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Curriculum for diagnostic endoscopic ultrasound training in Europe: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement

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Abstract:
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<main rec>MAIN RECOMMENDATIONS

The European Society of Gastrointestinal Endoscopy (ESGE) has recognized the need to formalize and enhance training in diagnostic endoscopic ultrasound (EUS). This manuscript represents the outcome of a formal Delphi process resulting in an official Position Statement of the ESGE and provides a framework to develop and maintain skills in diagnostic EUS. This curriculum is set out in terms of the prerequisites prior to training; the recommended steps of training to a defined syllabus; the quality of training; and how competence should be defined and evidenced before independent practice.

1 Trainees should have achieved competence in upper gastrointestinal endoscopy before training in diagnostic EUS.

2 The development of diagnostic EUS skills by methods that do not involve patients is advisable, but not mandatory, prior to commencing formal training in diagnostic EUS.

3 A trainee’s principal trainer should be performing adequate volumes of diagnostic EUSs to demonstrate maintenance of their own competence.

4 Training centers for diagnostic EUS should offer expertise, as well as a high volume of procedures per year, to ensure an optimal level of quality for training. Under these conditions, training centers should be able to provide trainees with a sufficient wealth of experience in diagnostic EUS for at least 12 months.

5 Trainees should engage in formal training and supplement this with a range of learning resources for diagnostic EUS, including EUS-guided fine-needle aspiration and biopsy (FNA/FNB).

6 EUS training should follow a structured syllabus to guide the learning program.

7 A minimum procedure volume should be offered to trainees during diagnostic EUS training to ensure that they have the opportunity to achieve competence in the technique. To evaluate competence in diagnostic EUS, trainees should have completed a minimum of 250 supervised EUS procedures: 80 for luminal tumors, 20 for subepithelial lesions, and 150 for pancreaticobiliary lesions. At least 75 EUS-FNA/FNBs should be performed, including mostly pancreaticobiliary lesions.

8 Competence assessment in diagnostic EUS should take into consideration not only technical skills, but also cognitive and integrative skills. A reliable valid assessment tool should be used regularly during diagnostic EUS training to track the acquisition of competence and to support trainee feedback.

9 A period of supervised practice should follow the start of independent activity. Supervision can be delivered either on site if other colleagues are already practicing EUS or by maintaining contacts with the training center and/or other EUS experts.

10 Key performance measures including the annual number of procedures, frequency of obtaining a diagnostic sample during EUS-FNA/FNB, and adverse events should be recorded within an electronic documentation system and evaluated.</main rec>

SCOPE AND PURPOSE

This Position Statement is an official statement of the European Society of Gastrointestinal Endoscopy (ESGE). It provides recommendations for a European core curriculum aimed at providing high quality training in diagnostic EUS. The recommendations presented are based on a consensus among endoscopists considered to be experts in the field of EUS who are involved in training and training courses in Europe.

Abbreviations

AE adverse event

ASGE American Society for Gastrointestinal Endoscopy

BSG British Society of Gastroenterology

CH-EUS contrast harmonic endoscopic ultrasound

CLT cognitive load theory

CUSUM cumulative sum

EFSUMB European Federation of Societies for Ultrasound in Medicine and Biology

ERCP endoscopic retrograde cholangiopancreatography

ESGE European Society of Gastrointestinal Endoscopy

EUS endoscopic ultrasound

EUS-E EUS-elastography

EUS-TA EUS-guided tissue acquisition

FNA fine-needle aspiration

FNB fine-needle biopsy

GAPS-EUS Global Assessment of Performance and Skills in EUS

GI gastrointestinal

TEESAT The EUS and ERCP Skills Assessment Tool

UGI upper gastrointestinal

VR virtual reality

Introduction

Over the three last decades, endoscopic ultrasound (EUS) has become an indispensable tool in the management of pancreaticobiliary, gastrointestinal (GI), and mediastinal diseases. Training in EUS is considered a long and challenging process, requiring optimal training conditions and a major personal investment. Many factors can influence the learning curve and the quality of training.

Training in EUS requires a standardized approach, which the European Society of Gastrointestinal Endoscopy (ESGE) has tried to define through the development of curricula. A curriculum in endoscopic retrograde cholangiopancreatography (ERCP)/EUS training in Europe has been already been developed, and was published in 2021 [1]. Therefore, ESGE next decided to focus specifically on diagnostic EUS training in developing a curriculum that will guide endoscopists in becoming competent in this field. Guidance for standardized training in diagnostic EUS for trainees and trainers, respecting the quality indicators, is essential and of paramount importance.

The 30 recommendations presented in this curriculum are based on a consensus among endoscopists considered to be experts in diagnostic EUS who are strongly involved in training. These recommendations are given along with their quality of evidence and strength of recommendation in **Table 1**.

In 2017, the ESGE board convened the Curricula Working Group, which was responsible for developing curricula that defined the minimum training standards for more advanced and therapeutic endoscopic practice that may often go beyond the core endoscopy training curricula in each country. This process has been outlined previously [2] and Position Statements on six endoscopy topics have been already published [1,3–7].

Aims

The aim of this position statement is to recommend best practice to optimize diagnostic EUS training in Europe, based on the currently published evidence and knowledge. This paper focuses on training, and aims to help trainees develop, evidence, and maintain their skills in diagnostic EUS.

Methods

This curriculum was developed through a Delphi consensus process among international experts in diagnostic EUS [8].

In October 2021, T.T. (Chair of the Curricula Working group) invited A.B. to be the section chair for the diagnostic EUS training curriculum. After an open call via ESGE communication in November 2021, T.T. and A.B. selected a working group of 14 EUS practitioners among more than 50 applicants to ensure that they were broadly representative in terms of their wide range of expertise in diagnostic EUS training, level of clinical experience, clinical background, sex, and nationality.

The first meeting of the working group was in January 2022. At this meeting, the overall aims of the project were defined, and the methodology was agreed. From three principal domains, previously defined by the ESGE [9], specific questions were developed using the Population, Intervention, Comparator, Outcome (PICO) format where possible:

(i) preadoption requirements to start diagnostic EUS training

(ii) training modules and learning methods to achieve competency in diagnostic EUS

(iii) definition and assessment of competence in diagnostic EUS, including maintaining competence after training.

The group was organized into five subtaskforces that covered the above domains, and one or two group members were nominated as the leads for each subgroup. A Delphi process was then used to review the evidence and develop consensus statements for each domain.

Each domain was the subject of a systematic literature review. Any publications emerging during the Delphi process and manuscript writing were also considered for inclusion. Statements were drafted based on this evidence and subjected to an appraisal using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework [1,3–7,10]. When a paucity of evidence was noted in an aspect of training that was deemed important, the groups relied on expert opinion to develop statements that were then fed into the Delphi process.

Two rounds of anonymous online voting on the categorized statements were necessary and took place in December 2022 and March 2023. In addition to the 16 working group members, 18 of the initial applicants to the curriculum who were not part of the working group also participated in the voting rounds. All of the rounds of anonymous electronic voting were based on a 5-point Likert scale, ranging from "Strongly disagree" through to "Strongly agree." Any statement that received at least an 80% level of "agreement" or "strong agreement" was accepted.

Taskforce meetings were held after each voting round to allow the statements to be discussed and modified based on the feedback in order to improve their acceptability without altering their sense.

1 Preadoption requirements for training in diagnostic EUS

A Preadoption requirements for trainees

<rec>RECOMMENDATION 1

Trainees should have achieved competence in upper gastrointestinal endoscopy before training in diagnostic EUS.

Level of agreement 100%.</rec>

<rec>RECOMMENDATION 2

Competence in sigmoidoscopy is desirable for training in rectal EUS.

Level of agreement 91%.</rec>

Trainees should have achieved competence in upper GI (UGI) endoscopy (at least 300 gastroscopies and meeting the ESGE quality measures for UGI endoscopy) with a minimum 18-month practical training period, and be qualified to perform and credentialed in basic endoscopy at an independent level. Diagnostic EUS is a technically challenging endoscopy procedure and requires substantial technical and interpretational skills, with an extensive knowledge of anatomy. Maneuvering the echoendoscope into the standard positions to obtain optimal endosonographic images of the areas of interest requires proficiency in diagnostic gastroscopy, as defined by the ESGE performance measures. Experience in sigmoidoscopy is desirable for rectal ultrasonography [1,11–14].

<rec>RECOMMENDATION 3

Experience in the interpretation of abdominal imaging such as transabdominal ultrasonography and other imaging modalities is advisable, but not mandatory, prior to commencing training in diagnostic EUS.

