

Thoracic Ultrasound – EFSUMB Training Recommendations – a Position Paper

Thoraxsonografie – EFSUMB-Ausbildungsempfehlungen – ein Positionspapier

Authors

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ABSTRACT

A wide range of medical specialists increasingly use thoracic ultrasound and transthoracic ultrasound-guided interventions in their clinical practice. To ensure high quality and standardized practice across specialties, this position paper of the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) describes the training requirements for thoracic ultrasound. The recommendations follow the three

EFSUMB competency levels for medical ultrasound practice. Level 1 describes the skills required to perform basic thoracic ultrasound examinations and basic interventions independently, level 2 includes more advanced transthoracic ultrasound imaging and guided interventions, while level 3 involves the practice of high-level thoracic ultrasound and the use of advanced technologies. Previously, a predefined minimum number of ultrasound examinations was used to determine competence, but in recent years, a general shift towards competency-based training and assessment has been implemented. For each EFSUMB level, we outline the theoretical knowledge and practical skills needed for clinical practice.

ZUSAMMENFASSUNG

Eine Vielzahl von Fachärzten setzt in ihrer klinischen Praxis zunehmend Thorax-Ultraschall und transthorakale ultraschallgesteuerte Interventionen ein. Um eine hohe Qualität und standardisierte Praxis über alle Fachgebiete hinweg zu gewährleisten, beschreibt dieses Positionspapier der European

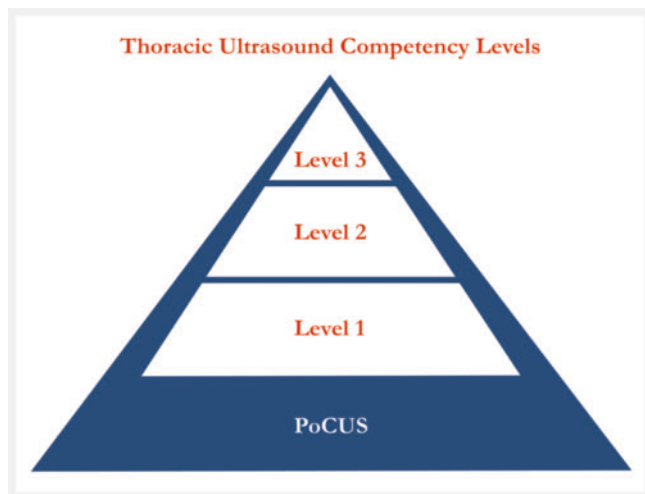
Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) die Ausbildungsanforderungen für Thoraxsonografie. Die Empfehlungen orientieren sich an den drei EFSUMB-Kompetenzstufen für die medizinische Ultraschallpraxis. Stufe 1 beschreibt die Fähigkeiten, die zur selbstständigen Durchführung grundlegender Thorax-Ultraschalluntersuchungen und -interventionen erforderlich sind, Stufe 2 umfasst fortgeschrittene transthorakale Ultraschallbildung und geführte Interventionen, während Stufe 3 die Anwendung der Thoraxsonografie auf hohem Niveau und den Einsatz modernster Technologien umfasst. Bisher wurde die Kompetenz anhand einer festgelegten Mindestanzahl von Ultraschalluntersuchungen bestimmt, doch in den letzten Jahren hat sich ein allgemeiner Trend zu kompetenzbasierten Schulungen und Bewertungen durchgesetzt. Für jede EFSUMB-Stufe beschreiben wir die theoretischen Kenntnisse und praktischen Fähigkeiten, die für die klinische Praxis erforderlich sind.

