Accepted Manuscript online: 2026-07-04 Article published online: 2026-09-08

The Core Compendium of the European Society for Emergency Medicine Ultrasound Curriculum

Das Notfallultraschall Kern Kompendium der Europäischen Gesellschaft für Notfallmedizin

Autorinnen/Autoren

Effie Polyzogopoulou[1*], Senad Tabakovic[2*], Tim Harris[3], Rudolf Horn[4], Jim Connolly[5], Beatrice Hoffmann[6*], Joseph Osterwalder[7*]

EUSEM EUS Curriculum Task Force Members.

EUSEM EUS Curriculum Task Force Authors:

Firas Abou-Auda[8], Mehmet A. Aslaner[9], Mohit Arora[10], Zeki Atesli[11], Azapoglou K. Burcu[12], Slaven Bajić[13], Linder Cardenas[14], Federico Capriles[15], Eric Chin[16], Irina Ciumanghel[17], Antonios Diakantonis[1], Özlem Dikme[18], Florence Dupriez[19], Merve Eksioglou[20], Rajat Gangahar[21], Adela Golea[22], Ivan Gornik[23], Jaroslaw Gucwa[24], Ossi Hannula[25], Hani Hariri[26], Ruben Haesendonck[27], Robert Jarman[5, 28], Barbara C. Hogan[29], Suleyman Ibze[30], Phillipe Le Conte[31], Felix Lorang[32], Azam Majeed[33], Ashley Matthies[34], Djan Can Meseli[35], Susanne Morf[4], Kalyana Murali[34], Najib Nasrallah[36], Umut Osak[37], Niccolo Parri[38], Sander Poks[39], Stefan Posth[40], Bojana Radulovic[24], Hannelore Raemen[41, 42], Ondrej Rennet[43], Arthur Rosendaal[44], Lunik Sarders[45], Megha S. Tveit[46], Ramazan Sivil[47], Roman Škulec[48, 49], Maša Sorić[50], Ahmed Souayah[51], Prem Sukul[44], Paul Van Overbeeke[52], Maria Velliou[1], Evert Verhoeven[53], Christos Verras[1], Tomas Villen[54], Gabor Xanthus[55], Chris Yap[56], Olga Zmijewska-Kaczor[57]

Affiliations

1 Department of Emergency Medicine, Attikon University Hospital, National and Kapodistrian University of Athens, Athens, Greece, Eusem Ultrasound Section
2 Department of Emergency Medicine, Zurich City Hospital, Zurich, Switzerland, Eusem Ultrasound Section
3 Department of Emergency Medicine, Queen Mary University London and Bart's Health NHS Trust London UK, Eusem Ultrasound Section, MEDSTAR and Emergency physician Central Adelaide Local Hospital Network, Adelaide, Australia
4 Department of Emergency Medicine, Center da sandà Val Müstair, Val Müstair, Switzerland, Eusem Ultrasound Section
5 Department of Emergency Medicine, Great North Trauma & Emergency Centre Royal Victoria Infirmary, Newcastle upon Tyne, Middlesbrough, UK, Eusem Ultrasound Section
6 Department of Emergency Medicine, BIDMC, Boston, USA, Eusem Ultrasound Section
7 Department of Emergency Medicine, CMO Polipraxis St. Gallen, St. Gallen, Switzerland, Eusem Ultrasound Section
8 Department of Emergency Medicine, Darent Valley Hospital, Dartford and Gravesham NHS Trust, Dartford, UK
9 Department of Emergency Medicine, Gazi University Faculty of Medicine, Ankara, Türkiye
10 Department of Emergency Medicine, Leeds Teaching Hospitals NHS Trust, Leeds, UK
11 Department of Emergency Medicine, East Sussex Health Care Greater Brighton and Hove Area, UK
12 Department of Emergency Medicine, Fatih Sultan Mehmet Education and Research Hospital, University of Health Sciences, Atasehir, Istanbul, Türkiye
13 Department of Emergency Medicine, Izola General Hospital, Izola, Slovenia
14 Department of Emergency Medicine, Universidad Católica de Murcia, Arrixaca University Hospital, Murcia, Spain
15 Department of Emergency Medicine, University Hospital Sant Joan de Reus, Rovira i Virgili University, Reus, Spain
16 Department of Emergency Medicine, Brooke Army Med Ctr, Fort Sam Houston, USA
17 Department of Emergency Medicine, Emergency County Hospital Saint Spiridon, Iasi, University of Medicine and Pharmacy Gr. T. Popa, Romania
18 Department of Emergency Medicine, University of Health Sciences, Istanbul Training and Research Hospital, Istanbul, Türkiye
19 Department of Emergency Medicine, Cliniques Universitaires Saint-Luc, University of Louvain, Brussel, Belgium
20 Department of Emergency Medicine, University of Health Sciences, Fatih Sultan Mehmet Education and Research Hospital, Istanbul, Türkiye
21 Department of Emergency Medicine, Royal Oldham Hospital, Manchaster, UK

* These authors contributed equally.

