

Emergency Point-of-Care Ultrasound Stewardship – A Joint Position Paper by EuSEM and EFSUMB and Endorsed by IFEM and WFUMB

Verantwortungsbewusste bettseitige Notfallsonografie – ein gemeinsames Positionspapier von EuSEM, EFSUMB und unterstützt von IFEM und WFUMB

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ABSTRACT

Emergency Medicine Point-of-Care Ultrasound (EMPoCUS) is a convincing concept. It has spread rapidly because of its intuitive, simple applicability and low equipment costs. The speed of its emerging growth frequently outpaces the development of quality assurance and education. Indeed, education standards vary worldwide, and in some cases seem to neglect the principles of modern competence-based education. Additional challenges are encountered such as remote or low resource medical practice. Here, EMPoCUS might be the only ad-hoc imaging modality available. Once mastery of EMPoCUS is achieved, emergency physicians should be able to independently and efficiently care for their patients using a variety of PoCUS skills. However, most curricula only define these tasks as non-binding and in general terms or use outdated measures, such as length of training and self-reporting of achieved examinations with variable oversight, or administrative measures to create educational milestones. This threatens to take quality assurance down the wrong path. It created a scenario in which concrete EMPoCUS skill outcome measures that would realistically reflect the training objectives and simultaneously would be easily observable and verifiable are lacking. In view of the dangers of poorly controlled EMPoCUS dissemination and the current lack of European guidelines, we would like to set central standards for European EMPoCUS stewardship based on a critical review of the current situation. This position paper, which was jointly developed by EuSEM and EFSUMB and endorsed by IFEM and WFUMB, is also intended to accompany the EFSUMB/EuSEM guidelines on PoCUS currently being prepared for publication.

ZUSAMMENFASSUNG

Der notfallmedizinische Point-of-Care-Ultraschall (EMPoCUS) ist ein überzeugendes Konzept. Es hat sich aufgrund seiner intuitiven, einfachen Anwendbarkeit und der geringen Gerätekosten rasch verbreitet. Die Geschwindigkeit des sich abzeichnenden Wachstums übertrifft häufig die Entwicklung der Qualitätssicherung oder der Ausbildung. In der Tat variieren die Ausbildungsstandards weltweit und scheinen in einigen Fällen die Grundsätze einer modernen kompetenzbasierten Ausbildung zu vernachlässigen. Hinzu kommen weitere Her-

ausforderungen wie abgelegene oder ressourcenarme medizinische Institutionen. Hier könnte EMPoCUS die einzige ad-hoc verfügbare Bildgebungsmodalität sein. Wenn die Notfallärzte die EMPoCUS-Ausbildung abgeschlossen haben, sollten sie in der Lage sein, ihre Patienten unter Einsatz einer Vielzahl von PoCUS-Spielarten unabhängig und effizient zu versorgen. In den meisten Curricula werden diese Anforderungen jedoch nur unverbindlich und allgemein definiert oder es werden veraltete Maßstäbe verwendet – wie die Dauer der Ausbildung, die Selbsteinschätzung der durchgeführten Untersuchungen mit variabler Kontrolle oder administrative Maßstäbe zur Erstellung von Ausbildungsmeilensteinen. Damit droht die Qualitätssicherung in die falsche Richtung zu

laufen. Es wurden Verhältnisse geschaffen, in denen es an konkreten Ergebniskriterien für EMPoCUS-Skills mangelt, welche die Ausbildungsziele realistisch widerspiegeln und gleichzeitig leicht beobachtbar und überprüfbar wären. Angesichts der Gefahren einer unzureichend kontrollierten EMPoCUS-Verbreitung und von fehlenden europäischen Richtlinien möchten wir auf der Grundlage einer kritischen Bestandsaufnahme zentrale Standards für eine europäische EMPoCUS-Stewardship setzen. Dieses Positionspapier, das gemeinsam von EuSEM und EFSUMB entwickelt und von IFEM und WFUMB unterstützt wurde, soll auch die EFSUMB/EuSEM-Leitlinien zu PoCUS begleiten, die derzeit zur Veröffentlichung vorbereitet werden.

