology
  - ectopic pregnancy

- To maintain competence at level 2 practitioners should perform at least 500 examinations each year
- The training should include a theoretical course of at least 30 hours (see below) followed by a theoretical examination and the trainee should read appropriate literature and textbooks

Level 2 Knowledge Base and Recommended Contents of Level 2 Theoretical Course

- New ultrasound modalities, e.g. ultrasound contrast agents
- The role of ultrasound in relationship to other imaging modalities, e.g., magnetic resonance imaging and computed tomography
- Uterine pathology including the use of Doppler and three-dimensional (3D) imaging
    a. Fibroids, sarcoma
    b. Adenomyosis/adenomyomas
    c. Uterine malformations
- Endometrial pathology: ultrasound based management of bleeding disturbances
- Cervical pathology including cancer
- Screening for ovarian and endometrial cancer
- Gynaecological oncology – Staging, recurrence, response to treatment
- Extragenital pelvic pathology (bowel, appendix, urinary bladder)
- Pelvic inflammatory disease (PID)
- Infertility – HysteroContrastSalpingography (HyCoSy), Saline Infusion Sonography (SIS), Follicle aspiration, Hyperstimulation Syndrome
- Early pregnancy complications – molar pregnancy and choriocarcinoma, all types of ectopic pregnancy (including both diagnosis and management)
- Use of ultrasound in the evaluation of women with pelvic pain including adnexal torsion, pelvic inflammatory disease, endometriosis and extragenital causes (eg appendicitis, diverticulitis)
- Paediatric and adolescent gynaecology
    - Assessment of normal development of the genital organs
    - Common findings in precocious puberty, adrenarche, thelarche, virilisation and primary amenorrhoea
    - diagnosis and management of adnexal masses in children
- Invasive procedures
- puncture of ovarian cysts
- drainage of pelvic abscesses
    - fine needle and larger bore needle biopsy of pelvic masses

Level 2 Competencies to be acquired

- Uterus
    - reliably discriminate between fibroids and adenomyosis
    - recognize the features of endometrial cancer
    - use ultrasound correctly in the management of bleeding disturbances including postmenopausal bleeding
- Adnexa
    - reliably discriminate between benign and malignant adnexal masses
    - reliably diagnose endometrioma, dermoid cyst, hydrosalpinx, peritoneal pseudocysts, paraovarian cysts, and benign solid adnexal masses
    - recognise acute and chronic pelvic inflammatory disease
    - assess by ultrasound the status of ectopic pregnancies of all kinds and plan treatment
    - assess the likelihood of torsion of normal adnexal structures and adnexal masses
    - use ultrasound in infertility workup (for trainees working in this area)
    - use ultrasound to monitor ovulation induction
- Interventional ultrasound
    - aspirate and/or drain pelvic cysts, abnormal fluid collections, abscesses etc under transabdominal and transvaginal ultrasound guidance
    - perform saline infusion Hysterosonography (SIH)
    - assess tubal patency with HysteroContrastSalpingography (HyCoSy) – not obligatory
- Have knowledge of
    - the common findings in children with precocious puberty, menarche
    - thelarche, adrenarche and virilisation
    - possible findings in primary and secondary amenorrhoea
    - the role of ovarian and endometrial cancer screening
    - the principles of oocyte collection by transvaginal ultrasound guided follicular aspiration

Level 3

A level 3 practitioner is likely to spend the majority of their time undertaking gynaecological ultrasound and/or teaching, research and development and will be an 'expert' in this area

Maintenance of Skills

Recommended numbers of examinations to be performed annually to maintain skills at each level are given in the text
Practitioners should:

- include ultrasound in their ongoing continued medical education (CME) and continued professional development (CPD)
- audit their practice
- participate in multidisciplinary meetings
- keep up to date with relevant literature

Appendix 3: Gynaecological Ultrasound Training Competency Assessment Sheet, see page 96.

Appendix 4

Obstetric Ultrasound

This curriculum is intended for clinicians who perform obstetric ultrasound scans. It includes standards for theoretical knowledge and practical skills. Level 1 competence should be obtained by anyone performing routine unsupervised scans in pregnancy

Level 1

- It is recommended that trainees should perform a minimum of 500 examinations over a 3 to 4 month period under supervision. However trainees will acquire the necessary skills at different rates and the end point of training should be judged by an assessment of competencies
- Examinations should encompass the full range of conditions listed below
- A log book listing the types of examinations undertaken should be kept
- Training should usually be supervised by a level 2 practitioner. In certain circumstances it may be appropriate to delegate some of this supervision to an experienced level 1 practitioner with at least two years of regular practical experience.
- Trainees should attend an appropriate theoretical course (see below) followed by a theoretical examination and the trainee should read appropriate textbooks and literature
- To maintain level 1 status the practitioner should perform at least 500 examinations each year
- During the course of training the competency assessment sheet should be completed as this will determine in which area or areas the trainee can practise independently

Level 1 Knowledge Base and Recommended Contents of Level 1 Theoretical Course

A minimum of 30 hours theoretical teaching is required preferably at the beginning of the training period. This should include:

- Physics and Technology, Ultrasound Techniques and Administration (see Appendix **2**)
- Dating of pregnancy
- Weight estimation and fetal growth
- Normal fetal anatomy
- Common fetal anomalies
- Multiple pregnancy
- Placenta, amniotic fluid
- Screening for fetal chromosomal anomalies: soft markers, nuchal translucency
- Invasive procedures: amniocentesis, chorionic villus biopsy
- Psychological aspects
- Ethical aspects
- Quality control