Level of agreement 91%.</rec>

EUS is a complex endoscopy procedure to learn. Thorough experience in the understanding of normal three-dimensional anatomy (i.e. vessels, organs, ducts) of the chest, upper abdomen, and pelvis is recommended prior to commencing training in diagnostic EUS to understand extraluminal abdominal and thoracic malignancies, and should be adapted for tumor (T), nodal (N), and metastases (M) staging. Experience in abdominal ultrasound will facilitate the recognition of the normal anatomy and pathology of organs. Ultrasound image pattern recognition is important for identifying peridigestive organs, allowing better EUS navigation and recognition of pathologies. This could improve the learning time through recognition of the landmark anatomies of EUS and ability to identify the presence or absence of abnormalities [11,15].

<rec>RECOMMENDATION 4

The development of diagnostic EUS skills by methods that do not involve patients is advisable, but not mandatory, prior to commencing formal training in diagnostic EUS.

Level of agreement 96%.</rec>

EUS training on models probably improves and accelerates the later practical learning process in the clinical setting. Examples of such models are ex vivo models, phantoms, virtual simulators, and virtual anatomic diagnostic slide shares. In addition, the early acquisition of cognitive skills is advisable and would probably improve and shorten the period of training needed to become an independent performer. Methods for acquiring cognitive skills include, but are not limited to, observational periods, self-taught courses, teaching videos, textbooks in EUS and anatomy, atlases, DVDs, didactic sessions, live courses in person or virtual (congress, universities, others), and formal EUS training programs [11,14].

<rec>RECOMMENDATION 5

Experience in ERCP is helpful, but not mandatory, prior to commencing training in biliopancreatic diagnostic EUS.

Level of agreement 84%.</rec>

EUS and ERCP are mainly used in pancreatic and biliary disease. Both procedures require similar cognitive skills in terms of the endoscopic diagnosis and treatment of these pathologies. The two procedures may complement each other or be substituted for each other in certain indications over time. Endoscopes for ERCP and EUS are more difficult to use than regular gastroscopes, demanding new physical skills for successful manipulation [1]. Moreover, learning ERCP requires good endoscopy skills, that will probably facilitate the learning of EUS.

For ESGE, ERCP skills are not a formal prerequisite for diagnostic EUS, nor is it envisaged that diagnostic EUS endoscopists should also be trained in ERCP. It is however conceivable that, for EUS trainees planning to learn therapeutic EUS, the cognitive and technical ERCP skills may be useful [1].

B Preadoption requirements for trainers and training centers

<rec>RECOMMENDATION 6

A trainee's principal trainer should ideally have more than 3 years' experience of independent diagnostic EUS practice.

Level of agreement 84%.</rec>

<rec>RECOMMENDATION 7

A trainee's principal trainer should be performing adequate volumes of diagnostic EUSs to demonstrate maintenance of their own competence.

Level of agreement 100%.</rec>

<rec>RECOMMENDATION 8

A trainee's principal trainer should be aware of the current management protocols in digestive neoplasms, should be involved in the multidisciplinary teams of their institution for decisions regarding the management of GI and pancreaticobiliary diseases, and should have a good knowledge of diseases managed with diagnostic EUS.

Level of agreement 98%.</rec>

In the previously published position statement on EUS training, ESGE proposed a minimum of 250 EUS procedures before a trainee is likely to demonstrate acceptable performance measures and competence [1]. Considering this factor and also that a trainee's principal trainer should perform adequate volumes of diagnostic EUSs to maintain their own competence, it follows that a reasonable volume of procedures could be 500 per year per center, unless the trainer has a long experience in EUS, in which case a lower number of procedures per year would be acceptable.

What makes a good trainer in EUS has never been specifically investigated. No good quality evidence can therefore be given for the above statements; however, in the previously published ESGE position statement on ERCP and EUS training, it is said that a trainer should ideally have more than 3 years' experience [1]. It follows that a practitioner's experience as an endosonographer likely influences their effectiveness as a trainer. Nonetheless, there are no data to substantiate this. We think that the number of procedures to maintain experience may vary over time: it could be 300 procedures/year at between 5 and 10 years' experience, but a little less maybe 200 procedures/year after 10 years. A good EUS trainer has to be involved in the working groups or committees for decisions in esophageal, gastric, rectal, and pancreaticobiliary cancer of their institution. Being part of the multidisciplinary approach to these diseases is crucial for optimizing the possibilities in diagnostic EUS.

Several studies have however been performed on other important aspects that define an effective endoscopy trainer, mainly using colonoscopy as an example. One of these aspects is cognitive load theory (CLT), which states that an individual's working memory can only process a finite amount of information at the time. Multiple studies performed by Sewell et al. tried to identify the best teaching skills, making use of the

CLT [16,17]. They found that even good teaching techniques had detrimental effects when used excessively. Therefore, the overall advice is to teach more reservedly during the procedure and to take advantage of pre- and post-procedure opportunities [16]. Moreover, the level of experience and competence of learners should be balanced with procedural complexity; part-task approaches and scaffolding may be beneficial, teachers should remain engaged, and factors within the procedural setting that may interfere with learning should be minimized [18].

Further papers have underlined these teaching skills [19,20], and have recommended trainers undertake a recognized “train the endoscopy trainer” course. Such specific courses are designed to improve their skills as trainers, for instance providing a framework for effective feedback and setting goals for each session. It seems plausible that these aspects can be extrapolated to EUS trainers.

<rec>RECOMMENDATION 9

Training centers for diagnostic EUS should offer expertise, as well as a high volume of procedures per year, to ensure an optimal level of quality for training. Under these conditions, training centers should be able to provide trainees with a sufficient wealth of experience in diagnostic EUS for at least 12 months.

Level of agreement 100%.</rec>

<rec>RECOMMENDATION 10

Training centers for diagnostic EUS should ideally be able to facilitate trainee involvement in multidisciplinary meetings and provide support for trainee involvement in research, and service and quality improvement initiatives.

Level of agreement 98%.</rec>

Training centers for diagnostic EUS should offer the minimum criteria to deliver quality training. One of the most critical aspects for centers where training takes place is the expertise. Training in diagnostic EUS should be performed in centers with a reasonably high volume of procedures per year, along with experienced and motivated trainers who can monitor the performance of the trainee through all phases of their training [21,22]. Training centers should implement an optimal and standardized assessment of the trainee's technical and cognitive competence [12].

Training centers that can provide adequate procedure experience for diagnostic EUS are likely to be referral centers/specialist centers for patients with pancreaticobiliary disorders and oncologic centers requiring the support of an advanced endoscopy service. It is recognized that regional hospitals providing an effective and important ERCP and EUS service play a vital role in training; however, trainees will benefit from spending a significant proportion of their time in specialist centers that can provide a multidisciplinary environment for the management of patients.

It has been shown that procedure experience is an important determinant of competence [23,24], but in addition there is evidence from UK colonoscopy training that the intensity of training (the rate at which cases are accrued) may have a positive effect on training [22]. It follows therefore that EUS training should include a significant period of time in a high volume center, which will ensure that a trainee is able to undertake a sufficient volume of procedures in a short amount of time to achieve competence. This means that a teaching program in diagnostic EUS should provide numbers of EUS procedures that substantially exceed the numbers of procedures required for minimum competency. These centers will provide the trainee with experience of all aspects of the syllabus, such as procedure planning, involvement in the planning of interventional strategies, management of complications, and trainee involvement in the whole inpatient stay. Nevertheless, there is ongoing disparity between the limited number of training centers and the increasing number of trainees pursuing training or eager to train in EUS [25].

2 Training/learning steps in diagnostic EUS: training modules and learning methods

<rec>RECOMMENDATION 11

Trainees should engage in formal training and supplement this with a range of learning resources for diagnostic EUS, including EUS-guided fine-needle aspiration and biopsy (FNA/FNB).

Level of agreement 98%.</rec>

As an advanced endoscopy procedure and given its technical complexity, diagnostic EUS procedures, including EUS-guided fine-needle aspiration (FNA) and fine-needle biopsy (FNB), require substantial technical skills and extensive cognitive and integrative knowledge that are acquired with a presumed long learning curve.

Two methods for learning diagnostic EUS have been reported: formal training, consisting of fellowship in a dedicated training center; and informal training, consisting of repeated short sessions of various didactic situations, usually including short “hands-on” experiences [12,26–28]. An international survey has demonstrated that current programs for EUS training vary widely across Europe and underlined the need for structured training and certification [29], as also exemplified by another survey [30]. Formal EUS training programs exist in only a few countries. In Europe, France and Belgium have by far the most advanced training curriculum in EUS, which are accepted for credentialing and taught in French and English, respectively [27].