Introduction

The term Point-of-Care Ultrasound (PoCUS) [1] originated from emergency medicine but was derived from the historical FAST (Focused Assessment of Sonography for Trauma) concept, which was developed by trauma surgeons. There are many synonyms, such as focused ultrasound, emergency ultrasound, and bedside ultrasound. The term PoCUS is widely understood as location-independent bedside use of sonography in conjunction with a patient evaluation/management encounter by the providing physician with usually portable ultrasound systems. It is used as an integral part of clinical evaluation and ad-hoc bedside management and expands the clinical evaluation [2]. This powerful tool makes it possible to make better-informed clinical management decisions. Qualified users can quickly narrow or even determine a diagnosis and start or monitor the effect of targeted therapy. It also allows patients to be repeatedly evaluated and increases the safety and efficiency of important invasive procedures. Emergency Medicine Point-of-Care Ultrasound (EMPoCUS) has spread rapidly because of its intuitive, simple applicability and low equipment costs. The speed of its emerging growth frequently outpaces the development of quality assurance and education. Additional challenges are encountered such as remote or low resource medical practice. Here, EMPoCUS might be the only ad-hoc imaging modality available [3, 4, 5].

The PoCUS concept is not limited to any medical specialty, specific protocols, or just one organ or organ system [1]. It is now considered standard practice in emergency medicine (EM), anesthesia and critical care medicine, family medicine, and many other specialties around the world. Although several studies are available demonstrating a benefit in important workflow processes, such as time and cost savings, robust work showing an effect on patient mortality, morbidity, and functional status is largely lacking [1].

As early as 1975, the founder of internal medicine sonography in Germany, Gerhard Rettenmaier, propagated that ultrasound diagnostics was the continuation of physical examination with technical means (personal communication K.H. Seitz). 13 years later in 1988, Roy Filly, an American radiologist, affirmed that diagnostic ultrasound will become the next stethoscope, used

by many, understood by few [6]. In a follow-up editorial nearly 15 years later, the discussion regarding the sonoscope expanded to include quality standards for the rapidly growing group of non-radiology users who were performing ultrasound, including the integration of ultrasound into medical school education, and the effects of the emerging hand-held ultrasound devices on quality standards [7, 8].

Enormous technical advances were required to make Filly's prediction of a sonoscope [9] used for echoscopy [10] at the point of care come true. Today, the seemingly simple and clinically attractive concept of PoCUS with hand-held ultrasound devices has become standard procedure for many clinicians in need of a fast diagnosis [7, 8, 11, 12, 13, 14, 15]. Its use is becoming more and more intuitive and portable, and a variety of PoCUS devices seem to be available, especially in the developed world. Low-cost hand-held devices with low or no subscription costs are starting to be employed in limited-resource and remote health care environments. This represents a massive opportunity for point-of care handheld ultrasound but also carries a significant demand with respect to training needs. The large number of potential new hand-held users combined with the intuitive concept of PoCUS diagnostics, which is positive in itself, carries a risk when adopted without appropriate training and quality assurance.

Successful diagnostic ultrasound requires not only proficiency in ultrasound physics and sonographic morphological pattern recognition, but also a longitudinal learning process where spatial aptitude and haptic skills with the machine and probe improve over time and eventually lead to the ability to obtain adequate imaging for specific diagnostic ultrasound indications. In addition to the pure imaging requirements, the mastery of PoCUS is based on clinical knowledge and experience, depending on the subject and question. Once such skills have been attained, PoCUS is a powerful diagnostic tool that can be employed during the physical examination. However, it takes deliberate practice to achieve such skills and requires the wisdom and guidance of advanced proctors. This supervision is best accomplished in two stages:

1. At the beginning, sound basic training could be realized most easily in a controlled standard diagnostic ultrasound setting, where the trainees are under the supervision of experienced physicians [16].

2. Once the basic skills are mastered, longitudinal and supervised training in the PoCUS setting follows. This makes mastery of diagnostic ultrasound a time and resource intensive skill. Not all training programs, institutions, and geographic regions seem to be able to provide the significant time and resource investments and thus default to using surrogate measures for competency that are outdated.