22 Discipline of Emergency Medicine, University of Medicine and Pharmacy Cluj, Clinical Emergency County Hospital, Cluj-Napoca, Romania
23 Department of Emergency Medicine, School of Medicine, University Hospital Centre Zagreb, University of Zagreb, Zagreb, Croatia
24 Department of Emergency Medicine, County Hospital of Bochnia, Bochnia, Poland
25 Department of Emergency Medicine, Central Finland Central Hospital, Wellbeing Services County of Central Finland, Jyväskylä, Finland
26 Department of Emergency Medicine, King Faisal Specialist Hospital & Research Centre, Riyadh, Saudi Arabia
27 Department of Emergency Medicine, Ziekenhuis Oost-Limburg Hospital, Genk, Belgium
28 School of Health & Life Sciences, Teesside University, Middlesbrough, UK
29 COO Ambulantisierung im KRH, Klinikum Region Hannover, Hannover, Germany
30 Department of Emergency Medicine, Akdeniz University Hospital, Konyaaltı, Antalya, Türkiye
31 Department of Emergency Medicine, Nantes University Hospital, Nantes University, Nantes, France
32 Department of Emergency Medicine, Zentralklinikum Suhl, Suhl, Germany
33 Department of Emergency Medicine, University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK
34 Department of Emergency Medicine, Homerton University Hospital, Homerton Healthcare NHS Foundation Trust, London, Teesside University, Middlesbrough, UK
35 Department of Emergency Medicine, Our Lady of Lourdes Hospital, Drogheda, Ireland
36 Department of Emergency Medicine, Rambam Medical Center and Nazareth Hospital, Nazareth, University of bar Ilan school of medicine, Israel
37 Department of Emergency Medicine, Bursa Yuksek Ihtisas Training and Research Hospital, University of Health Sciences, Bursa, Türkiye
38 Meyer Children's Hospital IRCCS, Florence, Italy
39 Department of Emergency Medicine, Tartu University Hospital, Tartu, Estonia
40 Department of Emergency Medicine, Odense University Hospital, Odense, Denmark
41 Department of Emergency Medicine, Ziekenhuis aan de Stroom Middelheim Hospital, Antwerp, Belgium
42 Department of Emergency Medicine, OLVZ Aalst, Aalst, Belgium
43 Department of Emergency Medicine, Pardubice Hospital, Pardubice, Czech Republic
44 Department of Emergency Medicine, Franciscus Gasthuis and Vlietland Hospital, Rotterdam, Netherlands
45 Department of Emergency Medicine, Barking, Havering and Redbridge University Hospitals NHS Trust, Queen Mary University of London, Romford, UK
46 Department of Emergency Medicine, Haukeland University Hospital, Bergen, Norway
47 Department of Emergency Medicine, University of Health Sciences Antalya Training and Research Hospital, Türkiye
48 Department of Emergency Medicine, Constantine the Philosopher University in Nitra, Slovakia
49 Department of Anaesthesiology, Perioperative and Intensive Medicine, J. E. Purkyně University in Ústí nad Labem, Masaryk Hospital in Ústí nad Labem, Czech Republic
50 Department of Emergency Medicine, Dubrava University Hospital, University of Zagreb, Croatia
51 Department of Emergency Medicine, Groupe Hospitalier Sud Ile-de-France, Melun, France
52 Department of Emergency Medicine, OLVG, Amsterdam, the Netherlands
53 Department of Emergency Medicine, Universitair Ziekenhuis Brussel, Vrije Universiteit Brussel, Belgium
54 Department of Emergency Medicine, Hospital Universitario Ramon y Cajal, Francisco de Vitoria University School of Medicine, Madrid, Spain
55 Department of Emergency Medicine, Semmelweis University Hospital, Budapest, Hungary Northern General Hospital
56 Department of Emergency Medicine, Sheffield Teaching Hospitals, NHS Foundation Trust, UK
57 Department of Emergency Medicine, Royal Cornwall Hospital Trust, Truro, UK

Keywords
emergency medicine, guidelines, point-of-care ultrasound

published online 2026

Bibliography
Ultraschall in Med
DOI 10.1055/a-2852-6050
ISSN 0172-4614

Georg Thieme Verlag KG, Oswald-Hesse-Straße 50, 70469 Stuttgart, Germany

Correspondence
Prof. Beatrice Hoffmann
Beth Israel Medical Center, Department of Emergency Medicine, Harvard Medical School, Boston, United States
bhoffma2@bidmc.harvard.edu

ABSTRACT

The diversity of healthcare systems across Europe has predictably resulted in significant variations in point-of-care ultrasound (PoCUS) training and practice for emergency medicine (EM). To encourage a more synchronized approach and address these inconsistencies, the European Society for Emergency Medicine (EUSEM) chartered its Ultrasound Section to develop a comprehensive curriculum compendium that should serve as a foundational guide for European Emergency

Medicine PoCUS clinical and educational guidelines and policies. Under the leadership of a dedicated task force, the EUSEM Ultrasound Section developed this compendium to provide a structured, tiered framework designed to meet the needs of physicians at every skill level, from novice to advanced users. The compendium emphasizes applications that are currently practiced in different and diverse emergency departments in Europe, including a broad range of topics. An important goal was allowing flexibility to accommodate the unique resources and challenges of different healthcare environments, so that EM physicians can achieve PoCUS competencies matching their local circumstances and needs. To achieve this goal, good educational and clinical stewardship throughout this process is a key part to the success of advancing PoCUS in European EM. This compendium is intended as a resource for creating standardized yet adaptable training pathways. It represents a major step toward harmonizing and advancing PoCUS practice in European EM.