The training curriculum should be founded on theoretical, clinical, and technical knowledge. Learning methods include theory sessions and hands-on training. Formal educational courses (lectures, live endoscopy demonstrations, workshops), defined as structured courses with clear learning objectives, expert faculties, and a range of goals, are considered to be helpful [1,11,31,32]. If national or regional training organizations are in place, they should ensure quality assurance of their courses.

Self-directed teaching by textbooks, videos, DVDs, e-learning tools, and guidelines should be considered as a basis for EUS training, with the aim of improving knowledge, and the trainee's ability to interpret findings and differentiate pathology from normal anatomy. It is important that this knowledge base and practices developed from it are based on quality evidence.

<rec>RECOMMENDATION 12

Training in diagnostic EUS should start first with the observation of EUS procedures on patients and, when available, training on simulators should begin with computer-based and mechanical models in the early phases, followed by ex vivo or in vivo animal simulators for more advanced training.

Level of agreement 93%.</rec>

To achieve competence in echoendoscope manipulation and EUS understanding, three-dimensional recognition of anatomy and ultrasonographic interpretation is required. Traditionally, EUS training has been based on an apprenticeship model on patients; however, in addition to EUS being highly operator-dependent, training on patients is becoming increasingly complex owing to issues related to inaccurate diagnosis, procedure safety, and patient permission. Taking this into account, several simulation models have been developed to facilitate EUS training in a safe environment for patients. Potentially, EUS simulation training could be advocated in a structured training program, combined with complementary learning methods (such as formal training courses and e-learning tools) and starting before hands-on learning. Simulators offer a risk-free solution for gaining competencies in endoscopy procedures at the trainee's own pace. Contrasting with the traditional hands-on training, simulation-based training allows trainees to repeatedly perform a specific set of tasks without increasing the duration of the real procedure and/or reducing a patient's comfort or safety.

For EUS, simulators can be divided into the following categories [33–38]: phantoms, in vivo and ex vivo animal models, and computer-based/virtual reality (VR) simulators. Several publications have reported the advantages and limitations of each type of simulator [36–49], which are summarized in **Table 1s**, see online-only Supplementary material. Their value appears to be complementary, rather than being mutually exclusive, as each could be useful in achieving different and specific steps of EUS training.

Matsuda et al. [37] conducted a survey asking several EUS experts to mark the utility of each of the learning tools relative to what stage the trainees were on their learning curve, and concluded that:

– computer-based/VR simulators were recommended right at the beginning of training, scoring highest for "doing EUS without FNA," followed by "before starting EUS fellowship"

– ex vivo animal models and EUS phantoms were recommended next "just before starting EUS-FNA"

– live pigs were recommended throughout the training process.

Taking these findings into account and in line with recommendations from other endoscopy procedures [1], EUS training could evolve as follows: beginning with basic endoscopy; moving onto basic hands-on training and VR simulators for very early training; followed by mechanical and ex vivo animal simulators; and finally EUS-FNA hands-on training and in vivo porcine training for more advanced endoscopy training.

Validation and health economic evaluation studies are still lacking for EUS simulators. A systematic review in training and competence assessment in GI endoscopy proposed the implementation of simulator training in GI endoscopy training curricula, given its potential for speeding up the early learning curve [28]. Specifically in EUS, some reports have suggested that they may indeed represent an overall aid in education [37,40–42,47,48,50,51]. Nonetheless, to date, there are no validation or clinical studies evaluating how these models affect the overall learning curve in EUS and whether they improve clinical outcomes. Furthermore, results from a recently published web-based survey have shown that only 51.2% of expert departments in EUS reported the availability of endoscopy simulators [29].

As such, recommendations can only be based on limited evidence. At present, simulators can be used in informal training moments and in organized short-term intensive training (1- or 2-day workshops, including didactic lectures, skills demonstration by experts, and hands-on training). Additional evidence is needed to determine the precise role of these EUS simulators and to consider the adoption of simulator training as a complement to supervised formal training.

<rec>RECOMMENDATION 13

Training with a linear echoendoscope should be mandatory, and this may be complemented by training with a radial echoendoscope when available.

Level of agreement 95%.</rec>

Primary training with a radial scanning echoendoscope has not been shown to improve performance for subsequent training with a linear-array echoendoscope. A prospective randomized comparative study, including 200 patients undergoing evaluation of the pancreaticobiliary region with either radial or curved linear-array echoendoscopes [36,52], demonstrated non-inferiority in the overall imaging capability of the two types of scope, whereas the radial scope was superior in delineating the major duodenal papilla and gallbladder, and for EUS-guided pylorus traversing [53]. Kim et al. showed that a curved linear-array echoendoscope provided a more complete examination of the pancreas [33] and Kaneko et al. demonstrated that a curved linear-array echoendoscope was superior to a radial scope in delimiting the pancreatic head–body transition area, the pancreatic tail, the area from the hepatic portal region to the superior bile duct, and the vascular bifurcation [53].

Radial-scanning echoendoscopes provide a 360° view and have been shown to offer advantages for diagnostic EUS procedures for upper and lower GI malignancies, especially for locoregional tumor staging, and anorectal and pelvic exploration [54,55]. Nevertheless, linear EUS was recently shown to be equally effective, compared with radial EUS, in scanning the esophagus and mediastinum [56]. Radial EUS is preferred for examination of the anal canal, whereas linear EUS is preferred for rectal and pararectal examinations [57]. Furthermore, competence in linear-array EUS is essential to be able to undertake tissue acquisition and to perform EUS-guided interventional procedures.

Therefore, ESGE states that training with a curved linear-array echoendoscope should be mandatory. Furthermore, the EUS training may then be supplemented with training on a radial scanning echoendoscope when available.

<rec>RECOMMENDATION 14

EUS-FNA/FNB should be included early in training, as soon as the basic skills for safe and stable scope handling have been achieved.

Level of agreement 93%.</rec>

The appropriate time to introduce the trainee to EUS-FNA/FNB has been a matter of debate. Some authors advocate previous experience with basic EUS before the introduction of EUS-FNA/FNB [58]. Others consider that it is appropriate and safe for the patient to perform EUS-FNA/FNB earlier in training [59,60]. Therefore, the ESGE curriculum working group suggests commencing supervised EUS-FNA/FNB early in training, once the identification of basic anatomic structures and common pathologic abnormalities based on EUS patterns, and basic skills for safe scope handling have been achieved [1].

<rec>RECOMMENDATION 15

Adequate competence in diagnostic EUS is a prerequisite before training in EUS image-enhancement techniques, such as elastography (EUS-E) and contrast harmonic EUS (CH-EUS).

Level of agreement 100%.</rec>

The ancillary EUS image-enhancement techniques, such as elastography (EUS-E) and contrast harmonic EUS (CH-EUS), provide information regarding stiffness and microvascularization, respectively, of the target lesion and surrounding tissue, and can help in differentiating lesions, especially solid pancreatic masses, when EUS-FNA/FNB is inconclusive [61–63]. These techniques require the latest generation ultrasound unit and, for CH-EUS, the availability of ultrasound contrast agents [64, 65].

There are no data in the literature about the learning methods of EUS-E and CH-EUS; however, we can be guided by the recommendations of the EFSUMB (European Federation of Societies for Ultrasound in Medicine and Biology) for training in ultrasound elastography. EFSUMB established minimum ultrasound training recommendations which stratified three levels of practice in conventional ultrasound: level 1, beginning; level 2, practicing; and level 3, advanced procedures and teaching [66].

To ensure high quality scanning and the lowest possible intraoperator variability, EFSUMB guidelines recommend that ultrasound elastography should be performed by operators that have passed competence level 1 [67]. In the cross-sectional observational multicenter study of Soares et al. [68], which included 11 endosonographers with different levels of experience in EUS and/or EUS-E, the overall interobserver agreement was moderate (k = 0.42, 95%CI 0.33–0.52). Reproducibility and diagnostic accuracy increased with experience in EUS and EUS-E.

EFSUMB recommends that contrast-enhanced ultrasound should be performed by operators at a competence level higher than level 1, under the supervision of an expert who is preferably at level 3 [69,70]. Several studies have demonstrated that CH-EUS is reproducible, even between endosonographers with no or limited experience in EUS and/or CH-EUS in the differential diagnosis of solid pancreatic masses [63,71–73]. However, a lengthy experience in EUS is a major contributor to the interobserver agreement and diagnostic accuracy of CH-EUS.