In view of these circumstances, it is not surprising that the Joint Commission on Accreditation of Health Care Organizations and the Emergency Care Research Institute recently classified the poorly regulated and uncontrolled spread of PoCUS as a safety risk [17]. Indeed, because PoCUS is highly examiner-dependent, it bears the risk that insufficient knowledge as well as poor skills could lead to false reassurance and, in the worst cases, serious misdiagnosis [18]. The European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB) has refined its concept of professionalism in ultrasound with the goal of making clinical ultrasound in its various categories, including PoCUS, a reliable professional service based on common and uniform quality standards [16]. Moreover, EFSUMB is planning a series of PoCUS clinical practice guidelines, the first of which covers heart and pulmonary applications [19]. The European Society for Emergency Medicine (EuSEM) is currently developing a curriculum for EMPoCUS that takes into consideration different practice settings in Europe. The International Federation for Emergency Medicine (IFEM) developed a white paper on curriculum development that includes guidelines for training programs in low resource countries [20]. Against this background and considering the different practice patterns throughout Europe, EuSEM and EFSUMB recognize the need to develop basic European training and quality standards for PoCUS in EM that are responsive to the different needs encountered in different European practice settings, but can achieve baseline standards.

Applying key concepts for designing training programs in emergency ultrasound

As a general principle, a successful PoCUS training program should aim to accommodate the different learning styles of trainees [21] and incorporate different educational concepts or strategies over a longitudinal time period. Different learners need different times to progress through a learning cycle to reach desired outcomes [22].

Learning styles can be defined as diverging, assimilating, converging events, and hands-on experiences. Learning strategies include paced practice, interleaving, elaborative interrogation, concrete examples, dual coding, and retrieval practice [23, 24]. However, blended learning concepts such as spaced repetition, deliberate practice, and cognitive load seem to be important for successful progression of learners.

For instance, in order to achieve a learning cycle, concrete learning, reflective observation, abstract conceptualization, and active experimentation are all required [21, 25]. Over time, effective learning can be achieved when the learner progresses through the cycle.

PoCUS training programs need to incorporate longitudinal opportunities for learners to practice and consolidate their skills in different sonographic procedures. The more the program is able to accommodate different learning styles and the more educational concepts can be included, the higher the likelihood of success for a wide range of learners. However, increasing these opportunities naturally comes with a requirement for more educational resources.

To develop a curriculum, a basic 6-step approach modified for local needs is recommended [26]. Components should include:

1. Identification of the problem and a general needs assessment
2. Targeted local needs assessment in prospective PoCUS trainees
3. Setting of goals and objectives for the local curriculum
4. Selection of educational strategies that match with the resources available and match with the length of longitudinal training opportunities
5. Implementation of the program
6. Development of concepts for evaluating the effectiveness of the curriculum again adhering to available resources and ability to measure outcomes to predetermined mastery standards [27].

The importance of matching a desired outcome of a PoCUS curriculum with available resources and hands-on learning opportunities is crucial. Recognizing that EM is not practiced uniformly throughout Europe and that PoCUS education and implemented curricula need to match local needs is of utmost importance.

Current approaches in Europe

Approaches to EMPoCUS in Europe vary significantly. Most curricula require proof of attendance at courses and practical examinations, either in educational or clinical settings, and possibly proof of passed examinations. These may differ in type of practical examinations accepted, and how many must be normal or pathological. In general, certification of trainees in EMPoCUS is based on one or all of the five pillars below:

1. Focus on clearly defined indications (aorta, gallbladder, trauma, etc.)
2. Courses attended
3. Number of documented examinations performed and
4. Longitudinal assessment of performed scans and/or real-time hands-on performance [28]
5. Length of educational program

There are still many regions with a paucity of longitudinal curricula/training opportunities for physicians in training or for established emergency physicians (EP) trained before PoCUS emerged. In many locations, it has also not yet been possible to integrate EMPoCUS into routine clinical practice [29]. In countries where ultrasound is not a compulsory part of training, experience has shown that the many graduates fail to complete the longitudinal practical training after an initial introductory course. Hence, a significant number of trainees do not reach competency in all or even any of the suggested number of PoCUS indications. As the

longitudinal phase of acquiring PoCUS mastery usually happens at their respective clinical practice sites, local paucity of resources, including lack of skilled proctors might be a significant contributor.

In many cases, appropriate quality assurance is minimal or lacking or still based on outdated concepts. However, on the other hand, some countries have been very successful in establishing well thought-out longitudinal training programs that lead to a significant number of trainees completing specialty-required EMPoCUS training [30]. Others require attendance at an ultrasound training “module” for sub- or supra-specialty certification, but without structured longitudinal training or proctoring requirements.