ZUSAMMENFASSUNG

Die Vielfalt der verschiedenen Gesundheitssysteme in Europa hat dazu geführt, dass grosse Unterschiede in der Ausbildung und Anwendung des Point-of-Care-Ultraschalls (PoCUS) in der Notfallmedizin bestehen. Um einen stärker synchronisierten Ansatz zu fördern und diesen Unterschieden zu begegnen, hat die Europäische Gesellschaft für Notfallmedizin (EUSEM) ihre Ultraschallsektion damit beauftragt, ein umfassendes Curriculum-Kompendium zu entwickeln. Dieses soll als ein Leitfaden für Europäische Richtlinien und Standards für PoCUS in der klinischen Ausbildung in der Notfallmedizin dienen. Unter der Leitung einer Task Force hat die Ultraschallsektion der EUSEM dieses Kompendium erarbeitet, um Rahmenbedingungen zu schaffen, die den Bedürfnissen von Ärztinnen und Ärzten auf jedem Kompetenzniveau – vom Einsteiger bis zum fortgeschrittenen Anwender – gerecht werden. Das Kompendium beinhaltet Ultraschallanwendungen, die in derzeit sehr diversen Notfallstationen in ganz Europa praktiziert werden, und deckt daher ein breites Spektrum PoCUS-Anwendungen in der Notfallmedizin ab. Ein zentrales Ziel dieser Arbeit war es, Flexibilität zu ermöglichen, um die spezifischen Merkmale wie auch Ressourcen der jeweiligen Gesundheitssysteme zu berücksichtigen, sodass Notfallmediziner:innen PoCUS-Kompetenzen erwerben können, die ihren lokalen Gegebenheiten und Anforderungen entsprechen. Um das Ziel der Weiterentwicklung von PoCUS in der europäischen Notfallmedizin zu erreichen, ist ein entscheidender Erfolgsfaktor eine gute Begleitung sowohl in der klinischen Anwendung, wie auch in der Ausbildung. Dieses Kompendium soll als Grundlage zur Entwicklung standardisierter, zugleich aber anpassungsfähiger Ausbildungspfade dienen. Es stellt einen wichtigen Schritt zur Harmonisierung und Weiterentwicklung des PoCUS in der europäischen Notfallmedizin dar.

The Core Compendium of the European Society for Emergency Medicne Ultrasound Curriculum

1. Introduction

Point-of-care ultrasound (PoCUS) has become an integral part of emergency medicine (EM) [1–4]. It provides highly valuable real-time diagnostic information at the bedside for physicians that acquire the necessary skills to integrate sonographic bedside information with their clinical findings and medical knowledge and it helps with invasive procedures. European physicians have played a pioneering role in the development of PoCUS. Some of the earliest applications were in trauma to detect splenic injury or free intra-abdominal fluid dating back to the 1970's and 1980's [510]. Around this time, many specialists around the world began integrating ultrasound into acute care settings. Over the next decades, European clinicians continued to contribute significant advancements to ultrasound applications in the emergency setting, assuring ultrasound's gradual evolution from a specialized imaging tool to a versatile point-of-care modality. With technical advancements, it became a reliable bedside tool for managing many emergency conditions.

Despite this rich history and widespread adoption, the diversity of healthcare systems across Europe has predictably resulted in variations in PoCUS training and practice for EM [11]. To address these disparities and promote a more harmonized approach to emergency ultrasound education and practice, the European Society for Emergency Medicine (EUSEM) tasked its Ultrasound Section with developing a comprehensive curriculum compendium that serves as the basis for European EM PoCUS guidelines and policies. The EUSEM Ultrasound Section under the leadership of its appointed task force developed this compendium to provide a structured, tiered framework designed to meet the needs of practitioners with different levels of expertise. The compendium emphasizes applications that are currently practiced in different and diverse emergency departments and other institutions where emergency patients are cared for in Europe. An important goal was allowing flexibility to accommodate the unique resources and challenges of different healthcare environments.

The compendium aims to ensure that emergency physicians across Europe have an opportunity to achieve at least baseline competency in PoCUS. Good educational and training stewardship is paramount to advancing PoCUS skills among European EM specialists. As a resource for standardized yet adaptable pathways, this curriculum marks a major step in PoCUS practice in European EM.

1.1 Background

1.1.1 The Long History and Diversity of PoCUS in Europe

The European history of PoCUS dates back several decades. Physicians from many specialties recognized sonography's potential for rapidly treating patients with health emergencies. One of the significant initial drivers for the adoption of bedside ultrasound in

Europe was trauma management [12–15]. Over time and as ultrasound technology and portability improved, its applications broadened to include many other indications, including cardiac, abdominal, thoracic, vascular, musculoskeletal, and procedural guidance [16]. As the EM specialty developed and propagated throughout Europe, it created diverse models of emergency care. In parallel, a similar development happened for emergency ultrasound. However, emergency ultrasound progress was also influenced by already existing national and local diagnostic ultrasound imaging practices. This probably caused today's varied emergency physician ultrasound practices in Europe. Terms such as focused, bedside, clinical, emergency, and point-of-care ultrasound are often used interchangeably.

1.1.2 Existing PoCUS Curricula and Guidelines in Europe

Several European countries have developed national guidelines for the use of PoCUS in emergency medicine. For instance, the United Kingdom's Royal College of Emergency Medicine (RCEM) has been at the forefront of promoting PoCUS [17]. Similarly, the French Society of Emergency Medicine has established guidelines covering a wide range of PoCUS applications [18]. Other examples include the Dutch Association of Emergency Physicians (NVSHA), Hungary, the Czech and Slovak Republics, Turkey, and Spain [19–23].

In Scandinavia, Sweden, Norway and Denmark have also implemented PoCUS training programs that are mandatory for EM trainees [24–26]. In central Europe, the German, Austrian, and Swiss Associations of Ultrasound in Medicine (DEGUM, OEGUM, SGUM) have been offering jointly accredited structured ultrasound courses and certification pathways for many decades, including for emergency ultrasound [27–30]. However, there are many other examples including pre-hospital EM PoCUS courses [31]. Despite these national efforts, there is no overarching European framework to harmonize these guidelines.