<rec>RECOMMENDATION 16

Diagnostic EUS training should follow a structured syllabus to guide the learning program.

Level of agreement 98%.</rec>

EUS training should be well structured and, in addition to the volume of EUS procedures, it should also ensure the progressive acquisition of the following knowledge, and cognitive and technical skills.

A Preprocedural: indication, informed consent, equipment, and sedation

(i) Patient

Appropriate patient assessment should include the acquisition of the relevant clinical history, including co-morbidities and regular medication (including antiplatelet agents and anticoagulants), a review of the relevant cross-sectional imaging, and a discussion regarding the potential benefits, risks, and alternatives to EUS. Trainees must have a comprehensive knowledge of the indications, contraindications, benefits, and risks of the procedures, and be able to communicate these effectively to the patient.

Patients should be informed about the potential benefits and risks of the procedure, and valid informed consent needs to be obtained, according to all facility rules and local regulations. Indications for potential prophylactic antibiotic administration and the management of patients' antiplatelet and anticoagulant medications should be known. Participation in decision-making in specialist multidisciplinary meetings should also be part of training.

(ii) Equipment

a) Processors Trainees should understand the features, capabilities, and differences between EUS processors, and the compatibilities between processors and imaging devices. It is essential to comprehend the relationship between sound-wave frequency and depth of penetration, and their implications for EUS imaging. EUS trainees must learn and understand the principles of elastography and contrast harmonic methods.

b) Imaging devices and accessories Two types of echoendoscopes are available: radial and curvilinear scopes. The differences between each modality regarding the imaging and the advantages and limitations of each should be understood. Each EUS training center must provide access to linear equipment and, if possible, also to radial equipment.

In addition, experience in using EUS catheter probes (miniprobes) for evaluating small mucosal and submucosal lesions is helpful. The use of intraductal ultrasound catheter probes should be taught only to those with training in ERCP. The indications for the use of a disposable balloon should be learned as well as the techniques to use it. Different types of EUS needles should be presented, with guidance on their choice according to the target lesion, as well as their indications, contraindications, and techniques for use, including how to advance and withdraw the needle and the sheath, when and how to use the stylet and suction, and proper safe handling.

B Intraprocedural

Trainees must know how to adapt the appropriate type of sedation and patient position depending on the procedure.

(i) Evaluation of passage of the echoendoscope

Echoendoscopes are much more challenging to maneuver than a standard forward-viewing endoscope. How the tip of the echoendoscope is made and the relation between the location of the optics and the transducer should be understood. Techniques to safely intubate and maneuver the echoendoscope through the pharynx, esophagus, gastroesophageal junction, pylorus, and duodenal sweep are primary steps to be learned.

Additionally, training should be given in rectal and sigmoid intubation. Knowledge of mediastinal, upper abdominal, and pelvic/perirectal anatomy are mandatory. Both normal anatomy and surgically altered anatomies should be understood.

(ii) Structures

Along with manipulation of the echoendoscope, the identification of basic anatomic structures and common pathologic abnormalities based on ultrasound patterns should be well understood [74,75]. Trainees must learn the interpretation of EUS images and appropriate patient diagnosis-making.

(iii) Image generation and manipulation

The ultrasound processor has several features that can be used to create the highest quality image. Different types of ultrasound images, namely the brightness mode (B-mode) and color Doppler imaging, are critical in EUS learning. Different processor functions, such as adjustment of the amplification (gain), time gain compensation, measuring, labeling, storing, magnification, zooming, and isolation of a particular zone of the field, should be included in this step in order to generate the highest quality image. Furthermore, EUS-E and CH-EUS can provide additional useful information for differentiating benign and malignant lesions, providing data regarding tissue stiffness and microvasculature, respectively, and trainees should have contact with them. The assessment of different stations is also necessary. Finally, the storage of endosonographic imaging should be learned.

(iv) Tissue sampling

Knowing how to maneuver the echoendoscope to gain and maintain access to target organs will make EUS-FNA/FNB a more precise, effective, and safe procedure for obtaining both cytologic and histologic specimens. Moreover, appropriate handling of tissue specimens is crucial to the successful performance of EUS-FNA/FNB.

(v) Needles

Trainees should know the indications, as well as the contraindications and potential complications, for EUS-FNA/FNB. There are different needles for cytology and histology purposes, each with their own advantages and limitations. Knowledge of the differences between FNA and FNB needles is crucial for choosing the most appropriate needle depending on the target lesion. The optimal technique for needle insertion, including EUS visualization of the needle tip and avoidance of intervening vascular and ductal structures, different technical aspects of tissue acquisition, and the potential need for the stylet and a suction syringe should be understood.

(vi) Specimen handling

Specimen handling is essential for proper pathologic evaluation and interpretation and includes: transferring the tissue from the needle to a slide and/or a preservative solution; and preparing the smears, and fixing (alcohol or air-dried) and staining them for rapid on-site specimen interpretation. Complementary studies, such as flow cytometry, tumor marker analysis, immunohistochemical staining, and cytogenetics, should also be taught.

(vii) Documentation for the cytopathologist

The endosonographer should provide relevant clinical information to the cytopathologist, including the patient’s history and the endoscopic and ultrasonographic findings (namely precise characterization of the lesion), along with the type of tissue sampling, in order to accurately interpret the cytologic specimens in an appropriate context.

(viii) Interpretation

The trainee should know how to interpret the result of cytopathologic analysis of the tissue specimen.

C Post-procedural

Comprehensive report writing with imaging documentation, and recognition and early management of complications

It is crucial for the trainee to have knowledge of the potential complications of EUS, including those related to EUS-FNA/FNB, to recognize these, and to learn how to manage and prevent these adverse events (AEs) appropriately. Trainees must communicate post-procedure instructions for care.

D Suggested performance item checklist

A performance item checklist to guide the learning program and structure trainee feedback in diagnostic EUS is recommended and proposed in **Table 2s**.

3 Assessment criteria for diagnostic EUS proficiency

A Definition and assessment of trainee competence in diagnostic EUS

<rec>RECOMMENDATION 17

Competence in diagnostic EUS should be defined as the ability to independently assess the need for and carry out successful and safe EUS procedures, with good patient satisfaction across a range of case difficulties and clinical contexts.

Level of agreement 98%.</rec>

An endoscopist is considered to be competent in EUS if he can undertake effective and safe procedures, and recognizes the importance of patient experience and the range of case complexities and contexts. The American Society for Gastrointestinal Endoscopy (ASGE) defines competence as the minimum level of skill, knowledge, and/or expertise derived through training and experience that is required to safely and proficiently perform a task or procedure [76].

<rec>RECOMMENDATION 18

The following performance measures should be used to indicate a trainee's competence in diagnostic EUS:

• successful documentation of anatomic landmarks in ≥90% of cases

• an EUS-FNA/FNB accuracy rate of ≥85%.

Level of agreement 95%.</rec>

These performance measures, considered as benchmarks for independent practice, are in line with the ESGE Quality Improvement Initiative for EUS [77]. The visualization and documentation of anatomic landmarks and the issue of successful tissue sampling are central to EUS, although it is important to realize that the accuracy rates of EUS-guided tissue acquisition (EUS-TA) are as dependent on the quality of the pathology service as they are on the competency of the endosonographer. Trainees should be able to demonstrate that they are performing to the required level as evidence of their competence in EUS.

<rec>RECOMMENDATION 19

A minimum procedure volume should be offered to trainees during diagnostic EUS training to ensure that they have the opportunity to achieve competence in the technique. To evaluate competence in diagnostic EUS, trainees should have completed a minimum of 250 supervised EUS procedures: 80 for luminal tumors, 20 for subepithelial lesions, and 150 for pancreaticobiliary lesions. At least 75 EUS-FNA/FNBs should be performed, including mostly pancreaticobiliary lesions.

Level of agreement 93%.</rec>

Systematic training is required to acquire EUS competence. It has been shown that there is a correlation between competence and endoscopists' experience [78,79]; traditionally, procedure volume has been considered to be a surrogate marker of competence. Limited data suggest that case volume influences EUS accuracy rates for cancer staging [80].

In 2001, ASGE suggested competence should be evaluated after performing at least 190 supervised EUS procedures divided into two levels: level 1 for mucosal and subepithelial lesions, in which the minimum number of EUS procedures should be 75 for mucosal tumors and 40 for subepithelial abnormalities; and level 2 for pancreaticobiliary lesions, in which the minimum number should be 75. At least 50 EUS-TAs should be performed to assess competence in EUS, of which 25–30 should be pancreatic EUS-TAs [23].