Introduction

Thoracic ultrasound (TUS) is used to visualize pathologies and provide clinical information about the chest wall, parietal pleura, pleural cavities, visceral pleura, lung tissue, diaphragm, upper and anterior mediastinal compartments, as well as related anatomical structures [1, 2]. The increased availability and mobility of ultrasound systems and rapidly growing evidence has made TUS a first-line imaging modality in many different specialties (e.g., respiratory medicine, emergency medicine, radiology, intensive care and anesthesiology) and clinical settings (e.g., prehospital, emergency room, hospital ward, operating theater, intensive care unit, outpatient clinic). TUS is especially useful when applied in a focused manner to answer clinically relevant dichotomous (yes/no) questions as part of a point-of-care ultrasound examination (POCUS) [3, 4]. Low costs, bedside implementation, and the lack of radiation exposure mean that TUS can be repeated as often as required. In recent years, TUS has also been increasingly used with more advanced ultrasound modalities (e.g. contrast-enhanced ultrasound (CEUS)) and advanced ultrasound-guided interventions and monitoring have been developed and implemented, especially within the field of respiratory medicine [1, 2, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19].

The increased use of clinical TUS has been proven to improve patient care and outcome [15, 20, 21]. However, TUS can be a complex and operator-dependent technique, requiring sufficient competency to allow both diagnostic ultrasound and ultrasound-guided interventions to be performed safely [22, 23]. In this paper we have considered TUS and other forms of chest imaging (e.g., chest X-ray (CXR), computed tomography (CT)) as methods that supplement each other. Local guidelines and availability will help the clinician to decide which method will be of most benefit to the patient.

This position paper of the European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) describes the training requirements for TUS in Europe. A group of specialists in ultrasound and thoracic ultrasound from across Europe including specialists in respiratory medicine, radiology, intensive care, anesthesiology, surgery, and internal medicine were invited to participate. A preliminary version was drafted by CBL and CE and circulated among the other authors. All comments and changes were incorporated in one document which was again circulated together with an accompanying letter stating the specific points where there were discrepancies among the experts. After the second round, only minor flaws remained that were checked by CBL and CE and re-circulated for consensus. The final version of the Position Paper has been approved by all members of the authors group and finally by the EFSUMB Executive Bureau. In recently published position papers, the EFSUMB has described general professional standards for medical ultrasound, advanced ultrasound techniques, ultrasound-guided interventions, and CEUS. The training recommendations presented here are based on EFSUMB's fundamental statements [24, 25, 26, 27, 28]. The training recommendations will follow the general principles of three competency levels for the practice of medical ultrasound used by EFSUMB and the Royal College of Radiologists and are aligned with the European Respiratory Society's certified training program in TUS regarding content [29, 30]. The rapid expansion, clinical implementation, and training with respect to TUS as part of PoCUS have led to significant overlaps between the more classic three competency levels and TUS performed with a PoCUS approach (► Fig. 1). TUS performed as part of PoCUS has, therefore, not been specified in this document, since it may involve aspects from different TUS levels as well as other types of ultrasound.



► **Fig. 1** Thoracic ultrasound competency levels.

Throughout the document the following terminology applies:

- PoCUS: PoCUS approach to TUS.
- TUS Level 1: involves the knowledge and skills needed to perform essential diagnostic TUS examinations and basic TUS-guided interventions independently.
- TUS Level 2: defines the knowledge and skills needed to perform more advanced real-time TUS-guided interventions and diagnostic examinations.
- TUS Level 3: involves training and practice on a more advanced level and requires additional knowledge of advanced ultrasound technologies and engagement in education and research.

Traditionally, the use of ultrasound-guided procedures has been considered EFSUMB level 2 by default. Ultrasound-guided diagnostic pleural puncture and ultrasound-guided pleural catheter insertion (i. e., real-time use of ultrasound to guide the needle or catheter) are, however, essential skills for any physician performing TUS level 1, since the finding of a pleural effusion may directly result in the immediate need for these interventions. Therefore, we have decided to consider these interventions as basic TUS-guided interventions and include them in competency level 1.