In this context, introducing standards that utilize reliable and valid instruments of competency assessment that are universally accessible are of central importance.

Goals of stewardship

Various national and international organizations have published ultrasound training curricula for EM, many following the guidelines of the American College of Emergency Physicians (ACEP) in their basic structure [31, 32]. Although the EMPoCUS organization, application, teaching, skills acquisition and maintenance, and quality tools vary from country to country, the goal remains the same for all, i. e., to ensure independent competence and safety in sonography and to efficiently integrate sonography into the routine care of emergency patients.

Based on discussions with many colleagues from different countries, we believe that, unfortunately, many curricula still rely on outdated principles. There can be overemphasis on theoretical knowledge and final traditional examination, a paucity of required bedside training by allowing a wide margin in the implementation of supervision, insufficient adopting of modern teaching methods including workplace-based assessments (for example, entrustment scales). Further complicating this situation is the largely lacking scientific work on how we can best achieve and verify the aforementioned goal for EMPoCUS training.

This document aims to present principles underpinning an efficient European emergency medicine PoCUS stewardship (EMPS). It includes 4 elements:

1. PoCUS setting in EM
2. Definition, components, and critical assessment of EMPS
3. Recommendations
4. Future directions

PoCUS setting in emergency medicine

In the developed world, EM is available to everyone 24 hours a day for all injuries, illnesses, and disorders of well-being, for which patients or their surrogates require or demand urgent medical attention, based either on subjective or objective assessment.

EMPoCUS is practiced not only in emergency departments, but also in many other settings, such as family/general practices, outpatient or inpatient care, or prehospital settings, including

combat casualty and disaster medicine. Indeed, in these remote or low-resource settings, EMPoCUS might be the only imaging modality available. The application of EMPoCUS as multi-modal sonography not bound by organ or body regions can range from helping to answer simple sonographic yes-no questions during basic applications, e. g., does this patient have an abdominal aortic aneurysm, to using advanced PoCUS for multiple and more complex questions, e. g., responsiveness and tolerance to fluid during resuscitation, depending on training, experience, and circumstances. Basic EMPoCUS should be adopted as a basic adjunct to aid and enhance clinical evaluation (increase specificity of a suspected pathology), as well as to monitor and guide diagnostic and therapeutic interventions. EMPoCUS can also improve the success and safety of EM procedures, e. g., peripheral and central vascular access, and nerve blocks.

Definition, role, and critical evaluation of the emergency medicine point-of-care stewardship

We define stewardship as an ethical value that embodies the careful and responsible management of something or somebody entrusted to one's care [33]. The term EMPS as we understand it can be used to describe the envisioned goal of creating a structure or guard rails for guidelines for initial and continuing EMPoCUS training and lifelong assessment of training. Shokoohi et al. described that the PoCUS concept applies to all medical disciplines and types of ultrasound applications, ranging from the focused clinical approach to evaluation of complex clinical syndromes [29].

The authors subsume four elements under the term PoCUS stewardship:

1. Optimizing clinical indications
2. Adopting pre-test probability
3. Staging the spectrum of the disease based on onset and severity of the pathological process, and
4. Assessing the diagnostic accuracy of the test (sensitivity, specificity and likelihood ratio).

The basic requirement for EMPS is to ensure that the national bodies and societies for EM in the various European countries have established a curriculum. It is based on seven core elements:

1. Organization
2. Scope
3. Indication
4. Teaching
5. Acquisition of skill
6. Maintenance of skill, and
7. Quality assurance

The catalog of learning objectives plays a central role in the curriculum. The theoretical and practical requirements for each individual examination per indication should be defined in as much detail as possible. This is the only way to guarantee that the proctors focus on the desired competences and that the trainees ob-

jectively fulfill these requirements, regardless of the chosen method of examination at the end.

The IFEM has published guidelines that can help bodies and societies in EM to design an exemplary curriculum [20]. This curriculum includes the basic principles and processes. They can be easily adapted to local conditions.

The EMPS is ultimately intended to objectively and safely demonstrate and guarantee future independent, prudent, and optimal application of EMPoCUS for the individual physician after continuing or advanced training.