More recently, the suggested number of EUS procedures required to achieve competence has risen. The British Society of Gastroenterology (BSG) recommended in 2011 that 250 EUS procedures should be completed, including: 80 luminal cancers (esophageal, gastric, and rectal cancers [with at least 10 rectal tumors]); 20 subepithelial lesions (esophageal, gastric, and duodenal); 150 pancreaticobiliary lesions, with at least half of these being likely pancreatic adenocarcinoma; and 75 EUS-TAs, including at least 45 likely pancreatic adenocarcinomas) [77]. In 2016, the guidelines of the EFSUMB on interventional ultrasound agreed on the need for at least 50 EUS-guided sampling procedures to obtain basic expertise for this method [81]. In 2017, ASGE increased to 225 the number of EUS procedures that needed to be achieved before competency should be assessed [76].

A systematic review by Shahidi et al. [82] also showed that, in clinical practice, a much higher number of procedures is needed to achieve competency: 65–231 procedures in T-staging assessment for GI tumors and 30–40 procedures for EUS-TA. Overall competency was reached by only 4/17 trainees after 225–295 procedures. Wani et al. [83] concluded that the average trainee achieved core EUS competence after 225 procedures (including 110 EUS-TAs), although the range was notable (median EUS procedure numbers 400, range 200–750).

Therefore, ESGE proposes that a minimum of 250 EUS procedures are required before a trainee is likely to demonstrate acceptable performance measures and competence [1]. We should keep in mind that these recommended numbers of procedures are important to guide training programs to consider an absolute minimum case volume that needs to be offered to trainees, after which competence assessment of trainees can be considered, although it is not guaranteed that the necessary skills will have been obtained. Trainees do not learn at the same speed, and have neither equivalent trainers nor see procedures of similar complexity.

Additionally, it is quite difficult to achieve these numbers of procedures, as was shown by a recent study, where only 3% of trainees actually expected to reach these numbers at the end of their fellowship [29]. Therefore, to ensure sufficient exposure and training of trainees, it is advisable, if necessary, to reduce the number of training positions in line with the studies previously mentioned. Moreover, assessing the quality of EUS training based solely on procedure volume has been questioned and a transition from a volume-based to a value-based practice has been suggested to produce high quality independent practitioners [84].

<rec>RECOMMENDATION 20

Competence assessment in diagnostic EUS should take into consideration not only technical skills, but also cognitive and integrative skills. ESGE recommends that a reliable valid assessment tool should be used regularly during diagnostic EUS training to track the acquisition of competence and to support trainee feedback.

Level of agreement 95%.</rec>

Competence in performing EUS includes more than technical skills. Training programs in EUS should include assessment of the following parameters [85]:

• technical skills – the ability to maneuver the echoendoscope effectively and safely obtaining the desired images, including safe intubation, scope navigation, tip control, and loop reduction for optimal sonographic visualization of various organs; it also involves EUS-TA and the recognition and management of AEs

• cognitive skills – the knowledge and capability to: understand the diseases, indications, procedures, risks, benefits, and alternatives, along with the use of antibiotics, and management of antiplatelet agents and anticoagulants; perform adequate TNM staging and characterization of subepithelial lesions; and provide an appropriate differential diagnosis

• integrative skills – the capability to transform the knowledge into clinical decisions regarding the appropriate use of EUS in the management of patients.

The fulfillment of these parameters should be evaluated through a formative assessment, in which progress is regularly monitored and trainees are provided with benchmarks for their learning and feedback for further improvement, instead of adopting a summative assessment, in which the evaluation is performed at the end of the training to determine if thresholds and objectives have been reached [86].

To standardize the assessment of training, through evaluation of technical, cognitive, and integrative skills, some of the quality indicators of EUS, combined with direct observation from an expert, should be applied and the outcomes should be recorded on a scale over time. An ideal assessment tool should be reliable (consistent and reproducible), valid (measure what it is supposed to measure), impactful on education (improve the quality of feedback and improve performance), and acceptable to all stakeholders [87].

Several assessment tools have been developed for this purpose. Meenan et al. evaluated the ability of the trainees to use the radial ultrasound controls and to visualize a number of predetermined anatomic stations via the esophagus, stomach, and duodenum [88]. Wani et al. developed a standardized data collection tool including different steps of the EUS procedure: the ability to acquire images of anatomic stations and identify, characterize, and sample lesions [89,90]. This assessment tool, the EUS and ERCP Skills Assessment Tool [TEESAT], was later validated, while proving to be advantageous in monitoring the learning curve and providing precise feedback to trainees [12,91]. The tool allows documentation of the indication for the procedure, the type of echoendoscope used, and the grading of trainees in technical and cognitive end points, using a four-point scoring system with well-defined anchors. Global Assessment of Performance and Skills in EUS (GAPS-EUS) is another easy-to-use and reliable tool with a recorded high validity for the assessment of competence among trainees in EUS [92]. In GAPS-EUS, both the trainer and the trainee perform an assessment of the procedure. These assessment tools in diagnostic EUS training are referenced in **Table 3s**.

<rec>RECOMMENDATION 21

Trainees should undertake regular self-assessments and record all cases performed in a contemporaneous logbook. The logbook should include information on the type of procedure performed and the support given by the trainer for each aspect of the procedure.

Level of agreement 98%.</rec>

Self-assessment will give the trainee an indication of their areas of knowledge that are lacking to achieve the required cognitive skills to be an independent EUS performer.

The logbook will support the trainer in evaluating the training process. The logbook will show the type of procedures that have been performed and other procedures that need to be performed to achieve broad EUS skills for different indications. The logbook will also show the type of procedures that the trainer needs to focus on to improve the performance of the trainee.

Nonetheless, despite the importance of the logbook, a recent international survey showed that only 36.7% of trainees perform formal self-assessment [29]. Efforts should be made to optimize this rate. Suggested fields for a logbook for completion in diagnostic EUS training are outlined in **Table 4s**.

<rec>RECOMMENDATION 22

A trainee should undergo a formal summative assessment process prior to commencing independent practice in EUS.

Level of agreement 86%.</rec>

In view of the substantial variability in learning curves among trainees [90,91], competence assessment should account for the variable rates at which competence thresholds are achieved. The TEESAT [12,92] and GAPS-EUS [13] are evaluated assessment tools of competence in EUS, which emphasize the shift from the use of volume thresholds to the use of validated performance metrics for determination of competence [12,13,92].

ESGE proposes that the national legislature responsible for accreditation in endoscopy undertakes a formal assessment of trainees prior to independent EUS practice. This assessment should include an independent review to determine that the procedure numbers, quality indicators, and performance thresholds outlined in this document have been attained. This assessment can also review whether a trainee has undertaken formal training courses and their progress in formative assessment, when these have been brought into national training programs.

Currently, only 29.6% of trainees undergo a formal summative assessment process prior to commencing independent practice in ERCP/EUS and formal assessment tools are being used in only 25.9% of cases [29]. ESGE proposes that accreditation bodies organize a summative assessment, preferably by means of an assessment tool (TEESAT or GAPS-EUS [12,13,92]), whereby a trainee is observed undertaking EUS by independent assessors as a further robust test of competence beyond training experience and performance measures, in order to determine whether a trainee can practice EUS independently.

B Maintaining competence after training in diagnostic EUS

<rec>RECOMMENDATION 23

Newly trained endosonographers should start diagnostic EUS practice immediately after training. If a relevant delay occurs, making the endosonographer less confident, retraining should be considered.

Level of agreement 95%.</rec>

There are scant data on endosonographers beginning independent practice after training. It is assumed that a freshly trained physician should possess adequate competence to start practice immediately after the end of training. The maintenance of competence is as important as its process of acquisition. We know very little, if anything, about the consequences of not starting EUS practice right after training. The reasons for this might be beyond the endosonographer’s control, but they will likely affect competence maintenance. EUS is complex and technically demanding, and skills are highly dependent on case volume [93].

Whether interruptions to freshly started EUS activity affect the maintenance of competence is unclear. Short breaks to colonoscopy training of <6 weeks in an American study had only a small effect on the cecal intubation rate, but the effect increased for longer interruptions [94]. On the other hand, in a UK nationwide study, training breaks of up to 6 months were not shown to be detrimental to colonoscopy learning curves [79]. It is not known whether these findings translate to either EUS or to the post-training period. Nevertheless, it seems advisable that good plans be in place before endoscopists undertake training in EUS, including a prediction of when they will start EUS activity at their center, ideally right after training, to ensure the maintenance of skills. It is not straightforward to establish how long it actually takes for the effects of training to either weaken or be lost completely. Retraining in endoscopy is usually seen as an opportunity to complete and reinforce skills and competence throughout one’s career, but it could also become a necessity if more than a year has passed without practicing EUS.