Level 1 Competencies to be acquired

At the end of the training the trainee should be able to

- Perform a systematic abdominal ultrasound examination of the pregnant uterus, placenta, amniotic fluid and fetus
- Optimize and correctly orientate the ultrasound image
- Obtain accurate measurements of the fetal biparietal diameter, femur length and abdominal diameter or circumference for dating and/or weight estimation
- Evaluate fetal anatomy, rerognizing the following structures and discriminating normal from abnormal findings in these structures:
  - Skull/brain
  - Midline echo in brain
  - Cavum septum pellucidum
  - Cerebellum
  - Cisterna magna
  - Cerebral ventricles
  - Neck
  - Thorax
  - Four chamber view of heart plus outflow tracts
  - Stomach
  - Umbilical cord insertion
  - Kidneys
  - Urinary bladder
  - Spine
  - Extremities (arms, legs, hands and feet)
  - The ability to communicate both normal and abnormal findings to the pregnant woman

Level 2

- Training should take the form of at least 30 clinic sessions in a centre under the supervision of at least a level 2 practitioner
- A minimum of 800 examinations will have been undertaken
- A log book of 10 well documented cases (eg fetal malformations, intrauterine growth restriction, twin complications etc) should be kept. This should include ultrasound images, clinical data and literature research
- The training requisite to this level of practice would be gained by a period of subspecialty training which may either be within or after the completion of a specialist training programme.
- During the couse of training the competency assessment sheet should be completed
- Training should include a theoretical course of at least 30 hours (see below) followed by a theoretical examination
- To maintain level 2 status the practitioner should perform at least 400 obstetric examinations per year

Level 2 Knowledge Base and Recommended Contents of Level 2 Theoretical Course

Appendix 4: Obstetric Ultrasound Training Competency Assessment Sheet, see page 97.

- Safety of Ultrasound
- Literature search, internet databases, etc
- Fetal malformations (more advanced than level 1)
- Role of ultrasound compared to other imaging modalities, e.g., magnetic resonance imaging
- Fetal echocardiography
- Fetal Doppler
- Soft markers
- Diagnosis of syndromes
- Genetics
- Quality control
- Psychology, counselling
- Ethics

Level 2 Competencies to be acquired

Be able to:

- Diagnose common fetal malformations and have knowledge of their management
- Diagnose intrauterine growth restriction and have knowledge of its management
- Diagnose complications in twin pregnancies and have knowledge of their management

Level 3

A level 3 practitioner is likely to spend the majority of their time undertaking obstetric ultrasound and/or teaching, research and development and will be an 'expert' in this area

Maintenance of Skills

Recommended numbers of examinations to be performed annually to maintain skills at each level are given in the text

Practitioners should:

- Include ultrasound in their ongoing continued medical education (CME) and continued professional development (CPD)
- Audit their practice
- Participate in multidisciplinary meetings
- Keep up to date with relevant literature

Appendix 5

Gastroenterological Ultrasound

This curriculum is intended for clinicians who perform gastroenterological ultrasound scans. It includes standards for theoretical knowledge and practical skills. At least Level 1 competence should be obtained by anyone performing gastroenterological ultrasound unsupervised

Level 1

- It is recommended that at least 5–10 examinations are performed by the trainee (under supervision) per week and that a minimum of 300 examinations in total are undertaken. However different trainees will acquire the necessary skills at different rates and the end point of the training programme should be judged by an assessment of competencies
- Examinations should encompass the full range of pathological conditions listed below
- A log book listing the types of examinations undertaken should be kept
- Training should usually be supervised by a level 2 practitioner. In certain circumstances it may be appropriate to delegate some of this supervision to an experienced level 1 practitioner with at least two years of regular practical experience.
- Trainees should attend an appropriate theoretical course and should read appropriate textbooks and literature
- It is recommended that a medical practitioner performing level 1 ultrasound should continue to perform at least 300 examinations each year on a regular basis and attend regular ultrasound meetings
- During the course of training the competency assessment sheet should be completed as this will determine in which area(s) the trainee can practice independently

Knowledge Base

Physics and Technology, Ultrasound Techniques and Administration:

see Appendix **2**

Sectional and Ultrasonic Anatomy

- Liver
- Gallbladder
- Bile ducts
- Pancreas
- Spleen
- Kidneys, Bladder and Adrenal Glands
- Other structures (uterus, ovaries, lymph nodes, vessels, hollow digestive tube)

Pathology in relation to ultrasound

- Liver: Cysts, benign and malignant tumours, metastatic disease, fatty change, cirrhosis.
- Biliary system: Gallbladder stones, acute and chronic cholecystitis, gallbladder tumours, bile duct obstruction including level of obstruction, intra hepatic duct gas and stones.
- Pancreas: Pancreatitis (acute and chronic), duct stones, duct dilatation, pancreatic tumours.
- Portal venous system and spleen: Splenic enlargement, portal venous distension, varices, thrombosis, ascites and loculated fluid collections

Appendix 5: Gastroenterological Ultrasound Training Competency Assessment Sheet, see page 98.

- Kidneys: Size, hydronephrosis and masses
- Other structures: Gastrointestinal masses and masses of gynaecological origin including cysts, tumours, fibroids and unexpected pregnancy.