Taking these goals into account, we consider the following two elements, which differ from those of Atkinson et al. (20), to be central:

1. Acquisition and maintenance of EMPoCUS competency and
2. Skills integrated into patient care with quality assurance in terms of certification and recertification

Program for skill acquisition and maintenance

Skill acquisition

The continuing education program (► **Table 1**) includes courses with speakers/tutors and other formats for teaching theory and allowing initial hands-on instruction, as well as hands-on ultrasound in real life to acquire the appropriate skills in clinical practice.

The theoretical knowledge can be delivered in a modular fashion and can be learned or supplemented through computer-based

learning programs at home or at the workplace, and certain hands-on skills can be acquired using simulators. Blended learning approaches have been incorporated with success and certainly the current SARS-CoV-2 pandemic has significantly increased the need for online learning opportunities [34]. However, comprehensive practical skills in human medicine can only be learned on human beings. For beginners, planned sessions away from the pressures of the clinical environment with normal volunteers or patients (covering the spectrum of ages/sex/body habitus) can help ultrasound learners to become proficient.

The key practical skills required are how to operate the ultrasound machine, how to optimize images, and how to develop psychomotor skills and muscle memory. This is useful to prepare the trainees to scan in a clinical environment and hence get the optimal benefit of supervision. The courses and other formats are primarily designed to provide participants with basic knowledge and scanning instructions. They are also intended to motivate participants to use ultrasound in everyday life. Different educational strategies, depending on available resources, should be incorporated for maximum success [21].

The most crucial and lengthy part of education and training is individualized supervision at the patient's bedside, i.e. proctored examinations of trainees in the usual clinical environment on their patients [35]. A proctor guides trainees through the entire examination, possibly using the four-step concept [16, 36]. In view of the often frenetic and pressured environment trainees and proctors face, supervision from the beginning to the end of the examination is not always possible. To this end, we find little guidance

► **Table 1** Skills acquaintance program.

Components	Content	Elements
Traditional courses with physical presence or other teaching formats such as e-learning, blended learning	Theory Physics basics and knobology, indications, anatomy and landmarks, sono-anatomy and sono-pathology, interpretation and integration into patient management	<ul style="list-style-type: none"> ▪ Frontal and/or participative teaching ▪ E-learning ▪ Blended learning incl. exercises in image pattern recognition ▪ Case simulations ▪ Case discussions ▪ Journal clubs
	Hands-on To generate and optimize images, to correctly represent normal anatomy, pathology and functionality	<p>Tutor on-site with</p> <ul style="list-style-type: none"> ▪ Trainees examining normal subjects or patients ▪ Simulators (mannequins and web-based) incl. clinical cases <p>Tutor on PC (remote learning)</p> <ul style="list-style-type: none"> ▪ The trainees are guided by means of a camera, and the tutor has direct access to the screen of the US machine <p>No tutor</p> <ul style="list-style-type: none"> ▪ Simulator (mannequins and web-based) ▪ Web-based
Acquirement of practical skills	Scanning on patients in everyday life with supervision and focus on the following components: <ul style="list-style-type: none"> ▪ Indication ▪ Representation of the target structures with image generation and optimization ▪ Image pattern recognition and interpretation ▪ Integration into clinical decision-making 	<ul style="list-style-type: none"> ▪ Supervisor on-site or remote proctoring ▪ Beginners: Planned and controlled, standardized diagnostic setting with experienced proctors ▪ Scan shifts (could be remote) ▪ More advanced trainees: With experienced proctor in the emergency setting ▪ Advanced training through a fellowship ▪ Scanning of specific known pathology cases in resource-limited regions

on how this laborious work can realistically be integrated into the emergency setting without compromising patient care. This seems mostly feasible during dedicated, ideally one-on-one, bedside scanning shifts or via routine sonography sessions outside emergency care in a planned controlled diagnostic setting [16, 37]. In resource-limited regions, this process might be very difficult to ensure. As the ratio of skilled proctors to trainees can seem insurmountable, another possibility would be that the trainee should try to reproduce a current and known finding, if the clinical situation allows. A further traditional, all-time classic method is self-assessment, where the provider compares self-scans and self-interpretation with clinical examinations performed by experts.

Future possibilities such as remote proctoring, i. e., the supervisor has access from a distance to the screen and can influence the examination via camera, are promising but not yet widespread. This still requires significant effort and time commitment, which translates into cost and funding of such programs. Furthermore, clinical case simulations, exercises to train specific indications, image pattern recognition and interpretation, and integration into clinical decision making should ideally be included.