<rec>RECOMMENDATION 24

A period of supervised practice should follow the start of independent activity. Supervision can be delivered either on site if other colleagues are already practicing EUS or by maintaining contacts with the training center and/or other EUS experts.

Level of agreement 100%.</rec>

As previously mentioned, ASGE defines competence in endoscopy as the minimum level of skill, knowledge, and/or expertise derived through training and experience that is required to safely and proficiently perform a task or procedure [76]. However, the attainment of competence in EUS is not a single event, but a career-long process. In other words, when an endoscopist reaches the standards defined in the training phase, it is not the end of the learning process, but merely a checkpoint at which independent practice can commence [1].

ESGE has indicated that a more experienced colleague should mentor endoscopists beginning practice independently for at least 6 months, particularly for challenging cases [1]. Training in EUS must also address the needs of those maintaining the skill, their staff, and those likely to draw on the service [93].

Small-volume centers that work together as a network can perform comparably to high volume centers. For this reason, it is advised that new EUS programs remain in an EUS network that has the potential to fulfill the desired service provision outlined by BSG [95]. For example, the Wessex EUS group maintains collaboration among eight endoscopists working in four centers. The group also has histopathology consultants, biomedical technicians, and nurses. They meet every 4 months, report ongoing audit data, and agree on common practice standards. The QUEST (Quality in EndoSonography Team) group in The Netherlands reported improved outcomes specifically for EUS-TA in solid pancreatic lesions after starting a collaboration of regional community hospitals with a similar multidisciplinary approach [96].

For healthcare facilities with limited EUS experience, it may also be beneficial for both nurses and physicians to visit other healthcare facilities with more mature EUS programs to learn about strategies for successful long-term results. This on-site experience offers an opportunity to gain valuable insights and expertise in how to handle patient needs and echoendoscopes, and the potential need for additional training [97].

<rec>RECOMMENDATION 25

Significant efforts must be devoted to establishing a multidisciplinary collaboration with colleagues in order to obtain feedback from other imaging techniques, pathology, and surgery results. This is particularly important when EUS is a new practice for the center.

Level of agreement 95%.</rec>

The addition of an EUS program to an existing gastroenterology service can be advantageous for healthcare facilities, interventional endoscopists, patients, and communities [93].

During the 2018 Forum for Canadian Endoscopic Ultrasound, the experts of an advisory board established the criteria for an EUS program to be sustainable and cost-effective [97]. An internal evaluation team should be responsible for assessing the program objectives, conducting a formal needs analysis, and establishing metrics for successful implementation. The team should ideally be composed of gastroenterology, nursing, pathology, radiology, and surgery staff, and management leadership. A project plan should include the goals of the EUS program, target patient populations, additional training needs, and equipment costs. Communication of the program to referring physicians, regional cancer centers, and other healthcare facilities should also be envisaged.

<rec>RECOMMENDATION 26

While it is expected that the number of diagnostic EUS procedures will gradually increase after the initiation of a new practice, a minimum number of 100 yearly examinations per endosonographer should be established to maintain proficiency.

Level of agreement 95%.</rec>

Procedure volume remains an objective and reproducible measure that must be achieved for maintenance of competency. An Asia–Pacific survey found that most EUS practitioners (90%) recognized that formal training with a minimum of 100 supervised procedures completed for ≥6 months was required to achieve acceptable EUS competence [98]. The Erasmus University Medical Center investigated whether the number of EUS investigations performed per year affected the results of esophageal cancer staging [80]. They found that individual endoscopists with ≥90 cases/year produced better results in terms of their accuracy for T-staging and their ability to pass strictures with an echoendoscope compared with endoscopists with ≤50 cases/year. The UK working group, in 2011, did not advise a specific number of cases that are required to be performed annually by endosonographers to maintain competence, but they nonetheless emphasized that the situation where each endosonographer performs small numbers of cases at a single center is to be avoided [93].

The numbers of procedures needed for training do not necessarily translate to the numbers needed for maintaining competence, which can vary according to the characteristics of both the individual and the endoscopy center. Nevertheless, we speculate that the amount of yearly activity cannot be fewer than 100 EUS examinations per endosonographer after the start of independent activity.

<rec>RECOMMENDATION 27

Key performance measures including the annual number of procedures, frequency of obtaining a diagnostic sample during EUS-FNA/FNB, and adverse events should be recorded within an electronic documentation system and evaluated.

Level of agreement 98%.</rec>

ESGE has recommended that endoscopists continue to keep a record of their cases to evidence that they are retaining acceptable key performance measures and complication rates after training [5]. Endosonographers must cooperate with healthcare administrators to measure pre-established metrics of success and identify opportunities for improvement. Performing EUS safely requires basic knowledge and technical and nontechnical skills. Before the procedure, endosonographers must know the indications and possible alternatives to EUS, discuss the possible risks with patients, and share the planned use of scopes and devices with staff. During the procedure, endosonographers must make sure that risks and errors are minimized, communication among staff members works effectively, and echoendoscopes are properly handled to cover all the required anatomic stations. Post-procedure, endosonographers must write a comprehensive report and share the appropriate management plan with the patient and their referring physician [1].

The UK working group also recommended that all those practicing EUS must make an annual report to their local oversight group detailing their individual case numbers in the categories esophagogastric cancer, rectal cancer, subepithelial lesions, and pancreaticobiliary lesions [93].

An American study also looked at the impact of structured feedback on trainee learning curves and quality indicators in EUS during the first year of independent practice [13]. Endosonographers were graded based on all relevant cognitive and technical aspects, including: clear identification of important landmarks; performance of EUS-FNA; appropriate TNM staging; and formulation of an appropriate management plan. Of the 24 advanced endoscopy trainees included in the final analysis, 22 completed a total of 3258 EUS examinations during their first year of independent practice (median of 136.5 EUS procedures per physician). The overall diagnostic rate of an adequate sample for all solid lesions undergoing EUS-FNA was 94%, with the performance target of ≥85% being reached by 91% of participants. The incidence of AEs including acute pancreatitis, perforation, and bleeding was below the established threshold.

Both this American group and a Dutch group used graphical representations of the cumulative sum (CUSUM) learning curves to view individual learning curves provided on a quarterly basis and compare individual performance with the average [99]. These tools seem highly valuable in comparison to tables with numbers, as their interpretation is easy (a downward trend is not good, a horizontal line is good, and an upward trend is better) and they allow the determination of best practices and comparison among peers.

<rec>RECOMMENDATION 28

Any relevant deviation from major diagnostic standards (i.e. the successful documentation of anatomic landmarks in ≤90% of cases and/or an EUS-FNA/FNB accuracy rate of ≤85%) should be promptly acknowledged and countermeasures should be undertaken.

Level of agreement 93%.</rec>

Measures of training outcomes must be objective and professional development must be measurable in terms of the quality of service offered, specifically for EUS [93]. EUS competence should be defined as the ability to independently assess the need for and carry out successful and safe procedures, with good patient satisfaction across a range of case difficulties and clinical contexts [1].

ESGE has stated that, in patients with solid lesions undergoing EUS-FNA, the frequency of obtaining a full diagnostic tissue sample should be at least 85%, with the desired target of 90% as a key performance measure [77]. It was also stated that appropriate EUS landmarks should be documented in ≥90% of cases. As previously mentioned, CUSUM learning curves can be used to as a feedback and monitoring tool for centers and individual endosonographers.

<rec>RECOMMENDATION 29

Any significant increase in rates of adverse events compared with the published literature should be promptly acknowledged and countermeasures should be undertaken.

Level of agreement 98%.</rec>

ASGE recently looked at AEs associated with routine EUS, with or without FNA/FNB [100]. Luminal perforation was relatively rare and was associated with trainee involvement, operator inexperience, advanced patient age, history of difficult esophageal intubation, presence of esophageal malignancy, or cervical spine osteophytes. Bleeding was reported mainly after EUS-FNA/FNB and was associated with antiplatelet and/or anticoagulant medications or prophylactic doses of low-molecular weight heparins and sampling of the liver. Other AEs, albeit rare, were infection, pancreatitis, and needle tract seeding. Data were scarce regarding AEs correlated with EUS training and trainees and their assessment was deemed urgent.