Competencies to be acquired

Liver
To be able to:
- Perform a thorough ultrasound examination of the liver in different scan planes.
- Recognize normal hepatic anatomy and variants.
- Recognize normal and abnormal liver texture such as fatty change and anatomical variants.
- Recognize focal lesions and be able to determine those requiring further investigation.
- Recognize normal hepatic and portal venous anatomy within the liver.
- 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
- Recognize normal ultrasonic anatomy of the biliary system and its frequent normal variants.
- Recognize abnormalities of the gallbladder wall
- Recognize gallbladder stones
- Be able to assess bile duct dilatation at intra hepatic and extra hepatic levels

Pancreas
To be able to:-
- Perform a thorough examination of the pancreas
- Recognize the limitations of pancreatic ultrasound because of bowel gas
- Recognize solid and cystic tumours within the head and body of the pancreas
- Recognize the changes seen in pancreatitis (acute and chronic)
- Recognize pancreatic duct dilatation and pancreatic duct stones

Portal Venous System and Spleen
To be able to:
- Evaluate the size of the spleen and recognize focal lesions.
- Evaluate the portal vein and its diameter and the presence of portal venous thrombosis

Bowel
To be able to:
- Recognize normal stomach, small and large bowel
- Recognize focal intestinal abnormalities and understand the principles of further investigation.
- Recognize intestinal obstruction.

Other
To be able to:
- Recognize abdominal aortic aneurysm
- Recognize hydronephrosis and other renal abnormalities
- Recognize free and loculated fluid collections
- Recognize lymphadenopathy
- Recognize gynaecological and other pelvic abnormalities

Level 2
- Competencies will have been gained during training for level 1 practice and then refined during a period of practice, which will involve at least one year of experience at level 1 with a minimum of one ultrasound clinic per week.
- A further 500 examinations should have been undertaken in order to encompass the full range of conditions and procedures listed below.
- Supervision of training should be undertaken by someone who has achieved level 2 competence in gastrointestinal ultrasound and has had at least 2 years experience at that level.
- The trainee should be competent to accept referrals from level 1 practitioners

Knowledge Base

Sectional and Ultrasonic Anatomy:
- Detailed understanding of gastrointestinal, 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.
- An understanding of the role of ultrasound contrast agents in differentiating between different types of focal liver lesions
- Hollow digestive tube tumours and other masses

Competencies to be acquired
- Perform a comprehensive ultrasound examination of all of the solid organs within the abdomen.
- Be able to evaluate the small bowel for focal or diffuse disease.

- Be able to evaluate the large bowel for the presence of diverticular disease and its complications, tumours and obstruction.
- Be able to evaluate the peritoneal cavity, its mesenteries, compartments and the omentum for the presence of infective or malignant disease.
- Be able to undertake ultrasound guided drainage of peritoneal fluid collections.
- Be able to evaluate the hepatic and portal venous systems using spectral, colour and power doppler ultrasound.
- Be able to undertake ultrasound guided biopsy of focal liver lesions.
- Be able to undertake endoscopic ultrasound
- Be able to undertake an ultrasound contrast examination of the liver
- Be able to undertake some percutaneous ultrasound guided therapeutic procedures such as radiofrequency ablation (RFA), percutaneous ethanol injection (PEI), laser and microwave tumour ablation.

Level 3

A level 3 practitioner is likely to spend the majority of their time undertaking gastrointestinal ultrasound or teaching, research and development and will be an 'expert' in this area.

Maintenance of skills:

Having been assessed as competent to practice there will be a need for continued professional development (CPD) and maintenance of practical skills.

Practitioners should:-

- include ultrasound in their ongoing continued medical education (CME)
- audit their practice
- participate in multidisciplinary meetings
- keep up to date with relevant literature

Appendix 6

Nephro-Urological Ultrasound

This curriculum is intended for clinicians who perform diagnostic nephrological and/or urological ultrasound. It includes standards for theoretical knowledge and practical skills. At least level 1 competence should be obtained by anyone performing nephro-urological scans unsupervised

Level 1

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

Level 1 Knowledge Base

- Physics and technology, ultrasound techniques and administration (see Appendix **2**)
- Sectional and ultrasonic anatomy
  - kidneys
  - ureters
  - other retro-peritoneal structures (adrenals, aorta, i.v.c.)
  - bladder
  - seminal vesicles
  - prostate
  - scrotal contents
  - other pelvic structures (uterus, ovaries, lymph nodes, vessels, bowel)
- Pathology in relation to ultrasound
  - kidneys: congenital anomalies, cysts, tumours (benign and malignant), stones, collecting system dilatati-

Appendix 6: Nephro-Urological Ultrasound Training Competency Assessment Sheet, see page 100.

on, renal and peri-renal abscesses, trauma, diffuse renal diseases, acute and chronic renal failure
- ureters: dilatation, obstruction
- bladder: tumours, diverticula, wall thickening, calculi, volume estimation
- prostate: zonal anatomy, infection, hyperplasia, tumours
- scrotal contents: testicular tumours, cysts, torsion, hydrocele, inflammatory problems, trauma

Level 1 Competencies to be Acquired

- Kidneys
  To be able to:
  - perform a thorough ultrasound examination of the kidneys in different planes
  - recognise normal renal ultrasonic anatomy and common normal variants
  - measure renal length and assess variation from normality
  - recognise and assess the degree of collecting system dilatation
  - recognise and diagnose simple cysts
  - recognise complex cysts and refer for appropriate further investigation
  - recognise renal tumours and refer for appropriate further investigation
  - recognise diffuse renal medical diseases associated with renal dysfunction
  - 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 (for Urologists)
  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 epididymes
  - recognise abnormalities which need referral to a more experienced ultrasonologist and/or for further investigation
- Prostate (for Urologists)
  To be able to:
  - recognise normal ultrasonic anatomy and common normal variants
  - perform trans-rectal ultrasound
  - measure prostatic volume
  - identify abnormal focal lesions
  - perform a standardised technique of trans-rectal prostatic biopsy (optional depending on clinical practice/national guidelines)
  - 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
  - renal failure
  - hypertension
  - abdominal trauma

- lower urinary tract symptoms
- recurrent urinary tract infections
- supra-pubic mass
- palpable masses in the scrotum
- scrotal pain

Level 2 Training and Practice

- Practical training should involve at least 1 year of experience at level 1 with a minimum of one ultrasound clinic 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 log book 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 and has had at least 2 years experience at that Level.
- A Level 2 practitioner will be able to accept referrals from Level 1 practitioners.