Skills maintenance

Keeping up with theory and further developing practical skills is just as important as training and continuing education. Blueprints for this format exist for continuing education in general (► **Table 2**). A complementary tool for the acquisition and maintenance of ultrasound skills is quality assurance review of saved EMPoCUS cases, and assessment of image generation and interpretation. The review should be conducted by EMPoCUS-accredited faculty and an ultrasound director. It can be undertaken at regular departmental quality assurance meetings or separate ultrasound meetings, thus promoting good practice and maintenance of skills.

Quality assurance, certification, and recertification

Quality assurance

Reaching certification and competency means that the trained physicians achieved a defined level of competence, e. g., can prac-

tice safe and independently. However, this does not necessarily equate to being an expert. Therefore, it should be accepted and promoted that newly “qualified” trainees will and should expect to continue learning and at times will require expert support. Many professions, e. g., nursing, have preceptors to support newly qualified staff. Learning EMPoCUS is not binary (e. g., trainee/trained) but should be considered a progression on a spectrum, which will end for some upon reaching an expert level, and for others with basic competency levels. Here, we focus on the discussion of certification and recertification of trainees reaching basic competency (see ► **Table 3**), i. e., the way in which it is ensured that EPs have the formally required competencies in EMPoCUS after training, maintain these skills after a defined period of time has elapsed, and are familiar with new developments. In individual countries, different institutions are responsible for the accreditation of training centers and the “certification and recertification” of physicians in EMPoCUS. They may also issue corresponding continuing education and training regulations, recognize continuing education centers and instructors, and issue titles or certificates. Depending on the case, EMPoCUS may be part of the continuing education title for emergency physicians or may be issued as a separate certificate.

Accreditation of training sites/institutions and certification of trainers

In principle, either hospitals/institutions or individuals are authorized to provide continuing medical education in EMPoCUS. The hospitals and institutions in question must have a training concept that meets predefined criteria, and the head of the training center and their team must be accredited with the appropriate certificates/training titles [37]. The institution must have the required infrastructure and patient volume.

Physicians in specialty or subspecialty training may receive a certificate of completion from their institution if the institution confirms that they fulfilled the requirements of the program and achieved competency in this area. Such a general confirmation provided by the director of the respective training center would be sufficient, for example in Germany. The situation is quite different if an individual proctor and not a training center is responsible for training courses and supervision. In this case, the trainee must

► **Table 2** Skills maintenance program.

Components	Content	Elements
Traditional course with physical presence or other teaching formats	Theory	<ul style="list-style-type: none"> ▪ Literature study ▪ Frontal and/or participatory teaching ▪ Webinars ▪ E-learning incl. exercises in image pattern recognition ▪ Case studies ▪ Tape review
	Hands-on	<ul style="list-style-type: none"> ▪ Workshops with tutors ▪ Workshops with online tutors in resource-limited settings
Consolidate practical skills	Scanning of patients in everyday clinical practice	<ul style="list-style-type: none"> ▪ Short internship ▪ Remote supervising, especially in resource-limited settings

► **Table 3** Quality assurance.

Components	Content	Evaluation of competencies
<ul style="list-style-type: none"> Institutions accredited or individuals certified for continuing education 	<ul style="list-style-type: none"> Hospitals/institutes Individuals 	<ul style="list-style-type: none"> Accreditation of training centers Certification and recertification of course directors, tutors and supervisors Recognition of courses/workshops
<ul style="list-style-type: none"> Certification – specialty training 	<ul style="list-style-type: none"> Theory 	<ul style="list-style-type: none"> Proof of course attendance Written tests
<ul style="list-style-type: none"> Recertification – training to maintain skills and learn new features 	<ul style="list-style-type: none"> Practice 	<ul style="list-style-type: none"> Proof of workshop visits Evidence of supervised and independent examinations/ patient management and image review Evidence of independent examinations with findings verified by other means (CT, surgery, discharge report or traditional US-exam by an expert) and image review Workplace-based assessments (objective structured clinical exam or standardized direct observation)

► **Table 4** Means of testing theoretical competencies – pass/fail.