Monitoring programs of EUS quality are warranted, such as those existing for colonoscopy outcomes. A study from the Netherlands aimed to assess the feasibility of linking two national registries and described the results of colonoscopy quality per indication [101]. AE rates were calculated and correlated to indications and types of colonoscopy procedure. As a result, the importance of defining benchmarks per indication in future guidelines was emphasized.

<rec>RECOMMENDATION 30

Endosonographers should demonstrate ongoing competence in the form of continuing cooperation with former EUS mentors/other more experienced colleagues, consulting dedicated literature and other online content, and attendance at focused courses to maintain EUS privileges.

Level of agreement 95%.</rec>

The UK working group, in 2011, established that each trained endosonographer ought to report at least 15 hours/year of continuing professional development specific to EUS and quality assurance measures [93]. In addition to traditional training and fellowships, regular short intensive EUS courses that provide training at various levels may help endosonographers improve and maintain their knowledge and skills. Theoretical knowledge can also be acquired from lectures, textbooks, atlases, slides, DVDs, and websites. Importantly, most academic and tertiary referral centers often constitute a precious resource for continuous informal EUS referral after formal supervised training [11].

Conclusion

This ESGE Position Statement on training in diagnostic EUS was developed by a working group made up of experts from all over Europe and the USA, having different backgrounds in training and professional experiences.

The statements were proposed and agreed using a standard Delphi methodology. They concern the requirements for diagnostic EUS training, the steps in training and the quality of training, and the definition and assessment of competence prior to independent practice including maintenance of competence after training. While these suggestions have no legal implication, they are still used to recommend best practice in training. It is hoped they will assist national societies, program directors, and trainees in improving the standards of diagnostic EUS training.

This curriculum in diagnostic EUS training in Europe aims to guide training by defining minimum standards, specific end points, and thresholds for competence in diagnostic EUS. The next steps beyond this curriculum might be to define a proposal for standardized training, and ultimately to provide a tool for performance measurement and ESGE certification in diagnostic EUS.

Disclaimer

ESGE Position Statements represent a consensus of best practice based on the available evidence at the time of preparation. This is NOT a guideline but a proposal for training in diagnostic EUS. The statements may not apply in all situations and should be interpreted in the light of specific clinical situations and resource availability. Further studies may be needed to clarify aspects of these statements, and revision may be necessary as new data appear. Clinical considerations may justify a course of action at variance with these recommendations.

This ESGE Position Statement is intended to be an educational device to provide information that may assist endosonographers in providing care to patients. The recommendations made are not rules and should not be construed as establishing a legal standard of care or as encouraging, advocating, requiring, or discouraging any particular treatment.

The legal disclaimer for ESGE guidelines applies to the present position statement [8].

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Competing Interests

P. Fusaroli has participated in an advisory board for Olympus (2023). J.-W. Poley has received consultancy, travel, and speaker's fees from Cook Endoscopy (2010 to 2022) and Boston Scientific (2012 to 2022), and consultancy and travel fees from Mediglobe GmbH (2022 to present). R. Gincul has provided EUS workshops for Ipsen (2022) and Olympus (2023) and has received sponsorship from Celltrion (2023) and Abbvie (2023). R. Sadik has received lecture fees from Cook Medical (2011 to present), Boston Scientific (2020 to present), and Olympus (2022 to present).

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Table 1 Summary of recommendations, with quality of evidence and strength of recommendation.

Recommendation		Quality of evidence	Strength of recommendation
1 Preadoption requirements for training in diagnostic EUS			
A Preadoption requirements for trainees			
1	Trainees should have achieved competence in upper gastrointestinal endoscopy before training in diagnostic EUS	Moderate	Strong
2	Competence in sigmoidoscopy is desirable for training in rectal EUS	Low	Weak
3	Experience in the interpretation of abdominal imaging such as transabdominal ultrasonography and other imaging modalities is advisable, but not mandatory, prior to commencing training in diagnostic EUS	Low	Weak
4	The development of diagnostic EUS skills by methods that do not involve patients is advisable, but not mandatory, prior to commencing formal training in diagnostic EUS	Low	Strong
5	Experience in ERCP is helpful, but not mandatory, prior to commencing training in biliopancreatic diagnostic EUS	Low	Weak
B Preadoption requirements of trainers and training centers			
6	A trainee's principal trainer should ideally have more than 3 years' experience of independent diagnostic EUS practice	Very low	Weak
7	A trainee's principal trainer should be performing adequate volumes of diagnostic EUSs to demonstrate maintenance of their own competence	Very low	Strong
8	A trainee's principal trainer should be aware of the current management protocols in digestive neoplasms, should be involved in the multidisciplinary teams of their	Very low	Strong

	institution for decisions regarding the management of GI and pancreaticobiliary diseases, and should have a good knowledge of diseases managed with diagnostic EUS		
9	Training centers for diagnostic EUS should offer expertise, as well as a high volume of procedures per year, to ensure an optimal level of quality for training. Under these conditions, training centers should be able to provide trainees with a sufficient wealth of experience in diagnostic EUS for at least 12 months	Very low	Strong
10	Training centers for diagnostic EUS should ideally be able to facilitate trainee involvement in multidisciplinary meetings and provide support for trainee involvement in research, and service and quality improvement initiatives	Very low	Strong
2 Training/learning steps in diagnostic EUS: training modules and learning methods			
11	Trainees should engage in formal training and supplement this with a range of learning resources for diagnostic EUS, including EUS-guided fine-needle aspiration and biopsy (FNA/FNB)	Moderate	Strong
12	Training in diagnostic EUS should start first with the observation of EUS procedures on patients and, when available, training on simulators should begin with computer-based and mechanical models in the early phases, followed by ex vivo or in vivo animal simulators for more advanced training	Low	Weak
13	Training with a linear echoendoscope should be mandatory, and this may be complemented by training with a radial echoendoscope when available	Low	Strong
14	EUS-FNA/FNB should be included early in training, as soon as the basic skills for safe and stable scope handling have been achieved	Low	Weak
15	Adequate competence in diagnostic EUS is a prerequisite before training in EUS image-	Low	Strong

	enhancement techniques, such as elastography (EUS-E) and contrast harmonic EUS (CH-EUS)		
16	Diagnostic EUS training should follow a structured syllabus to guide the learning program	Moderate	Strong

3 Assessment criteria for diagnostic EUS proficiency

A Definition and assessment of trainee competence in diagnostic EUS

17	Competence in diagnostic EUS should be defined as the ability to independently assess the need for and carry out successful and safe EUS procedures, with good patient satisfaction across a range of case difficulties and clinical contexts	Low	Strong
18	The following performance measures should be used to indicate a trainee's competence in diagnostic EUS: – successful documentation of anatomic landmarks in ≥90% of cases – an EUS-FNA/FNB accuracy rate of ≥85%	Low	Strong
19	A minimum procedure volume should be offered to trainees during diagnostic EUS training to ensure that they have the opportunity to achieve competence in the technique. To evaluate competence in diagnostic EUS, trainees should have completed a minimum of 250 supervised EUS procedures: 80 for luminal tumors, 20 for subepithelial lesions, and 150 for pancreaticobiliary lesions. At least 75 EUS-FNA/FNBs should be performed, including mostly pancreaticobiliary lesions	Moderate	Strong
20	Competence assessment in diagnostic EUS should take into consideration not only technical skills, but also cognitive and integrative skills. ESGE recommends that a reliable valid assessment tool should be used regularly during diagnostic EUS training to track the acquisition of competence and to support trainee feedback	Moderate	Strong

21	Trainees should undertake regular self-assessments and record all cases performed in a contemporaneous logbook. The logbook should include information on the type of procedure performed and the support given by the trainer for each aspect of the procedure	Very low	Strong
22	A trainee should undergo a formal summative assessment process prior to commencing independent practice in EUS	Low	Weak
B Maintaining competence after training in diagnostic EUS			
23	Newly trained endosonographers should start diagnostic EUS practice immediately after training. If a relevant delay occurs, making the endosonographer less confident, retraining should be considered	Low	Strong
24	A period of supervised practice should follow the start of independent activity. Supervision can be delivered either on site if other colleagues are already practicing EUS or by maintaining contacts with the training center and/or other EUS experts	Moderate	Strong
25	Significant efforts must be devoted to establishing a multidisciplinary collaboration with colleagues in order to obtain feedback from other imaging techniques, pathology, and surgery results. This is particularly important when EUS is a new practice for the center	Low	Strong
26	While it is expected that the number of diagnostic EUS procedures will gradually increase after the initiation of a new practice, a minimum number of 100 yearly examinations per endosonographer should be established to maintain proficiency	Very low	Weak
27	Key performance measures including the annual number of procedures, frequency of obtaining a diagnostic sample during EUS-FNA/FNB, and AEs should be recorded within an electronic documentation system and evaluated	Moderate	Strong

28	Any relevant deviation from major diagnostic standards (i.e. the successful documentation of anatomic landmarks in ≤90% of cases and/or an EUS-FNA/FNB accuracy rate of ≤85%) should be promptly acknowledged and countermeasures should be undertaken	Low	Strong
29	Any significant increase in rates of AEs compared with the published literature should be promptly acknowledged and countermeasures should be undertaken	Low	Strong
30	Endosonographers should demonstrate ongoing competence in the form of continuing cooperation with former EUS mentors/other more experienced colleagues, consulting dedicated literature and other online content, and attendance at focused courses to maintain EUS privileges	Low	Weak

EUS, endoscopic ultrasound; ERCP, endoscopic retrograde cholangiopancreatography; GI, gastrointestinal; AE, adverse event.