Level 2 Knowledge Base

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

Level 2 Competencies to be Acquired

- Competencies will have been gained during training for Level 1 practice, and then refined during a period of clinical practice.
- Kidneys, bladder, prostate, scrotal contents
  To be able to:
  - recognise all pathology affecting the urinary tract and provide an accurate diagnosis in almost all cases
  - recognise abnormalities which are outside his/her experience and refer on appropriately to a more experienced ultrasound professional
  - perform ultrasound-guided invasive procedures, including cyst aspiration, abscess drainage, renal biopsy, percutaneous nephrostomy, supra-pubic bladder catheter insertion and trans rectal prostate biopsy
  - 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 nephro-urological ultrasound, teaching, research and development and will be an 'expert' in this area.
- He/she will have spent a continuous period of specialist training in nephro-urological ultrasound.
- He/she will perform specialised examinations at the leading edge of ultrasound practice.
- He/she will accept tertiary referrals from Level 1 and Level 2 practitioners and will perform specialised examinations (e.g., the use of intravascular ultrasound agents in evaluating possible malignancy) as well as performing advanced ultrasound guided invasive procedures.

Maintenance of skills: All Levels

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

Appendix 7

Breast Ultrasound

Level 1

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

Knowledge Base

Physics and Technology, Ultrasound Techniques and Administration:-

see Appendix **2**.

Sectional and Ultrasound Anatomy

- Normal Anatomy of female and male breast.
- Anatomical, physiological and developmental anomalies associated with the breast.
- The changes in ultrasound appearances associated with age, pregnancy and lactation, hormonal status, medication.

Pathology in relation to ultrasound

- Benign conditions including cysts, fibroadenomas, fibroadeno-lipomas, lipomas, haematomas, fat necrosis, hamartomas.
- Indeterminate abnormalities including duct papillomas, radial scar.
- Malignancy including ductal, lobular, inflammatory and other carcinomas.
- Normal and abnormal appearances of axillary lymph nodes.
- Inflammatory breast conditions including infection and abscess formation.
- Iatrogenic appearances including breast implants, early and late post-operative changes, seromas, haematomas, radiotherapy changes, fat necrosis, scarring.

Competencies to be acquired

To be able to:

- Perform a thorough ultrasound examination of the breast and axilla
- To recognise normal anatomy
- Understand the indications for and the importance of ultrasound in the triple assessment process.
- Understand the strengths, weaknesses and limitations of breast ultrasound.
- Be aware of the interdependency and significance of mammographic and ultrasound appearances.
- Be competent in recognising the criteria for lesion characterisation
- Confidently exclude the presence of a sonographic lesion within the breast.
- Write a detailed report of the ultrasound findings with grading, differential diagnosis, conclusion and recommendation for further management.
- Understand the principle of Doppler ultrasound and its relevance to breast imaging.
- Recognise personal limitations and ask for more expert advice if required

Level 2

Interventional Techniques

- After reaching competency at Level 1 practitioners may progress to Level 2. This should involve a minimum of 1 scanning clinic per week (at least 10 cases per week) for at least 3 months.

Appendix 7: Breast Ultrasound Training Competency Assessment Sheet, see page 102.

- Training for interventional techniques should include observation initially followed by performance of the examination and/or procedure under close supervision. When competence has been acquired then procedures may be undertaken alone but with support close to hand
- A logbook of diagnostic and interventional procedures performed should be kept with pathological correlation

Competencies to be Acquired

- Cyst aspiration: Initially to perform a minimum of 10 guided cyst aspirations of which at least 5 should be of cysts less than 2cms
- Aspirate cysts of less than 1cm diameter
- Guided fine needle aspiration biopsy (FNAB): Perform a minimum of 10* FNABs of solid lesions, with pathological correlation of cytology result and final pathology (if available)
- If FNAB is not performed in the department to be aware of the uses and limitations of the technique
- Guided core biopsies: Perform a minimum of 10* guided core biopsies with pathological correlation of core biopsy histology and final pathology (if available)
- Perform guided abscess aspiration and drainage
- Perform pre-operative guided localisations using skin marking and wire insertion techniques
- Perform guided marker or coil insertion prior to neo-adjuvant chemotherapy
- Ability to accept referrals from level 1 practitioners
- Absolute numbers may vary according to the practice of individual breast units

Level 3

Competencies to be Acquired

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

Maintainance of Skills

In order to maintain competence the practitioner should perform at least 1 ultrasound clinic per week and a minimum of 500 examinations per year.

There should be continuing professional updating with attendance at multidisciplinary breast meetings and relevant and appropriate courses with a component relating to breast ultrasound scanning together with regular reviews of the current literature. Regular audit of the individual's ultrasound practice should be undertaken.