In the previously published EFSUMB training recommendations for TUS, the recommendations included the use of ultrasound when combined with endoscopic procedures [31]. Since then, the theoretical knowledge, clinical use, and required competencies of both “transthoracic” TUS and “endoscopic” TUS have expanded significantly and training and mentoring programs have now been subdivided into two separate categories. In order to reflect this division, we have decided to include only transthoracic ultrasound in this recommendation. Another important difference with regard to the previous TUS recommendation is a shift from a predefined minimum number of examinations as an indicator of competency to competency-based education where valid assessments are used to determine competency [22, 32, 33].

A systematic approach, a good and thorough technique, effective reporting including documentation of images, and clinical

integration of TUS findings into the given clinical context are mandatory for patient safety. TUS operators must acknowledge their limitations and decide when to ask for help from more experienced colleagues, or to consider other imaging modalities. All these aspects should, therefore, be included in TUS training. For each EFSUMB level, we will outline the required theoretical knowledge, detailed competencies, training, and assessment of TUS competency.

TUS – level 1

Necessary theoretical knowledge

Ultrasound physics, techniques, and clinical integration

Knowledge and understanding of:

- Basic ultrasound physics
- The generation of ultrasound images
- Types of transducers, their particular imaging characteristics, and their use
- Basic ultrasound controls (e. g., presets, gain, depth, focus, frequency)
- B-mode, M-mode, and Doppler ultrasound
- Common artifacts, including their physical fundamentals and specific role in TUS
- Technical applications for artifact suppression (e. g., Tissue Harmonic Imaging and Compounding) and their impact on the visualization of artifacts diagnostically relevant for TUS
- The indications for TUS
- The integration of TUS findings into the clinical context in accordance with relevant local, national, or international clinical practice guidelines
- The strengths, weaknesses, and limitations of TUS
- The advantages/disadvantages and risks of TUS and TUS-guided interventional techniques in comparison to alternative diagnostic and interventional tools (including safety aspects)

Knowledge of normal ultrasound anatomy of the chest and related structures

Detailed knowledge of the ultrasound anatomy of the chest wall, parietal pleura, pleural cavity, visceral pleura, lung tissue, and diaphragm and basic knowledge of the ultrasound anatomy of the mediastinum (upper/prevascular compartments).

Knowledge of the ultrasound patterns and signs seen in common pathologies in the thorax and related structures and relevant pitfalls

Chest wall:

- Fractures (e. g., rib, sternum, clavicle)
- Subcutaneous emphysema, edema, hematoma, and inflammatory infiltration
- Intercostal and accessory muscle respiratory effort
- Signs of possible malignancy (e. g., focal lesions, signs of direct invasive growth)
- Foreign bodies (e. g., catheters and drains)
- Diagnosis of benign processes such as lipomas

Parietal pleura and pleural cavities:

- Parietal pleural thickening, nodularity, and other findings (e.g., calcification)
- Pleural adhesions
- Pleural effusion incl. semiquantitative assessment of size, fluid characteristics such as septation/loculation, and signs indicating the cause of the effusion (e.g., pleural metastases/carcinosis)
- Pneumothorax incl. semiquantitative assessment of size

Visceral pleura and lungs:

- B-lines either present as focal pattern or “interstitial syndrome”
- Thickened and/or fragmented visceral pleura line and artifacts associated with pathologies of the visceral pleura and sub-pleural lung (comet tail artifacts)
- Common lung parenchymal pathologies causing a “lung consolidation” pattern (e.g., infectious pneumonia, pulmonary embolism, obstruction atelectasis, compression atelectasis, contusion, malignancy) and the corresponding ultrasound patterns seen in typical cases

Diaphragm:

- Abnormal shape, herniation, tumors or nodular change on the diaphragm
- Abnormal movement of the diaphragm

Competencies to be acquired

Preparation and ability to select and use the correct equipment

- Ability to choose the optimal patient positioning for a given clinical context
- Ability to decide if the available US system is sufficient for the application (for instance handheld devices should not be used for advanced TUS)
- Ability to choose the optimal transducer and presets to optimize an image (e.g., using gain, depth, focus, frequency, image optimization software).
- Ability to perform measurements and to insert pictograms/ annotations
- Ability to perform supplementary Doppler ultrasound for large vessel identification
- Ability to recognize important anatomical landmarks on the thorax and related anatomical structures