2. Education Goals and Objectives and Learning Outcomes

A Tiered Approach to PoCUS Education

The EUSEM Ultrasound Section's new curriculum compendium is designed to accommodate the diverse needs of European emergency medicine practitioners. It is designed to offer a tiered approach to skill development. Its structure includes both basic and advanced levels, acknowledging the gradual advancement of skills.

2.1 Educational Goals and Objectives

The primary goal of the EUSEM Ultrasound Curriculum Compendium is to provide emergency medicine physicians across Europe with a framework to acquire the knowledge and skills needed to use PoCUS effectively. Progress from novice to advanced competencies is achieved through a tiered educational structure that supports both basic and advanced trainees. This enables stepwise skill development across indications and expertise levels.

Basic Level Objectives:

- To develop foundational technical proficiency in PoCUS, including understanding ultrasound principles (e.g., transducer selection, image optimization, artifact recognition).
- To master essential indications and clinical applications such as cardiac, abdominal, and thoracic ultrasound to aid in the diagnosis and management of life-threatening conditions (e.g., pericardial effusion, free intra-abdominal fluid in trauma, pleural effusion, and pneumothorax).
- To save time and increase safety with simple ultrasound-assisted interventions.
- To promote early identification of critical pathologies, improving decision-making in various emergency scenarios through the integration of ultrasound findings.

Advanced Level Objectives:

- To advance technical abilities by incorporating more complex ultrasound applications and ultrasound modalities, including Doppler techniques, or detailed PoCUS assessments of anatomical areas and for advanced procedures.
- To encourage the use of PoCUS in specialized clinical syndromes, but also in high-stakes emergency scenarios, utilization for monitoring of treatment effects and more sophisticated ultrasound-guided interventions, ensuring a broader scope of application beyond the basics.

Overall Educational Goals:

- To foster a harmonized approach to PoCUS education across Europe, providing a standardized yet adaptable framework that can be integrated into diverse healthcare systems and facilitate a smooth exchange between the different European countries.
- To empower practitioners to use PoCUS to improve patient outcomes by ensuring rapid, safe, and accurate bedside diagnostic, monitoring, and interventional capabilities.
- To build up and encourage common continuous learning and professional development, with a focus on both clinical competence, and patient safety in the use of emergency ultrasound and good stewardship in PoCUS teaching and clinical practice.

2.2 Program Framework

The EUSEM Ultrasound Curriculum Compendium uses a flexible tiered structure to meet diverse needs across Europe. Two tiers are described: basic and advanced. Training can accommodate local disease prevalence and needs. This framework should help design or advance comprehensive yet adaptable learning experiences and pathways to competency.

Tier 1 (Basic Level)

This level introduces foundational knowledge and essential skills in emergency ultrasound. Trainees learn basic principles of the specific clinical approach for PoCUS in emergency situations, physics and image generation, including transducer selection and handling, basic image acquisition, interpretation of normal findings and pathological patterns as well as appropriate storage and

documentation. Clinical applications focus on exams that use basic techniques, as outlined in the compendium. The basic level suits trainees or practitioners beginning ultrasound education.

Tier 2 (Advanced Level)

This level is designed for physicians that have already mastered indications at the tier 1 level. It focuses on higher-order spatial skills and more complex diagnostic applications as outlined in the compendium. Examples include cardiac or pulmonary evaluations, Doppler, hemodynamic monitoring, and procedural guidance.

This tiered approach allows flexibility to tailor training to needs and stage.

Over time, continuous re-evaluation and updates will be necessary to ensure alignment with the latest developments in emergency ultrasound practice.

2.3 Program Supervision

Effective supervision is a critical element of any curriculum implementation. We recommend that training programs emphasize a structured mentorship model, as ultrasound is a hands-on skill requiring the development of spatial aptitude [32]. Mentors with more advanced skill sets should guide trainees in real time as often as feasible.

Mentorship Structure

The ideal PoCUS learning pathway assures that trainees should be connected to a mentor or supervisor with more advanced proficiency in emergency ultrasound. These supervisors should provide oversight and feedback during sufficient supervised practice. Receiving structured feedback on acquisition, interpretation, and guidance is paramount.

Assessment and Evaluation Methods and Continued Support

Trainees' progress should be assessed at regular intervals. This can be achieved through the assessment methods outlined in section 2.5. Methods can be tailored to local resources and availability. Workshops and reviews help maintain proficiency.

The goal of the supervision model should be not only to foster a collaborative learning environment but also to encourage growing of the next generation of trainers and mentors. Physicians of any skill level should be encouraged to continually develop their expertise.

2.4 Minimum Training Requirements

The minimum training requirements should focus primarily on regional disease burden as well as conditions with high acuity. The training of PoCUS applications that evaluate patients for potential pathologies with immediate and high mortality should be prioritized. Examples include cardiac and abdominal imaging for rapid diagnosis of critical conditions as outlined in the compendium.

While many of the listed basic skills might be considered essential for all emergency physicians, prescribing a universal minimum number of training hours and mastery of a minimum number of basic indications or procedures was not considered feasible due to the significant variations in resources, healthcare system variations, and training environments across Europe. Therefore, each country or even local institution should tailor and govern its initial and subsequent training based on available resources, ensuring that emergency physicians achieve competency in at least the most critical, life-saving applications and applications with local high disease burden.