Type	Grade	Comment
Proof of course attendance	1	Inclusion of written test
Completed e-learning	1	Inclusion of written test
Completed blended learning	1–2	In the “classroom” possibility to deepen the theory and to test knowledge via web
Web-based test on the content of recommended literature	1–2	Easy to perform
Written exam	1–2	Intermediate and final examination of the learning objectives catalog on-site or more easily web-based

1 = weak; 2 = moderate; 3 = high

► **Table 5** Means of testing mixed competencies (theory and practical skills) – pass/fail.

Type	Grade	Comment
Proof of course attended	1	Written test and test of hands-on during and/or at the end of the course
Image recognition and interpretation exercises on-site or web-based	1–2	Image pattern recognition – (normal, artifact, pathological) and interpretation are important components of EMPoCUS and include theoretical and practical aspects
Case simulation on-site or web-based	1–2	On-site or web-based case simulations. Main skills to be evaluated are indications, image pattern recognition and interpretation, as well as integration into clinical decision-making

1 = weak; 2 = moderate 3 = high

provide individual proof that he or she has fulfilled all conditions for continuing education, as done, for example, in Switzerland.

► **Table 4**, ► **Table 5**, and ► **Table 6** summarize and evaluate possibilities that are currently used for the verification of competences.

Certification of trainees

Damewood et al. (2020) discussed the advantages and disadvantages of the instruments currently available to measure the ultrasound competency of emergency physicians and proposed concrete strategies and future directions [27]. We advocate that the goal of continuing ultrasound education should no longer be defined by “pure length of stay,” or courses attended, number of examinations documented, and midterm/final examinations, but

rather whether physicians can independently and safely perform the required, concrete tasks [38]. With regards to the number of EMPoCUS examinations documented, completing an arbitrary number does not necessarily equate to achieving competency, as not all scans are of equal educational value. For example, multiple poorly supervised and rushed examinations may be significantly inferior to fewer examinations overseen by an effective supervisor with adequate imaging and time allocated. On the other hand, clinical emergencies usually do not allow for “comprehensive point-of-care imaging”, with the term being almost an oxymoron in itself, but the skill to tailor the exam to the clinical situation and enhance clinical decision making with as few exam steps as possible should be considered a competency in itself and one of the de-

► **Table 6** Means of testing practical competencies – pass/ fail.

Type	Grade	Comment
Workshops in courses	1–2	Testing during and/or at the end
Proof of performed examinations	1	Image review <ul style="list-style-type: none"> ▪ Random sample without predetermined number of exams regarding individual sonographic questions ▪ In many cases, 10 to 25 examinations per question/theme are required, part of which must be pathological ▪ Part of the examinations must be directly supervised ▪ Part of the exams can be independent, but the findings should be verified by objective measures (CT, surgery, discharge report, or traditional exam by an expert)
Supervision (proctoring)	2	Supervisor present or web-based (remote)
Case discussions	1–2	Presentation of clinical cases by trainees to a panel or to an individual expert
Workplace-based assessments in terms of mini-clinical evaluation exercise (Mini-CEX) and direct observation of procedural skills (DOPS)	2–3	Elaborate procedure that has been proven valuable in many continuing education programs
Practical test on-site	1–2	Intermediate and/or final hands-on test Remote in resource limited setting

1 = weak; 2 = modest; 3 = high

sired competency outcomes and this should be measured throughout training.

The term ultrasound competency is based on seven points that were defined by an interdisciplinary, international panel of experts including emergency physicians by means of a Delphi process [18]. They are summarized in ► **Table 7** and, of course, apply point by point to EMPoCUS as well. It is crucial that trainers identify and use appropriate teaching situations in everyday life and provide effective and supportive feedback [38]. Workplace-based assessments are well suited for this purpose including entrustment criteria. If assessments are carried out regularly, it is no longer simply a matter of checking what has been learned (assessment “Of-learning”), but to expand and monitor competencies and also to learn more (assessment “For-learning”) [38]. From the sum of several assessments, a final examination decision (pass-fail) can be made more easily.

Recertification of trainees

The same instruments as for continuing education can be used for the assessment of lifelong learning for maintaining competencies and integrating innovations, but they must be weighted differently for various reasons. We consider periodic external credentialing with workplace assessment by credentialed faculty to be crucial.