Systematic TUS examination, incl. related anatomical structures and assessment of region(s) of interest in two planes

- Ability to describe the location and character of a parietal pleural lesion (size, echogenicity, margins, general appearance, signs of invasive growth, possible diagnosis in case of typical appearance in the clinical context)
- Ability to describe the location and character of pleural effusions (semiquantitative size estimation, echogenicity, general appearance, septations, signs of possible malignancy, signs of possible underlying non-expandable lung)
- Ability to exclude and diagnose a pneumothorax (incl. semiquantitative size estimation)

- Ability to describe the location and character of visceral pleural abnormalities (B-lines/ comet tail artifacts, interstitial syndrome, thickened visceral pleura, fragmented visceral pleura) and to correlate the pattern to a possible diagnosis based on the clinical context.
- Ability to describe the location and character of lung parenchymal lesions (size, echogenicity, margins, general appearance)
- Ability to describe the shape of tumors or nodular abnormalities on the diaphragm
- Ability to assess respiratory effort and identify abnormal movement of the diaphragm

Interventional procedures

- Ability to use TUS for real-time puncture or drain insertion prior to performing a pleural puncture or insertion of a pleural catheter or drain
- Ability to use Doppler ultrasound to identify possible intercostal vessels at a chosen puncture or drain insertion site

Documentation and reflection

- Ability to write a detailed and systematic report of the ultrasound findings, differential diagnoses, and conclusion including clinical integration where appropriate
- Ability to perform comprehensive and standardized documentation of the ultrasound examination, including adequate acquisition and storage of images and video files
- Recognize limitations of personal expertise and limitations presented by scanning conditions or artifacts
- Describe the effect of limitations on diagnostic certainty and know when to ask for more expert advice or recommend other imaging modalities

Required training and assessment of ultrasound competencies

To meet the EFSUMB level 1 standard, the trainee should demonstrate basic knowledge of the normal and pathological sonoanatomy of the thorax and practical skills in performing a systematic TUS examination, image interpretation, documentation, optimal clinical integration, and medical decision making based on the TUS examination [2, 22, 23, 34]. For EFSUMB TUS level 1, we recommend an approach in which the TUS training and competency assessment are fully integrated in each training step as described below. Several competency assessment tests have been developed and validated making this stepwise approach possible in an evidence-based manner [35, 36, 37, 38, 39, 40, 41]. A comprehensive evidence-based training program including all these steps has been developed and described [42].

We recommend the following stepwise approach:

Step 1a – theoretical TUS knowledge: The TUS core knowledge described above can be obtained through lectures, online material, alternative knowledge platforms (e.g., virtual reality), courses, or textbooks. The material may be part of an ultrasound training program endorsed by EFSUMB, national ultrasound societies, or national or international medical societies offering training curriculum in TUS.

Step 1b – theoretical knowledge assessment: The TUS core knowledge obtained as part of step 1a is tested using a validated test. A validated multiple-choice questions (MCQ) test has been published, and the test is available upon request [37]. The TUS core knowledge test for EFSUMB level 1 should be passed before proceeding to step 2.

Step 2a – TUS practical skills: The TUS skills should be obtained as part of a practical “hands-on” course. A significant proportion of the course time should be reserved for “hands-on” ultrasound training on volunteers and real patient cases. Simulators or phantoms with typical pathological findings can be used as a partial substitute for real patient cases. In settings with limited resources or special scenarios (e.g., COVID-19 pandemic), travelling for participation in a practical “hands-on” course may not be a feasible option. Web-based training courses may in these cases be the only alternative to no training. Hence, step 2a, can be modified but should always be followed by steps 3a and 3b to ensure sufficient bedside clinical training and assessment prior to certification.