Appendix 8

Vascular Ultrasound

Level 1 Training and Practice

- Practical training should involve at least two half day ultrasound clinics per week over a period of no less than 3 months and up to 6 months, with approximately four to six examinations performed by the trainee under supervision per clinic.
- A minimum of 100 imaging examinations of each type (eg carotid, lower limb venous etc) should be undertaken if this is the first practical training module undertaken.
- Examinations should encompass the full range of pathological conditions listed below.
- A log book listing the types of examinations undertaken should be kept.
- Training should usually be supervised by a Level 2 practitioner in vascular ultrasound. In certain circumstances it may be appropriate to delegate some of this supervision to an experienced level 1 practitioner with at least two years of regular practical experience. This will usually mean that training is carried out in dedicated vascular duplex sessions supervised by an accredited vascular physician/scientist/technologist, specialist sonographer or radiologist.
- Trainees should attend an appropriate theoretical course which fully covers all areas of the required knowledge base and should read appropriate textbooks and literature.
- During the course of training the competency assessment sheet should be completed as this will determine in which area or areas the trainee can practise independently.

Level 1 Knowledge Base

- Physics and technology, ultrasound techniques and administration (see Appendix **2**).
- 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 including common normal variants

Appendix 8: Vascular Ultrasound Training Competency Assessment Sheet, see page 104.

  - peripheral extremity arteries
  - peripheral extremity veins
  - abdominal aorta
  - extracranial vessels
- Pathology and results of treatment in relation to ultrasound
  - peripheral extremity arteries: patency, stenosis, occlusion, 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 percutaneous interventions including angioplasty, stenting, grafts, Miller vein cuffs, dissections, and neointimal hyperplasia

Level 1 Competencies to be Acquired

- To be able to perform continuous wave hand-held Doppler and segmental pressures (ABPI)
- Lower extremity peripheral arteries and grafts
  To be able to:
  - perform a complete imaging ultrasound examination of the external iliac to popliteal arteries
  - recognise and assess patency, occlusion, stenosis and aneurysmal dilatation, and measure approximate extent of abnormality
  - diagnose > 50% stenosis
  - recognise common surgical interventions, arterio-venous (AV) fistulas and pseudoaneurysm formation
- Peripheral veins
  Lower extremity deep veins
  To be able to:
  - perform a complete imaging ultrasound examination of external iliac to popliteal deep veins
  - perform compression and augmentation
  - recognise acute femoro-popliteal venous thrombosis
  - recognise, diagnose and locate reflux
- Lower extremity superficial veins
  To be able to:
  - identify the saphenofemoral and saphenopopliteal junctions
  - recognise and locate clinically relevant venous reflux, incompetence and perforators
  - perform vein mapping and marking
- Abdominal vessels
  To be able to:
  - recognise and locate patency and occlusion of the abdominal aorta
  - recognise and size aneurysmal dilatation of the abdominal aorta
- Extracranial vessels
  To be able to:
  - recognise and locate patency, occlusion, plaque and stenoses in the carotid vessels

Level 2 Training and Practice

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

Level 2 Knowledge Base

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

Level 2 Competencies to be acquired

- Competencies will have been gained during training for Level 1 practice and then refined during a period of practice
- To be able to:
  - perform a complete imaging ultrasound scan and identify all abnormalities detailed in Level 1 in the upper and lower extremities, from common iliac to pedal vessels 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.
- He/she will accept tertiary referrals from Level 1 and 2 practitioners.
- He/she should have the capability to utilise developing technologies and ultrasound techniques, develop research and teaching skills and the performance of specialised examinations including the use of non-invasive physiological studies, contrast agents, intravascular or intra-operative ultrasound and ultrasound guided invasive procedures.

Maintenance of skills: all Levels

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

APPENDIX 3: GYNAECOLOGICAL ULTRASOUND TRAINING COMPETENCY ASSESSMENT SHEET

Trainee

Trainer

Competencies/Skills to be acquired Level 1

	Trainer Signature	**Date**		**Trainer Signature**	**Date**
To be competent to perform/diagnose:			**To be competent to perform/diagnose:**		
• Systematic examination of pelvic organs (TA & TV)	_____	_____	• Uterine fibroids ? size, number and position	_____	_____
• Obtain optimal images of uterus and adnexae	_____	_____	• Intrauterine gestation sac of > 5mms in diameter	_____	_____
• Obtain accurate measurements of uterus, endometrium and ovaries	_____	_____	• Fetal heart activity in embryo > 10mms CRL	_____	_____
• Physiological changes in uterus & ovaries during menstrual cycle	_____	_____	• Ultrasound in management of miscarriage & tubal pregnancy	_____	_____
• Localize position of an intrauterine contraceptive device	_____	_____			
• Discriminate between normal and abnormal appearances of pelvic organs in non-pregnant woman	_____	_____	• **Logbook of 300 completed cases**	_____	_____
			• **Illustrated logbook of 20 completed cases**	_____	_____
			• **Passed theoretical examination**	_____	_____

