**Appendix 5.**

Recommendations for training arising from the PERSEUS Delphi Consensus process

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| Statement | Median score | DI |
| **Section 1 - Generic learning/training objectives** **At the completion of their training the practitioner should be able to demonstrate:** |
| Knowledge of what ultrasound is and how it is generated | 9 | 0.132 |
| An understanding of the relationship between frequency used, tissue penetration and image quality | 9 | 0 |
| Knowledge of the biological effects and safety of ultrasound | 8 | 0.137 |
| An understanding of the basic principles of real time and Doppler ultrasound including colour flow and power Doppler | 8 | 0.137 |
| Selection of the most appropriate transducer for different examinations | 9 | 0 |
| Adjustment of ultrasound machine settings to optimise Image quality | 9 | 0 |
| Adjustment of transducer pressure, alignment, rotation and tilting to optimise Image quality | 9 | 0 |
| Identification of arteries, veins, nerves, tendons, muscle and fascia, bones and air-filled spaces | 9 | 0 |
| Recognition of common artefacts and provision of an explanation as to how they occur | 9 | 0 |
| An understanding of in-plane and out-of-plane needle visualisation techniques | 9 | 0 |
| Knowledge of the benefits and limitations of in-plane and out-of-plane techniques | 9 | 0 |
| The ability to minimise unintended transducer movement during needle visualisation | 9 | 0 |
| The ability to maintain visualisation of the needle shaft and tip during in-plane techniques | 9 | 0 |
| The ability to visualise the needle tip during out-of-plane techniques | 9 | 0 |
| That they can record ultrasound images | 9 | 0.292 |
| An understanding of the principles of patient information, consent and preparation for ultrasound guided procedure | 9 | 0.046 |
| Understanding the importance of practising within their own level of competence | 9 | 0 |
| Procedures to minimise the risks of incorrect-site interventions | 9 | 0 |
| Procedures to minimise cross-infection from ultrasound equipment | 9 | 0 |
| The ability to perform ultrasound guided procedures under sterile condition | 9 | 0 |
| An understanding of the value and techniques of continual personal audit for quality assurance and improvement | 9 | 0.046 |
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| **Section 2 - Learning & assessment methods for generic competencies** |
| Learning and assessment methods should be tailored to learning objectives | 9 | 0 |
| Certificating organisations should decide learning and assessment methods for each learning objective | 8 | 0.187 |
| Training course organisers should be able to request approval for proposed learning and assessment methods from the European Society of Anaesthesiology or relevant national societies. | 8 | 0.299 |
| Training and successful assessment in a teaching laboratory simulation environment is essential before the practitioner undertakes US guided procedures on patients | 9 | 0.187 |
| Assessment of competence to perform practical procedures is best undertaken using a global rating score added to a checklist of the individual components of the task | 9 | 0.132 |
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| **Section 3 - Specific learning/training objectives for US guided vascular access.** **At the completion of their training the practitioner, in addition to achieving the generic objectives, should be able to demonstrate:** |
| Knowledge of the sectional and ultrasonic anatomy of the neck, axillary/subclavian veins, arm (basilic vein), groin/femoral triangle, forearm (radial artery) | 9 | 0 |
| That they can recognise vascular pathology using ultrasound e.g. vessel patency, occlusion, deep venous thrombosis, arterial thrombosis, pseudo aneurysm, arteriovenous fistula | 7.5 | 0.200 |
| Ability to use techniques to augment the size of different veins | 9 | 0 |
| Proper selection of the catheter/vein ratio | 9 | 0 |
| Identification of the intravascular location of guide wire and catheter tip | 9 | 0 |
| Techniques for catheter tip navigation | 9 | 0.132 |
| Pleural and lung ultrasound techniques for ruling out complications of central venous access | 8.5 | 0.187 |
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| **Section 4 - Training & assessment methods for US guided vascular access** |
| Before attempting their first directly supervised attempt for each ultrasound guided vascular access procedure the practitioner should have observed 5 ultrasound guided procedures of that type and performed 5 ultrasound scans on patients scheduled for that ultrasound guided procedure | 9 | 0.132 |
| The practitioner undergoing training in US guided vascular access should maintain a logbook that documents every procedure they perform | 8 | 0.200 |
| For each ultrasound guided vascular access procedure the practitioner should be directly observed for at least 5 ultrasound guided procedures of that type before their ability is assessed for subsequent practice with distant supervision | 9 | 0.187 |
| For each ultrasound guided vascular access procedure the practitioner should be signed off as appropriately skilled for that procedure by an expert trainer using a global rating scale before they perform the procedure with distant supervision. | 8.5 | 0.187 |
| To be eligible for completion of competency-based training in paediatric US guided vascular access the practitioner should have performed 30 US guided vascular access procedures of any type in a 12 months period | 7.5 | 0.467 |
| To be eligible for completion of competency-based training in US guided vascular access cumulative summated outcomes for key performance indicators should be within the tolerance limits of expert practice standards. | 9 | 0.046 |
| Competence in US guided vascular access for eligible practitioners can be signed off if they achieve satisfactory global rating scores following direct observation of a procedure by an expert trainer | 8 | 0.187 |
| Maintenance of competence in US guided vascular access will require cumulative summated outcomes for key performance indicators to be within the tolerance limits of expert practice standards | 8 | 0.292 |
| Maintenance of competence in US guided vascular access will require evidence of regular continuing professional development activities relevant to US guided vascular access | 8 | 0.137 |
| Maintenance of competence in US guided vascular access should be based on performance indicators only and not number of procedures | 9 | 0.132 |
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| **Section 5 - Performance indicators for US guided vascular access procedures.** **The following are useful performance indicators for US guided vascular access:** |
| First-time puncture rate | 8.5 | 0.132 |
| Successful completion of procedure within 30 minutes | 8 | 0.164 |
| Total procedural time | 7.5 | 0.271 |
| Incidence of major complications | 9 | 0 |
| Incidence of overall complications | 9 | 0.046 |
| Patients’ satisfaction (valid for patients capable of verbalising, and measured on numeric scale) | 8 | 0.29 |
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| **Section 6 - Criteria for defining an expert trainer in US guided vascular access.** **An expert trainer in US guided vascular access must be able to demonstrate** |
| One year of independent practice in US guided vascular access following completion of competency-based training, or | 8 | 0.361 |
| Continuous independent practice in US guided vascular access for at least 3 years which began before the introduction of competency-based training ("Grandfather" clause) | 9 | 0.137 |
| Cumulative summated outcomes for key performance indicators to be within the tolerance limits of expert practice standards | 8.5 | 0.187 |
| Evidence of regular continuing professional development activities relevant to US guided vascular access and education/training | 8 | 0.093 |
| For paediatric practice, should meet relevant national criteria for maintaining practice privileges as specialist paediatric clinician in children from the relevant age group (neonate, infant, toddler, older child) | 8 | 0.132 |
| **Legend: MAS 7-9: appropriate DI <1 indicates consensus** |