Step 2b – TUS skills assessment: The hands-on course (step 2a) should include a post-course assessment of the obtained skills to ensure that the trainee has reached a sufficient level prior to proceeding to step 3. The assessment should include direct observation of the trainee performing a TUS examination. The examination by the trainee should be assessed with a validated assessment tool by a practitioner who has reached EFSUMB level 2 or a corresponding level. Several types of assessment tools have been validated for such use (e.g., Objective Structured Assessment of Ultrasound Skills (OSAUS) and a simulator-based assessment) [35, 36, 38, 39]. If step 2a is conducted as an online course, we recommend the trainee still be tested using the principles described above. The test can be performed locally at the trainee’s institution by a practitioner who has reached at least EFSUMB level 2 or a comparable qualification level from a national ultrasound society or a national or international medical society offering TUS training curricula.

Step 3a – TUS clinical training: After completing steps 1–2, the trainee should perform a reasonable number of ultrasound examinations and basic TUS interventions (depending on local/national requirements and practice under supervision) to qualify for a skills assessment for level 1 certification. The scanned cases should include an appropriate range of normal and abnormal cases. We recommend that mentorship and supervision of training should be provided by a practitioner who has reached at least EFSUMB level 2 or a comparable qualification level from a national ultrasound society or a national or international medical society offering TUS training curricula (e.g., societies for radiology, respiratory medicine, emergency medicine, anesthesiology, intensive care, pediatrics). If no local or national guidelines exist, we recommend at least 30 supervised and approved examinations being performed on a regular basis during a three-month period prior to proceeding to step 3b.

Step 3b – TUS final assessment and certification: The final competency assessment should include direct observation of the trainee performing a TUS examination and questioning with regard to the interpretation and clinical integration of the TUS examination. The ultrasound examination by the trainee should be assessed with a validated assessment tool (e.g. OSAUS) [35, 36, 38, 39],

by a practitioner who has reached EFSUMB level 2 or 3 or a corresponding level. Observations of several TUS examinations of different cases with a variation of findings are recommended to ensure reliable assessment. Recently, an Objective Structured Clinical Examination (OSCE) has been validated for performing the final assessment. The TUS OSCE is based on five assessment stations that the trainee must pass. The five stations incorporate two MCQ tests, two procedures on simulated patients assessed using OSAUS and a simulator-based test [41]. Video-recorded ultrasound exams could also be used as a more flexible alternative for the assessment of ultrasound skills if direct observation of performance is impossible, but since validated video-based assessment tools are currently lacking, this approach is generally not recommended. EFSUMB level 1 standards will have been met when the trainee has followed the recommendations above and passed a competency-based assessment approved by EFSUMB or an international medical society offering TUS training curricula as mentioned above.

TUS – level 2

Necessary theoretical knowledge

Knowledge and understanding of:

- The principles of real-time ultrasound-guided interventions and how to optimize needle visualization
- The different techniques for real-time ultrasound-guided interventions, including use of needle-guide or freehand technique and in-plane and out-of-plane techniques
- The different needle types and equipment used for fine-needle aspiration (FNA) and core biopsy (CB), and optimal use of these depending on the clinically suspected diagnosis and the target structure
- The assessment and planning of the optimal TUS-guided access path in order to avoid and minimize the risk of complications (e.g., pneumothorax, hemorrhage)
- The handling of specimens depending on the cytopathology/histopathology/microbiology/biochemical analyses needed (e.g., smearing on microscope slides, basic assessment of adequacy of obtained specimens, applying fixation techniques, cell block or liquid-based cytology, optimal handling of pleural fluid)
- The general principles of the TNM staging of the most common thoracic malignancies including consequences for further management
- The clinical guidelines for the use of indwelling pleural catheters (IPC)
- The principles of ultrasound-guided intercostal nerve blocks (ICNB)
- Observation and treatment strategies for common and uncommon severe complications to TUS-guided interventions and biopsies (e.g., pneumothorax, hemothorax, infection, air embolism)
- The principles of quantitative TUS for assessment of lung parenchymal pathology (e.g., computation of the lung ultrasound score, B-lines score)

- The principles of quantitative assessment of diaphragmatic function (M-mode, area method)
- The principles of TUS for the quantification of lung loss of aeration and the integration of quantitative TUS in the monitoring and management of acute respiratory failure and acute respiratory distress syndrome (ARDS), requiring invasive or noninvasive respiratory support or extracorporeal membrane oxygenation (ECMO)

Competencies to be acquired

Depending on the specialty and clinical field of practice, four of the bullets below should be achieved.