Competencies/Skills to be acquired Level 2

	Trainer Signature	**Date**		**Trainer Signature**	**Date**
To be competent to perform/diagnose etc.:			**Knowledge on:**		
• Discriminate between fibroids & adenomyosis	_____	_____	• Oocyte collection by TV ultrasound guided follicular aspiration	_____	_____
• Features of endometrial cancer	_____	_____	• Changes in children with precocious puberty, menarche, thelarche, adrenarche & virilisation	_____	_____
• Saline infusion sonography	_____	_____	• Abnormalities in primary & secondary amenorrhoea	_____	_____
• Ultrasound in bleeding disturbances before menopause	_____	_____	• Ultrasound screening for cancer	_____	_____
• Discriminate between benign & malignant adnexal masses	_____	_____			
• Discriminate between endometrioma, dermoid cysts, peritoneal inclusion cysts, hydrosalpinx, para-ovarian cysts and benign solid adnexal masses	_____	_____			
• Recognise pelvic inflammatory disease	_____	_____	• **Logbook of 2000 completed cases**	_____	_____
• Ectopic pregnancy and plan treatment	_____	_____	• **Passed theoretical examination**	_____	_____
• Torsion of normal adnexae & adnexal masses	_____	_____			
• Postmenopausal bleeding assessment	_____	_____			
• Infertility workup – not obligatory	_____	_____			
• Tubal patency using HyCoSy – not obligatory	_____	_____			
• Aspirate/drain pelvic cysts and fluid collections (TA & TV)	_____	_____			

APPENDIX 4: OBSTETRIC ULTRASOUND TRAINING COMPETENCY ASSESSMENT SHEET

Trainee

Trainer

Competencies/Skills to be acquired Level 1

A formal theoretical and practical examination should take place at the end of training

To be competent to perform/diagnose etc the following:

	Trainer Signature	Date
• Systematic examination of pregnant uterus, placenta amniotic fluid & fetus	_____	_____
• Obtain optimal images in a correct orientation	_____	_____
• Obtain accurate measurements of biparietal diameter, femur length, abdominal diameter & circumference	_____	_____
Discriminate normal from abnormal in:		
• Skull/Brain	_____	_____
• Midline echo in brain	_____	_____
• Cavum septum pellucidum	_____	_____
• Cisterna Magna	_____	_____
• Cerebellum	_____	_____
• Cerebral Ventricles	_____	_____

Competencies/Skills to be acquired Level 2

To be competent to perform/diagnose etc the following:

	Trainer Signature	Date
• Diagnose common fetal malformations	_____	_____
• Diagnose intrauterine growth restriction	_____	_____
• Diagnose complications in twin pregnancies	_____	_____
• **Logbook of 800 completed cases**	_____	_____
• **Illustrated logbook of 10 cases including clinical information & completed literature search**	_____	_____
• **Passed theoretical examination**	_____	_____

Competencies/Skills to be acquired Level 1

To be competent to perform/diagnose etc the following:

	Trainer Signature	Date
• Neck	_____	_____
• Thorax	_____	_____
• Four chamber view of heart/outflow tracts	_____	_____
• Stomach	_____	_____
• Umbilical Cord insertion	_____	_____
• Kidneys	_____	_____
• Bladder	_____	_____
• Spine in three planes (coronal, transverse & sagittal)	_____	_____
• Arms, legs, hands & feet	_____	_____
• Ability to communicate findings to pregnant woman	_____	_____

APPENDIX 5: GASTROENTEROLOGICAL ULTRASOUND TRAINING COMPETENCY ASSESSMENT SHEET

Trainee

Trainer

Competencies/Skills to be acquired Level 1

To be competent to perform/diagnose etc. the following:

	Trainer Signature	Date
LIVER AND BILIARY SYSTEM		
• Normal liver segmental anatomy	_____	_____
• Common variants of anatomy	_____	_____
• Atrophy and hypertrophy of lobes and segments	_____	_____
• Abnormal texture	_____	_____
• Fatty liver	_____	_____
• Cirrhosis	_____	_____
• Focal lesions	_____	_____
• Cysts, Haemangioma, Metastases	_____	_____
• Hepatic Veins, dilatation, thrombosis	_____	_____
• Normal gall bladder	_____	_____
• Intra and extra-hepatic ducts and variants	_____	_____
• Duct dilatation	_____	_____
• Level of obstruction	_____	_____
• Gall bladder stones	_____	_____
• Chronic Cholecystitis	_____	_____
• Acute Cholecystitis	_____	_____
• Complications of Acute Cholecystitis	_____	_____
• Benign inflammatory conditions of gall bladder and gall bladder tumours	_____	_____
• Undertake biopsy of parenchymal liver disease	_____	_____
PANCREAS		
• Normal pancreatic anatomy	_____	_____
• Duct dilatation	_____	_____
• Duct stones	_____	_____
• Pancreatic tumours	_____	_____
• Pancreatitis	_____	_____

To be competent to perform/diagnose etc. the following:

	Trainer Signature	Date
PORTAL VENOUS SYSTEM/SPLEEN		
• Normal portal vein	_____	_____
• Dilated portal vein	_____	_____
• Varices	_____	_____
• Thrombosis	_____	_____
• Cavernous transformation	_____	_____
• Normal spleen	_____	_____
• Splenomegaly	_____	_____
• Focal splenic lesions	_____	_____
• Splenic trauma	_____	_____
OTHER STRUCTURES etc		
• Normal kidneys	_____	_____
• Uterus	_____	_____
• Ovaries	_____	_____
• Aorta	_____	_____
• Hydronephrosis	_____	_____
• Renal cysts	_____	_____
• Solid renal mass	_____	_____
• Uterine fibroids	_____	_____
• Pregnancy	_____	_____
• Ovarian cysts and masses	_____	_____
• Aortic aneurysm	_____	_____

APPENDIX 5: GASTROENTEROLOGICAL ULTRASOUND TRAINING COMPETENCY ASSESSMENT SHEET

Trainee _____ Trainer _____

Competencies/Skills to be acquired Level 2

To be competent to perform/diagnose etc. the following:

	Trainer Signature	Date
HOLLOW DIGESTIVE TUBE		
• Normal stomach, small and large bowel	_____	_____
• Diverticular disease and abscess	_____	_____
• Colonic Tumours	_____	_____
• Small bowel obstruction	_____	_____
• Inflammatory bowel disease	_____	_____
• Inflammatory masses	_____	_____

To be competent to perform/diagnose etc. the following:

	Trainer Signature	Date
PERITONEAL CAVITY, MESENTERY & OMENTUM		
• Peritoneal fluid collections	_____	_____
• Mesenteric masses	_____	_____
• Omental Disease	_____	_____
OTHER		
• Undertake drainage of fluid collections/abscesses	_____	_____
• Spectral and colour flow Doppler of portal and hepatic venous system	_____	_____
• Undertake biopsy of focal lesions	_____	_____
• Undertake endoscopic ultrasound	_____	_____
• Undertake ultrasound contrast examinations	_____	_____
• Undertake RFA	_____	_____
• Undertake PEI	_____	_____
• Undertake laser ablation of tumours	_____	_____
• Undertake microwave ablation of tumours	_____	_____

APPENDIX 6: NEPHRO-UROLOGICAL ULTRASOUND TRAINING COMPETENCY ASSESSMENT SHEET

Trainee _____ Trainer _____

Core knowledge base - Level 1

	Trainer Signature	Date		Trainer Signature	Date
• 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

To be competent to perform/diagnose the following:

	Trainer Signature	Date
Kidneys		
• ultrasound examination in different planes	_____	_____
• ultrasonic anatomy and common normal variants	_____	_____
• renal length and variation from normality	_____	_____
• collecting system dilatation	_____	_____
• simple cysts	_____	_____
• complex cysts	_____	_____
• tumours	_____	_____
• stones	_____	_____
• renal parenchymal disease	_____	_____
• reno-vascular hypertension	_____	_____
• peri-renal abnormalities	_____	_____
Bladder		
• ultrasound examination in different planes	_____	_____
• ultrasonic anatomy and common normal variants	_____	_____
• bladder volume	_____	_____
• diverticula	_____	_____
• tumours	_____	_____
• calculi	_____	_____
• use colour Doppler to assess ureteric jets	_____	_____
Prostate (for Urologists)		
• ultrasonic anatomy and common normal variants	_____	_____
• trans-rectal ultrasound	_____	_____
• prostatic volume	_____	_____
• abnormal focal lesion	_____	_____
• trans-rectal prostatic biopsy (optional/depending on national guidelines)	_____	_____

To be competent to perform/diagnose the following:

	Trainer Signature	Date
Scrotum (for Urologists)		
• ultrasound examination in different planes		
• ultrasonic anatomy and common normal variants		
• epididymal cysts		
• varicocoeles		
• intra-scrotal and intra-testicular calcifications		
• tumours		
• inflammatory changes in testes and epididymides		
• use Doppler to help differentiate torsion/inflammatory problems		
General		
• Use ultrasound in the assessment of patients presenting with:		
• haematuria		
• loin pain/renal colic		
• loin mass		
• renal failure		
• lower urinary tract symptoms		
• recurrent urinary tract infection		
• supra-pubic mas		
• palpable scrotal masses		
• scrotal pain		
• normal aorta and aortic aneurysm		
• normal liver and liver masses		
• normal uterus and ovaries and gynaecological masses		
• know when to refer to a more expert ultrasonologist		

APPENDIX 6: NEPHRO-UROLOGICAL ULTRASOUND TRAINING COMPETENCY ASSESSMENT SHEET

Trainee _____ Trainer _____

Competencies/skills to be acquired Level 2

To be competent to perform/diagnose the following:

	Trainer Signature	**Date**
Recognise all urinary tract pathology	_____	_____
Perform		
• cyst aspiration	_____	_____
• abscess drainage	_____	_____
• renal biopsy	_____	_____
• nephrostomy	_____	_____
• suprapubic bladder catheter insertion	_____	_____
• trans-rectal prostate biopsy	_____	_____
• perform Doppler studies	_____	_____
• recognise abnormalities elsewhere in the abdomen/pelvis	_____	_____

APPENDIX 7: BREAST ULTRASOUND TRAINING COMPETENCY ASSESSMENT SHEET

Trainee

Core Knowledge Base Level 1

	Trainer Signature	Date
• Physics and Instrumentation	_____	_____
• Ultrasound techniques	_____	_____
• Administration	_____	_____
• Sectional and Ultrasound anatomy	_____	_____
• Normal Anatomy of female and male breast.	_____	_____
• Anatomical, physiological and developmental anomalies associated with the breast.	_____	_____
• The changes in ultrasound appearances associated with age, pregnancy and lactation, hormonal status, medication	_____	_____
• Pathology in relation to ultrasound	_____	_____
• Benign breast conditions including cysts,f ibroadenomas, fibroadeno-lipomas, lipomas, haematomas, fat necrosis, hamartomas	_____	_____
• Indeterminate abnormalities including duct papillomas, radial scar	_____	_____
• Breast malignancy including ductal, lobular, inflammatory and other carcinomas	_____	_____
• Normal and abnormal appearances of axillary lymph nodes.	_____	_____
• Inflammatory conditions in the breast including infection and abscess formation	_____	_____
• Iatrogenic changes in the breast , including breast implants, early and late post-operative appearances, seromas, haematomas, radiotherapy changes, fat necrosis, scarring	_____	_____