Supplementary material

Curriculum for diagnostic endoscopic ultrasound training in Europe: European Society of Gastrointestinal Endoscopy (ESGE) Position Statement

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Table 1s Different type of simulators in diagnostic EUS, with their own advantages and limitations

Type of EUS simulator	Advantages	Limitations
Phantoms [1]	- Simple, easy to use, require minimal preparation - Reusable - Low cost - Useful for EUS and EUS-TA	- Not realistic for scope manipulation - Not realistic *in vivo* anatomy
Live animal models [2-6]	- The most human-like endoscopic experience with the closest resemblance to human structure - Easy use - Realistic for scope and needle manipulation - Useful for EUS and EUS-TA	- Ethical concerns - Needs specific facilities and equipment - High costs
Ex vivo animal models » Erlanger Active Simulator for Interventional Endoscopy (EASIE-R) [7-9] » Fukushima model [10]	- Intermediate realistic feel - Intermediate anatomy - Intermediate cost - Useful for EUS and EUS-TA	- Long preparation time - Disposal after use - Unfavorable tissue characteristics
Computer-based / Virtual Reality (VR) Simulators » GI-Mentor II EUS [11-14] » EUS Meets Voxel-Man [15, 16]	- Easy to use - Tactile feedback system - Library of clinical cases - Feedback and alert functions - Reusable	- High startup cost - Low realism index for anatomy - Limited in EUS-FNA training (not realistic for needle manipulation)

Table 2s Suggested performance item checklist to guide the learning program and structure trainee feedback in diagnostic endoscopic ultrasound training

Pre-procedural

Assessment of Indication and alternatives
Patient preparation (i.e. prophylactic antibiotic administration and management of antiplatelet and anticoagulant medications)
Informed consent and patient informed on potential benefits and risks of the procedure
Equipment set-up and checking (processor, type of scope, balloon and needles)

Intra-procedural

Sedation/general anesthesia, monitoring and patient position
Regular assessment of patient comfort
Traversing and progression in the upper and lower GI tracts Traversing of the pharyngoesophageal/esophagogastric junctions and pylorus Progression into the esophagus, stomach and duodenum Progression into the rectum and distal sigmoid
Ultrasound anatomical basic structures and common pathological abnormalities identification
Standardized visualization of landmarks and structures (organ and vessels)
Understanding of structure visualization in combination with the wheels/scope manipulation and scope progression, e.g.: ❒ Upper GI • <u>From the esophagus</u> Visualization of mediastinal stations*: 1, 2L, 2R, 3p, 4L, 4R, 5, 6, 7, 8, 9 Recognition of vascular and cardiopulmonary structures related to the mediastinal stations and allowing the latter to be identified (IVC, Right A, SVC, Left V with Aorta, Left A and Right PA, left bronchus and trachea, azygos vein, Left PA, ascending aorta, left subclavian artery…) • <u>From the esophagogastric junction</u> Longitudinal aorta with origin of celiac axis and SMA Left liver lobe with IVC and HV • <u>From the stomach</u> Celiac axis with origin of GA, SA and CHA Body of pancreas including PD, with SA/SV -towards the tail of pancreas with SVe, left kidney, left adrenal gland and spleen -towards the isthmus of pancreas-PVC- SMV/SMA- head of the pancreas PVC giving SMV and SV; PV until the hilum PD from body to the tail and from the body to the isthmus and head Gallbladder (from the antrum)

• From the bulb Papilla with origin of the CBD and PD -PD from the papilla to the pancreatic head and isthmus -CBD from the papilla to the hilum and LLL with intrahepatic ducts -CBD from the papilla to the cystic duct and gallbladder PVC, PV, PHA from CHA, CBD until the hilum and LLL with intrahepatic ducts GDA from CHA • From the D3/D2 parts Uncinate process and distal part of mesenteric vessels Papilla with origin of the CBD and PD Aorta, IVC and interaortocaval space Papilla with origin of the CBD and PD -PD from the papilla to the pancreatic head with mesenteric vessels and isthmus -CBD from the papilla to the hilum and LLL with intrahepatic ducts ❒ Lower GI Internal and external anal sphincters; rectal mucosal, submucosal and muscularis propria; ani elevator; mesorectum; rectosigmoid junction
Identification and following of structures (organ, vessels) both in withdrawal and pushing movements
Characterization of lesions: form, shape, echogenicity, size in 2 axis, relationship with vessels
Image generation and manipulation including EUS elastography and contrast-enhanced EUS
Tissue sampling FNA/FNB: Optimal choice of needle Optimal scope handling and maneuver for puncture of a lesion within a framework of a secure procedure Puncture with fanning Specimen handling Interaction with the nurse during the specimen handling Quality of specimen assessment
Actions to minimize complications
Recognition and early management of complications

Post-procedural

Standardized report writing including accurate description of lesions and cancer staging
Recognition and management of complications
Interpretation of the results of tissue specimen analysis
Interaction with the pathologist
Diagnostic yield assessment with reporting after successive procedures

General considerations

Management plan and situational awareness
Judgement and decision making
Communication and teamwork within room

Leadership

CBD: common bile duct; CHA: common hepatic artery; GA: gastric artery; GDA: gastroduodenal artery; HV: hepatic vein; IVC: inferior vena cava; Left A: left atrium; LLL: left liver lobe; Left PA: left pulmonary artery; Left V: left ventricle; PD: pancreatic duct; PHA: proper hepatic artery; PVC: portal vein confluence; PV: portal vein; Right PA: right pulmonary artery; SA: splenic artery; SMA: superior mesenteric artery; SMV: superior mesenteric vein; SVC: superior vena cava; SVe: splenic vessels; US: ultrasound.

* Station 1: highest mediastinal; Station 2L: left upper paratracheal; Station 2R: right upper paratracheal; Station 3p: retro-tracheal; station 4L: left lower paratracheal (including azygos nodes); Station 4R: right lower paratracheal (including azygos nodes); Station 5: subaortic (aortopulmonary window); Station 6: para-aortic; Station 7: subcarinal; Station 8: paraesophageal below carina; station 9: pulmonary ligament station

Table 3s Assessment tools in diagnostic EUS training

Tool	**DOI**
The EUS and ERCP Skills Assessment Tool (TEESAT) [17]	10.1016/j.gie.2018.02.009
Global Assessment of Performance and Skills in EUS (GAPS-EUS) [18]	10.1136/bmjgast-2021-000660

Table 4s Suggested fields for a trainee logbook for completion by a trainer after each diagnostic endoscopic ultrasound

Supervisor
Patient: Age/Sex
EUS indication
Case Complexity
Sedation/General anesthesia
Procedure success for: Orientation in space according the manipulation of the scope Identification of anatomical landmarks / structures (organ/vessels) Knowledge and understanding of organ/vascular anatomy Assessment and characterization of lesion and its relationship with vascular structures
FNA/FNB: fluency in the procedure, justification for choice of needle, fanning, number of passes and specimen handling
Accuracy of FNA/FNB: diagnostic yield according to the number of passes
Immediate and delayed complications and management of them
Learning points
Notes on procedure including difficulties encountered and discussion with the supervisor to overcome them
Degree of supervision*

FNA, fine-needle aspiration; FNB, fine-needle biopsy

* Degree of supervision defined as:
1. trainer performs or takes over
2. significant verbal and/or hands-on support
3. minimal verbal support
4. independent performance

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