- Ability to clinically integrate and use TUS for optimal selection of patients for advanced real-time TUS-guided interventions and other non-TUS-guided invasive diagnostic or therapeutic procedures in the thorax (e.g., thoracoscopy, pleurodesis, endoscopic, or transbronchial procedures)
- Ability to evaluate signs of invasive growth
- Ability to clinically integrate and use TUS to monitor and guide mechanical ventilation
- Ability to perform safe and accurate real-time ultrasound-guided FNA and CB of the chest wall, pleura, lung, mediastinal lesions as well as grossly abnormal structures in the axillary, supra/infracavicular regions, and lower neck
- Ability to perform an ultrasound-guided IPC insertion
- Ability to use ultrasound to assess and monitor the success and potential complications of a pleurodesis procedure
- Ability to perform an ultrasound-guided ICNB
- Ability to use TUS to diagnose, monitor, and guide treatment of complications to ultrasound-guided procedures and other invasive procedures (e.g., thoracoscopy, transbronchial lung biopsies) in the thorax (e.g., pneumothorax, hemothorax, infection)
- Ability to perform quantification of diaphragmatic movement (e.g., M-mode, Area method)
- Ability to perform quantitative TUS for the assessment of lung parenchymal pathology (e.g., computation of the lung ultrasound score, B-lines score)
- Ability to correctly quantify lung loss of aeration to phenotype acute respiratory failure including ARDS, to guide respiratory treatments, and to monitor lung aeration in patients with acute respiratory failure requiring invasive or noninvasive mechanical ventilation or ECMO.

Required training and assessment of competencies

As is the case with TUS competency level 1, a stepwise approach is recommended for level 2:

Step 1a – theoretical knowledge regarding advanced TUS and TUS-guided interventions: The knowledge described above can be obtained through online materials, alternative knowledge platforms (e.g., virtual reality), or textbooks. The materials used should be part of an ultrasound training program or a course endorsed by EFSUMB, national ultrasound societies, or national or international medical societies offering TUS training curricula.

Step 1b – theoretical knowledge assessment: The knowledge obtained as part of step 1a is tested using an MCQ test. Currently no

validated tests have been published and, until such a test is available, the MCQ test should be designed in agreement with the general recommendations for construction and use of MCQ tests. The TUS core knowledge test for EFSUMB level 1b should be passed before proceeding to step 2.

Step 2a – practical skills for advanced TUS-guided interventions: The advanced practical knowledge and skills for TUS-guided interventions should be obtained as part of a practical “hands-on” course. At least half of the course time should be reserved for “hands-on” ultrasound training on simulators or phantoms with typical pathological findings.

Step 2b – assessment of practical skills for advanced TUS-guided interventions: The practical hands-on course (step 2) should include a post-course assessment of the obtained practical knowledge and skills, to ensure a sufficient level before proceeding to step 3. The skill assessment should include direct observation of the trainee performing an advanced TUS-guided intervention on a phantom or simulator. A generic assessment tool (e.g., Interventional Ultrasound Skills Evaluation (IUSE)) can be used until dedicated validated assessment tools for the specific advanced TUS-guided interventions become available [43, 44]. The examination by the trainee should be assessed by a practitioner who has reached EFSUMB level 2 or a corresponding level.