Recommendations

Adopting advanced education techniques and competency-based assessments is paramount to support EMPoCUS proficiency. This involves the acquiring and maintenance of independent work performance, which is as observable and as verifiable as possible in terms of clearly defined outcome measures (► **Table 7**) [38]. For

► **Table 7** Objective structured assessment of ultrasound skills – OSAUS.

Points	Content
Indications	Why was the exam conducted and comparison of individual indications with evidence in the literature
Knobology and safety	Familiarity with the equipment and its functions and compliance with safety regulations (hygiene, etc.)
Image generation and optimization	Selection of the appropriate probe, representation of landmarks, and adjustment of the individual functions (gain, depth, etc.)
Correct approach	Meaningful clinical question, translating into a sonographic question, answers and, if necessary, new clinical question, etc.
Interpretation of images	Recognize image patterns and interpret them correctly
Documentation	Saving of representative images and oral and written assessment
Medical decision making	Immediate integration of findings/interpretation into patient care and medical decision making

this purpose, as already mentioned, a detailed catalog of learning objectives is necessary, according to which, regardless of the method of evaluation, the trainees can be evaluated to determine whether they meet the requirements for this continuing educa-

tion: correct indication, competent and independent carrying out of the proposed examinations, interpretation of findings and integration of this element into clinical management.

Proof of a certain number of completed courses and documented examinations, including supervised and passed one-time examination(s), is probably easy to obtain, but is not sufficient as a guarantee that a physician can independently, safely, and correctly apply the EMPoCUS in practice.

We strongly recommend that better and more efficient tools be used for the processes that measure outcome:

Assessment of continuing education (certification, credentialing)

- Better definition of documented EMPoCUS examinations in terms of minimal expected number of specific indications, expected proportion of examinations with normal or pathological findings, and whether examinations were performed independently or with supervision and the level of supervision.
- Evidence of a reference standard to validate an examination, such as CT, surgery, hospital discharge information, or other US exam by an expert confirming EMPoCUS findings when performed without supervision.
- Successful completion of a pattern recognition teaching program of typical image appearances, which may be web-based
- Supervised examinations with feedback (verbal and written)
- Individual or group case discussion(s) with feedback (verbal and written)
- Case simulations and case reviews with evaluation
- Multiple workplace-based assessments and final evaluation

Assessment of maintenance of skills (recertification)

- Evidence of a reference standard to validate an examination, such as CT, surgery, hospital discharge information, or traditional US exam by an expert confirming EMPoCUS findings when performed without supervision.
- Web-based review of the content of recommended new literature.
- Successful completion of a pattern recognition teaching program of typical image appearances, which may be web-based
- At least two workplace-based assessments in 5 years.

Future direction or challenges

Development of a European Certificate “Emergency Point-of-Care Ultrasound Stewardship” using a structured EMP curriculum as a reference. The diploma should be designed in order to confirm EMP competence within any country.

Executive summary

Good stewardship in EMPoCUS should focus on how to obtain and ensure skills to scan safely and independently and how to maintain and continue to advance these skills. Of course, assessing and documenting actual skill is always more challenging than documenting administrative milestones in EMPoCUS, such as atten-

dance of courses and length of training or number of scans performed. However, since the ultimate goal is mastery of EMPoCUS to improve patient care, efforts should be made to track more mastery milestones and less administrative achievements, although one will not be able to exist without the other. It is our hope that novel education methods and technology advancements will assist in this endeavor. Our patients deserve the best care by EMPoCUS-competent physicians we can offer, regardless of the health care system we are practicing in.

Conflict of Interest

Prof. C.F. Dietrich CFD has received lecture fees from Bracco, Siemens, Mindray, Hitachi (Fuji) and Janssen. CFD has received research support from Mindray, GE Healthcare, Fresenius, Youkey and Schallware. Prof. V. Cantisani VC has received lecture fees from Samsung, Canon and Bracco Prof. B. Jarman BJ has received honoraria for educational activities from Sonosite Fujifilm UK in the past 3 years; BJ has benefited from ultrasound equipment loans from Canon HealthCare Prof. C. Janssen CJ has received lecture honoraria from FALK Foundation, Freiburg/ Germany; Support of ultrasound courses CJ has received research support from GE Healthcare, Siemens Healthineers, Mindray and Bracco Prof. J. Conoly JC has received educational honoraria from Sonosite

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