2.5 Assessment

The assessment of competency in PoCUS must balance rigorous standards with adaptability to diverse resources and clinical settings. Effective strategies ensure learners gain theoretical knowledge and, most importantly, achieve successful clinical integration. Stewardship in guiding skill progression is essential. This requires both formative and summative assessments, aligned with modern competency-based frameworks. Potential methods were outlined in a recent joint EUSEM, EFSUMB, and IFEM document [32]. Key elements include direct observation, hands-on exams, and case-based discussions to evaluate mastery of PoCUS indications, image recognition, interpretation, and clinical relevance. Self-directed tools such as image review platforms and e-learning can supplement training, helping refine diagnostic skills and improve pattern recognition and integration. A longitudinal approach is recommended, allowing continuous feedback and adaptation of training plans. Entrustable Professional Activities (EPAs) can assess learners' ability to independently and safely perform essential PoCUS tasks in clinical settings, tailored to local contexts. A robust quality assurance process is also crucial. Regular image audits and peer review support consistency and accuracy. As emphasized in the stewardship framework, assessments should focus not only on the number of procedures but also on diagnostic accuracy and clinical decision-making. This approach ensures assessments remain practical and resource-sensitive, promoting high-quality PoCUS practice across diverse environments.

3. Development of the Core Compendium of the European Society for Emergency Medicine Ultrasound Curriculum

3.1 Methods

3.1.1 Panel Composition and Eligibility Criteria

To develop the Core Compendium of the European Society for Emergency Medicine Ultrasound Curriculum, a two-round survey was conducted. Criteria for invited expert panelists were membership in the EUSEM Ultrasound Section, an active European medical license, at least 5 years of PoCUS practice, and leadership in local, national, or European PoCUS training courses, ensuring region-specific standards and practices.

3.1.2 Survey Design

Our two-stage, structured consensus process incorporated elements of the Delphi method but was not anonymized and, therefore, does not constitute a classic Delphi procedure. In addition, the panel size represented a deliberate departure from traditional

Delphi methodology, which typically relies on small panels of approximately 8–23 participants and does not inherently ensure geographic representativeness. Our much larger group was intentionally selected to ensure geographic and practice diversity, enabling representation from nearly all European regions, including countries where emergency medicine is well established as well as those in which it is still developing.

Panelists were given a comprehensive list of emergency ultrasound indications, which was refined during an annual section meeting. The goal was inclusivity, capturing most indications practiced and taught by a diverse expert group from diverse European regions. Members rated the clinical relevance of each application and determined whether it should be classified as basic, advanced, or excluded.

The panel evaluated 11 ultrasound areas with 197 subsections, derived from expert input and refined by consensus to reflect current practice and anticipated developments.

Specific diagnostic uses, such as detection of pericardial effusion, and integration into clinical scenarios, such as PoCUS in cardiac arrest or dyspnea, were assessed, as were technical aspects like knobology, image documentation, and ultrasound-guided procedures. The survey covered all dimensions of PoCUS in emergency medicine. A Likert scale, a common survey method using 5–7 points, was applied [33], enabling respondents to indicate their agreement with each indication. Responses were grouped as Strongly Agree, Agree, Neutral, Disagree, or Strongly Disagree. Additional data included familiarity with the subject, whether the member practiced that PoCUS application, and comments. We opted for the most common definition of consensus, namely the percentage of agreement. In summary, a consensus of 70–80 % is considered acceptable, while 90–100 % is only required when high precision is necessary, such as in the case of end-of-life guidelines [34].

3.1.3 Data Collection

Two rounds of surveys via SurveyMonkey were sent to all EUSEM Ultrasound Section members by EUSEM staff, asking them to rank applications as basic or advanced. The compendium list was not meant to represent universal practice in each country but rather to reflect the diversity and evolving development of emergency ultrasound across Europe. Participants were encouraged to add comments, suggest new topics, or recommend reclassification of indications between tiers.

Round 1 (December 2023): The first survey was distributed to 56 panel members from 15 European countries. Panelists reviewed 197 ultrasound applications in 11 areas. Responses were grouped as Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree. Members could also propose new applications or suggest tier changes. Applications with ≥ 70 % combined “Strongly Agree” and “Agree” responses were included in the compendium tier. As no standard cut-off exists, 70 % was considered valid [34].

Round 2 (April 2024): The second survey included 67 eligible panel members from 20 countries, reflecting new participants. Applications with > 70 % agreement from round one were not resurveyed. Topics with < 70 % agreement were presented again, with some reclassified or merged, and new topics added. A total of 23 subsections in the basic tier and 46 in the advanced tier were adjusted. Panelists were additionally asked about familiarity, access to technology, and whether they had performed more or fewer than 100 exams in each category, to gauge expertise in lower-agreement areas. A total of one hundred exams was considered a rough benchmark for sufficient experience. Applications with ≥ 70 % “Strongly Agree” and “Agree” responses after excluding “Neutral” were included in their compendium tier.

3.1.4 Analysis

Percentages of “Strongly Agree” and “Agree” were summarized. Where 70 % was not reached, neutral responses were excluded and percentages were recalculated. A threshold of ≥ 70 % was again applied to capture broader consensus in borderline cases. This adjustment aimed to capture a broader consensus in cases where direct agreement was not predominant but still notable.