Step 3a – clinical training for advanced TUS-guided interventions: After completing steps 1–2, the trainee should perform a reasonable number of advanced TUS-guided interventions (depending on local/national requirements and practice under supervision) to qualify for a skill assessment for level 2 certification. The interventions should include an appropriate range of clinical cases and technical difficulty. We recommend that mentorship and supervision of training should be provided by a practitioner who has reached at least EFSUMB level 3 or a corresponding level. The clinical, technical, and practical difficulty of the procedures listed as “level 2” vary significantly. Additionally, the content of level 2 training will vary from specialty to specialty. Furthermore, there is no evidence to support a fixed number of examinations or time to obtain proficiency [32, 33]. Hence, it is not possible to provide an evidence-based recommendation for a predefined minimum required number of interventions prior to proceeding to step 3b. For all examinations they should be performed on a regular basis for at least a six-month training period prior to proceeding to step 3b.

Step 3b – final assessment and certification: The final competency assessment should include direct observation of the trainee performing each of the advanced TUS-guided procedures described above on a phantom or simulator. The procedure can be assessed using a generic assessment tool until specific assessment tools have been validated and published [43]. The assessment should be performed by a practitioner who has reached at least EFSUMB level 3 or a corresponding level. Whenever possible, the practitioner performing the assessment should be an external examiner. If this is not feasible, an internal practitioner who has not been mentoring the trainee can serve as an alternative. Video-recorded advanced TUS-guided interventions could also be used as a more flexible alternative for the assessment of ultrasound skills if direct observation of performance is impossible. However, since validated assessment tools are currently lacking,

this approach is generally not recommended. EFSUMB level 2 certification is obtained when the trainee has followed the recommendations above and passed a competency-based assessment approved by EFSUMB or another international medical society offering TUS curricula.

TUS – level 3

Necessary knowledge

- Knowledge of the principles of advanced ultrasound technologies such as elastography and contrast-enhanced ultrasound (CEUS) and their relevance for thoracic imaging
- Ability to describe the ultrasound characteristics of rare pathologies in the thorax
- Profound knowledge of the state of the art in thoracic ultrasound and, if possible, active scientific activity in this field

Competencies to be acquired

- Ability to perform diagnostic TUS at an advanced level with a representative number of rare or demanding pathologies
- Ability to use advanced technologies such as elastography or CEUS as a supplementary diagnostic tool or to guide TUS-guided interventions [12, 17, 28, 45]
- Acceptance of referrals from level 1 and level 2 practitioners and undertaking of more complex ultrasound examinations
- Ability to use required skills to develop advanced services under appropriate governance
- Mentoring and supervision of level 1 and 2 trainees and practitioners
- Either participation in or experience with faculty-level teaching of ultrasound courses at the local, national, or international level
- Profound knowledge of the state of the art in thoracic ultrasound and, if possible, active scientific activity in this field

Required training and assessment of competencies

Advanced diagnostic ultrasound skills are required, and physicians should regularly perform TUS corresponding to TUS level 2 for at least 12 months to obtain level 3 certification. It is also a requirement to be involved in teaching and, if possible, ultrasound research. Candidates for level 3 certification need to document the above-described competencies, which should be assessed by EFSUMB experts or experts from corresponding international medical societies offering TUS training curricula.

Maintenance of TUS skills – all levels

Practitioners should regularly, on a weekly basis, perform or supervise TUS examinations and relevant TUS-guided procedures to maintain competence. There should be continuing professional development and updating of practice. Attendance at appropriate ultrasound courses or conferences relevant to TUS and its clinical use, together with regular reviews of the current literature, are expected. Operators that undergo prolonged periods of time (> 12 months) without exposure to TUS should repeat the relevant

competency tests prior to re-starting clinical TUS. If the competency tests are not passed, structured training and assessment as described in this position paper should once again be completed before re-starting clinical TUS. The amount of time to be considered a prolonged period of time will be defined on an individual basis based on skill level and experience prior to the period without exposure to TUS.

Conflict of Interest

Christian B. Laursen: Lecture fees from AstraZeneca, Chiesi Pharma, GlaxoSmithKline Pharma, Boehringer Ingelheim.

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