Trainer

Competencies/skills to be acquired:

	Trainer Signature	Date
• Perform a thorough ultrasound examination of the breast and axilla	_____	_____
• Be able to recognise normal anatomy of breast and axilla	_____	_____
• Understand the indications for and the importance of ultrasound in the triple assessment process	_____	_____
• Understand the strengths, weaknesses and limitations of breast ultrasound	_____	_____
• Be aware of the interdependency and significance of mammographic and ultrasound appearances	_____	_____
• Be competent in recognising the criteria for lesion characterisation.	_____	_____
• Be able to confidently exclude the presence of a sonographic lesion within the breast	_____	_____
• Be able to write a detailed report of the ultrasound findings with grading, differential diagnosis, conclusion and recommendation for further management	_____	_____
• Understand the principle of Doppler ultrasound and its relevance to breast imaging	_____	_____
• Recognise personal limitations and ask for more expert advice if required	_____	_____

APPENDIX 7: BREAST ULTRASOUND TRAINING COMPETENCY ASSESSMENT SHEET

Trainee

Trainer

Level 2

After reaching competency at Level 1 practitioners may progress to Level 2.
This involves a minimum of 1 scanning clinic session per week (at least 10 cases per week) for at least 3 months.

Competencies/skills to be acquired:

	Trainer Signature	**Date**
Essential principles		
• Perform fine needle aspiration cytology on abnormalities with correlation of results to imaging and pathology. 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.	_____	_____
• Successfully perform ultrasound guided core biopsy with correlation of results to imaging and pathology.	_____	_____
• Perform ultrasound guided breast abscess aspiration.	_____	_____
• Perform ultrasound guided localisations pre-operatively, using both skin marking and wire insertion techniques.	_____	_____
• Perform ultrasound guided marker or coil insertion prior to neo-adjuvant chemotherapy.	_____	_____
• Accept referrals from level 1 practitioners	_____	_____
Level 3		
	Trainer Signature	**Date**
Essential principles		
• To accept referrals from level 1 and level 2 practitioners and undertake more complex ultrasound examinations.	_____	_____
• To be able to mentor and supervise practitioners at level 1 and 2.	_____	_____
• To understand and be familiar with vacuum assisted breast biopsy	_____	_____
• To conduct research.	_____	_____
• To teach U/S at all levels.	_____	_____
• To be aware of and pursue developments in breast U/S including Doppler and the use of intravascular contrast agents.	_____	_____

APPENDIX 8: VASCULAR ULTRASOUND TRAINING COMPETENCY ASSESSMENT SHEET

Trainee _____ Trainer _____

Core Knowledge Base Level 1

	Trainer Signature	**Date**
• Physics and technology	_____	_____
• Practical instrumentation/use of ultrasound controls	_____	_____
• Ultrasound techniques	_____	_____
• Administration	_____	_____
• Sectional and ultrasonic anatomy	_____	_____
• Pathology in relation to ultrasound	_____	_____

Competencies/skills to be acquired - Level 1

To be competent to perform/diagnose the following:

	Trainer Signature	**Date**
Essential Principles		
• CW hand-held Doppler and segmental pressures	_____	_____
• caliper measurements of distance and size	_____	_____
• colour flow and spectral analysis	_____	_____
• velocity measurement and Doppler angle	_____	_____
Peripheral arteries and grafts		
• recognise normal anatomy and common variants	_____	_____
• scan external iliac to popliteal arteries	_____	_____
• recognise patency, occlusion and aneurysm	_____	_____
• recognise and differentiate 50% stenosis	_____	_____
• recognise common interventions	_____	_____
Peripheral deep veins		
• recognise normal anatomy and common variants	_____	_____
• Scan external iliac to popliteal veins	_____	_____
• perform compression and augmentation	_____	_____
• recognise acute femoro-popliteal DVT	_____	_____
• diagnose and locate reflux	_____	_____

To be competent to perform/diagnose the following:

	Trainer Signature	**Date**
Peripheral superficial veins		
• recognise normal anatomy and common variants	_____	_____
• identify sapheno-femoral and sapheno-popliteal junctions	_____	_____
• diagnose reflux, incompetence, perforators	_____	_____
Abdominal ultrasound		
• recognise patency and occlusion of aorta	_____	_____
• recognise and size aortic aneurysm	_____	_____
Extracranial vessels		
• recognise normal anatomy and common variants	_____	_____
• recognise patency, occlusion, plaque and stenosis	_____	_____
• other competencies acquired	_____	_____
General		
• know when to refer to a more expert ultrasonologist	_____	_____

APPENDIX 8: VASCULAR ULTRASOUND TRAINING COMPETENCY ASSESSMENT SHEET

Trainee

Trainer

Core Knowledge Base Level 2

	Trainer Signature	Date
• Peripheral arteries and grafts	_____	_____
• Peripheral deep and superficial veins	_____	_____
• Transcranial Doppler	_____	_____

Competencies/skills to be acquired - Level 2

To be competent to perform/diagnose the following:	Trainer Signature	Date
• assessment from iliac to pedal arteries and veins	_____	_____
• assessment from subclavian to radial and ulnar arteries and veins	_____	_____
• patency, occlusion, stenosis reverse flow and steal in the carotid and vertebral vessels	_____	_____
• grade degrees of carotid stenosis and plaque type	_____	_____
• normal variants, aneurysmal dilatation, patency, stenosis and occlusion of major abdominal and iliac vessels	_____	_____