3.2 Results

3.2.1 Expert panel members

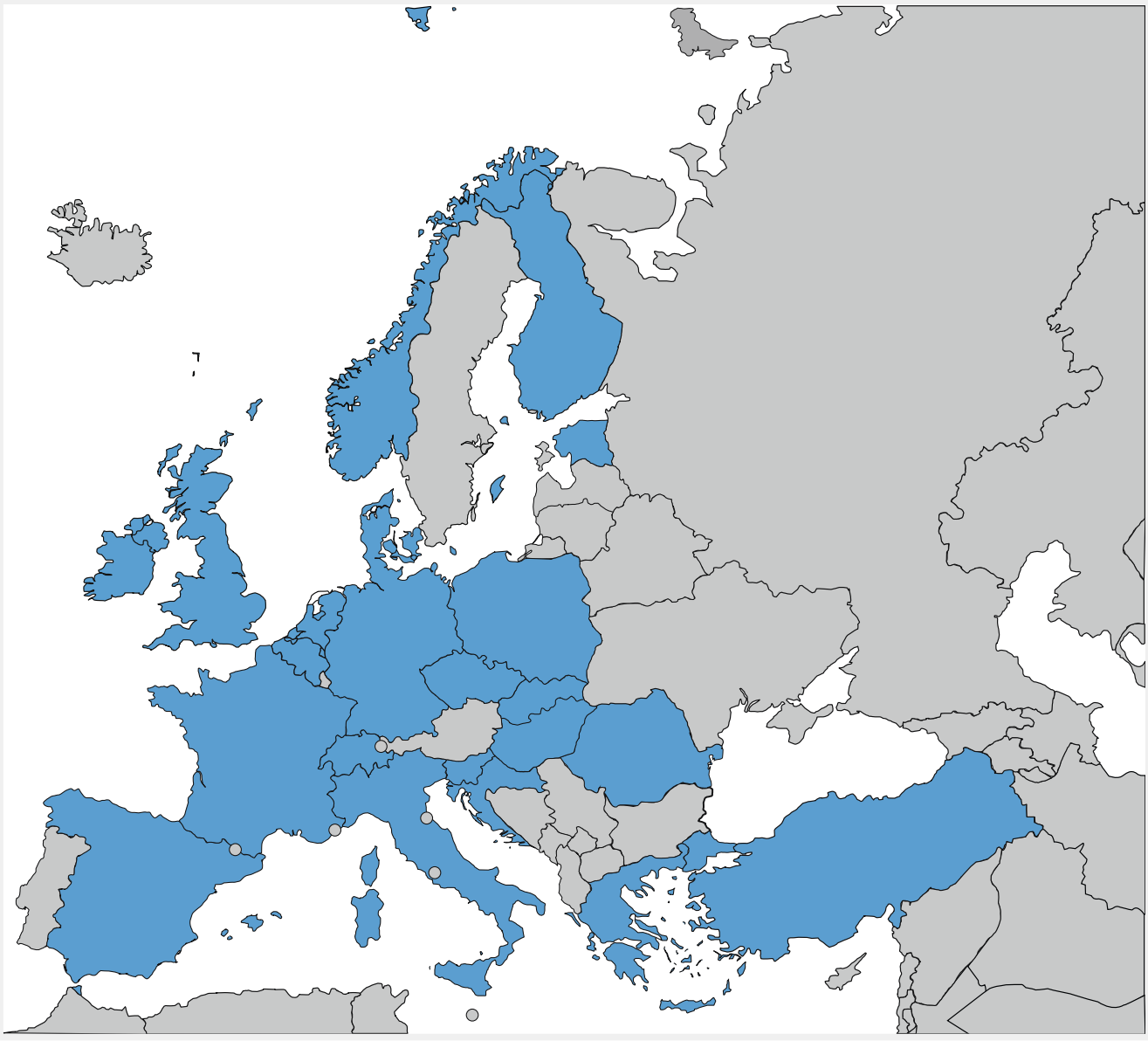
Expert panel members were members of the EUSEM Ultrasound Section and educational PoCUS leaders in their countries. A total of 85 expert panel members completed at least one round of the survey, and 2 international, non-European experts were invited as guests to give input on the survey design and structure. They had no voting privileges as they did not practice in Europe. The panel represented 22 countries (▶ **Fig. 1**).

3.2.2 Round 1

The survey response rate was 69.6 % (n = 39). Good positive agreement among the panel experts was observed for 63.9 % (n = 126) of the 197 topics. For the basic compendium tier, consensus was reached for the following categories of applications: technical knowledge and skills, chest ultrasound, abdominal and retroperitoneal ultrasound, vessels, soft tissue and musculoskeletal, pediatrics, and procedures. For the advanced tier compendium, consensus was observed for the following categories of applications: ocular, procedures, integration into clinical scenarios/syndromes.

3.2.3 Round 2

The survey response rate was 68.6 % (n = 46). Good positive agreement among the experts was observed for 36.6 % (n = 26) of the 71 applications. For the basic compendium tier, consensus was reached for the following categories of applications: technical knowledge and skills, chest ultrasound, abdominal and retroperitoneal ultrasound, male and female genitourinary, vessels, musculoskeletal, ocular. In the advanced tier, no applications initially reached agreement > 70 %. After deduction of “neutral” responses, consensus was reached for the following categories: chest ultrasound, male and female genitourinary ultrasound, vessels, pediatrics, and ENT. Topics integrated into clinical scenarios/syndromes reached consensus for both curricula.



▶ **Fig. 1** Geographical distribution of survey participants

3.2.4 Final Results

▶ **Table 1** (online supplement) summarizes the consensus process and results of both rounds, divided into basic and advanced. The final numbers are derived from topics <70 % in round one, modified topics, merged topics, new suggestions, and those moved between tiers. Topics with ≥70 % agreement via "strongly agree" and "agree" on a 5-level Likert scale are shown in ▶ **Table 2** (online supplement). Topics with ≥70 % agreement after excluding neutral answers, or those without consensus, are in ▶ **Table 3** and ▶ **Table 4** (online supplement). The final compendium appears in ▶ **Table 5**.

4. Discussion

This is the first EUSEM Emergency Ultrasound Curriculum Compendium, developed by a large, diverse expert panel of the EUSEM Ultrasound Section. It represents the first structured outline of basic and advanced applications for Europe. While Delphi surveys often involve 8–23 participants, our higher number ensured representation from almost all European regions, including countries where EM is well established and others that are still developing. To ensure geographic and practice diversity, we did not use the Delphi method. Among round 1 responders, 61.5 % also responded to round 2, suggesting continuity. The threshold of ≥70 % positive agreement is recognized in the literature [34, 35]. Re-analysis of applications below 70 % is not an international standard but was adopted after core group discussion. Based on this threshold, topics in Tables 2 and 3 are included. Eight topics were excluded,

▶ **Table 1** Basic and Advanced Tier-Consensus Process. The final numbers consist of and are calculated from the number of topics < 70 % of round 1, topics in modified form, topics merged, new topics suggested by the participants and topics moved from basic to advanced tier and vice versa. GI: gastrointestinal, GU: genitourinary, MSK: musculoskeletal, ENT: Ear, Nose, Throat.

Basic Tier							
Applications	**Round 1**		**Round 2**			**Rounds 1 and 2**	
	Total topics presented	**Total topics with > 70 % agreement**	**Total topics presented**	**Topics with > 70 % agreement**	**Topics with > 70 % agreement without neutral answers**	**Number of topics rejected**	**Final number of topics included in the curriculum**
1. Technical knowledge and knobology	7	7	1	1	–	–	8
2. Chest ultrasound (cardiac and lung)	9	9	2	2	–	–	11
3. Abdominal and retroperitoneal ultrasound (biliary, GI, aorta, renal)	10	9	2	2	–	–	11
4. Male and female GU	8	4	2	2	–	–	6
5. Vessels	1	1	1	1	–	–	2
6. Soft tissue and MSK	8	7	1	1	–	–	8
7. Ocular	4	1	3	3	–	–	4
8. Pediatrics	5	5	4	2	1	–	9
9. ENT	1	0	1	–	–	1	–
10. Procedures	9	7	3	2	1	–	10
11. Integration into clinical scenarios/ syndromes	14	5	3	3	–	–	8
Total	76	55	24	20	2	1	77
Advanced Tier							
Applications	**Round 1**		**Round 2**			**Round 1 and 2**	
	Total topics presented	**Total topics with > 70 % agreement**	**Total topics presented**	**Topics with > 70 % agreement**	**Topics with > 70 % agreement without neutral answers**	**Number of topics rejected**	**Final number of topics included in the curriculum**
1. Technical knowledge and knobology	4	2	3	1	1	1	4
2. Chest ultrasound (cardiac and lung)	13	7	6	–	4	2	10
3. Abdominal and retroperitoneal ultrasound (biliary, GI, aorta, renal)	28	13	10	5	3	1	19
4. Male and female GU	10	5	4	–	4	–	9
5. Vessels	5	3	3	–	3	–	6
6. Soft tissue and MSK	7	4	4	–	2	1	6
7. Ocular	6	5	1	–	-	1	4
8. Pediatrics	21	10	9	–	9	–	17
9. ENT	3	1	3	–	3	–	4
10. Procedures	10	8	2	–	1	1	7
11. Integration into clinical scenarios/ syndromes	14	13	1	1	–	–	6
Total	121	71	46	7	30	7	92

▶ **Table 2** Topics that reached agreement of ≥ 70 % via “strongly agree” and “agree”. FAST: Focused Assessment with Sonography in Trauma, CBD: common Bile Duct, DVT: Deep Vein Thrombosis, VTI: Velocity Time Integral, MSK:musculoskeletal, LV: left ventricle, EMS: Emergency Medical Services, NG: nasogastric.

1.0	Technical Knowledge and Skills	STRONGLY AGREE+ AGREE (%)
1.1	**Basic**	
	1.1.1 Transducers	100 %
	1.1.2 Probe Movements	97.4 %
	1.1.3 Modes	97.4 %
	1.1.4 Planes	97.4 %
	1.1.5 Artifacts	100 %
	1.1.6 Storage and Documentation	92.3 %
	1.1.7 Safety and Material Management	84.6 %
	1.1.8 Disinfection of Equipment After Use	93.4 %
1.2	**Advanced**	
	1.2.1 Advanced Knobology	94.8 %
	1.2.2 Advanced Doppler	87.1 %
	1.2.3 Power Doppler	83.3 %
2.0	**Chest Ultrasound**	
2.1	**Basic**	
	2.1.1 Basic Cardiac Views	100 %
	2.1.2 Pericardial Fluid	100 %
	2.1.3. Tamponade Signs	97.9 %
	2.1.4 Left Ventricular Function – Visual Assessment	94.8 %
	2.1.5 Right Ventricular Size, Dilatation, Function – Visual Assessment	94.8 %
	2.1.6 Inferior Vena Cava Size and Collapsibility	97.4 %
	2.1.7 Pleural Effusion	94.8 %
	2.1.8 Lung Congestion	92.1 %
	2.1.9 Consolidation	82.0 %
	2.1.10 Basic Lung Views (Anterior, Lateral, Posterior)	100 %
	2.1.11 Pneumothorax	97.3 %
2.2	**Advanced**	
	2.2.1 Diastolic Dysfunction	89.7 %
	2.2.2 Regional Wall Motion Abnormalities	84.6 %
	2.2.3 Valvular Assessment	79.4 %
	2.2.4 VTI	83.3 %
	2.2.5 Pulmonary Hypertension Evaluation	71.6 %
	2.2.6 Thoracic Aorta	84.6 %
3.0	**Abdominal and Retroperitoneal Ultrasound**	
3.1	**Basic**	
	3.1.1 Aortic and Iliac Aneurysm	97.4 %
	3.1.2 Free Intra-Abdominal Fluid Identification	100 %
	3.1.3 Hydronephrosis Assessment	100 %
	3.1.4 Bladder Distention	100 %
	3.1.5 Quantitative Bladder Volume Assessment	71.7 %
	3.1.6 Gallbladder and Gallbladder Wall Assessment	84.6 %
	3.1.7 Gallstones and Sludge	87.1 %

▶ **Table 2** (Continuation)

1.0	Technical Knowledge and Skills	STRONGLY AGREE+ AGREE (%)
	3.1.8 Acute Cholecystitis	84.6 %
	3.1.9 Recognize the Sonographic Appearance and Location of Other Organs	82.0 %
	3.1.10 Ureteral Jets	77.1 %
	3.1.11 General Ileus	87.5 %
3.2	**Advanced**	
	3.2.1 Doppler of Aorta and Branches	79.4 %
	3.2.2 Additional Abdominal FAST Views	77.1 %
	3.2.3 Hepatic and Splenic Lacerations	71.7 %
	3.2.4 Renal Doppler Flow	71.7 %
	3.2.5 CBD Assessment and Intrahepatic Biliary Dilatation	89.7 %
	3.2.6 Gallbladder Polyps and Masses	79.4 %
	3.2.7 Retroperitoneal Fluid or Hematoma	74.4 %
	3.2.8 Hemorrhage and/or Ischemia of Solid Abdominal Organs	74.4 %
	3.2.9 Cirrhosis and Ascites	78.7 %
	3.2.10 Hydroureter	87.5 %
	3.2.11 Appendicitis	89.7 %
	3.2.12 Diverticulitis	74.3 %
	3.2.13 Pneumoperitoneum	87.1 %
	3.2.14 Hernia	82.0 %
	3.2.15 Intussusception	82.0 %
	3.2.16 Splenomegaly	84.6 %
	3.2.17 Full or Empty Stomach (Gastroparesis)	70.2 %
4.0	**Genitourinary Ultrasound**	
4.1	**Basic**	
	4.1.1 Uterus	84.6 %
	4.1.2 Fetal Heart Rate and/or Fetal Movements in Pregnancy	81.2 %
	4.1.3 Free Fluid in Ruptured Ectopic	97.4 %
	4.1.4 Recognizing Intrauterine Pregnancy	87.1 %
	4.1.5 Fluid or Hematoma in the Scrotum	81.2 %
	4.1.6 Recognizing Scrotal Soft Tissue Free Air and Cellulitis	74.3 %
4.2	**Advanced**	
	4.2.1 Placenta Location in Pregnancy	74.3 %
	4.2.2 Ovaries and Ovarian Torsion	74.3 %
	4.2.3 Scrotum-Hydrocele	79.4 %
	4.2.4 Scrotum and Epididymitis/Orchitis	84.6 %
	4.2.5 Testes and Testicular Torsion	87.1 %
5.0	**Vessels**	
5.1	**Basic**	
	5.1.1 Lower Extremity-3 Point Compression Exam	82.0 %
	5.1.2 Lower Extremity-Focused Venous Doppler Exam	81.2 %
5.2	**Advanced**	
	5.2.1 Venous Thrombus of Torso or Neck Vessels	71.7 %
	5.2.2 Arterial Doppler of Extremities	73.6 %
	5.2.3 DVT of Upper Extremity	82.0 %

▶ **Table 2** (Continuation)

1.0	Technical Knowledge and Skills	STRONGLY AGREE+ AGREE (%)
6.0	**MSK and Soft Tissue**	
6.1	**Basic**	
	6.1.1 Foreign Body Localization and Removal	89.7%
	6.1.2 Abscess Detection and Drainage	94.8%
	6.1.3 Cellulitis	84.6%
	6.1.4 Free Air in Soft Tissue/Necrotizing Fasciitis	87.1%
	6.1.5 Tendinopathy, Including Tendinitis, Rendon Rupture	70.8%
	6.1.6 Large Bone Fractures	89.5%
	6.1.7 Large Joint Effusion	82.0%
	6.1.8 Large Tendon Rupture	76.9%
6.2	**Advanced**	
	6.2.1 Muscle Rupture	84.6%
	6.2.2 Bursitis	84.6%
	6.2.3 Lymph Node Assessment	84.6%
	6.2.4 Small Joint Effusion	74.3%
7.0	**Ocular**	
7.1	**Basic**	
	7.1.1 Retinal Detachment	85.4%
	7.1.2 Vitreous Detachment or Hemorrhage	77.1%
	7.1.3 Globe Rupture	72.9%
	7.1.4 ONSD	71.7%
7.2	**Advanced**	
	7.2.1 Foreign Body Detection	89.7%
	7.2.2 Papilledema	82.0%
	7.2.3 Lens Dislocation	79.4%
	7.2.4 Retrobulbar Hematoma and Air	82.0%
8.0	**Pediatrics**	
8.1	**Basic**	
	8.1.1 Intra-Abdominal Free Fluid and FAST	94.8%
	8.1.2 Pericardial Fluid	92.3%
	8.1.3 LV Function Estimation	89.7%
	8.1.4 Lung Congestion, Consolidation, Pleural Effusion, Pneumothorax	84.6%
	8.1.5 Edema, Cellulitis, Effusions, and Fractures	76.9%
	8.1.6 Hydronephrosis and Bladder Volume	72.9%
	8.1.7 Venous and arterial Vessels Access	84.6%
8.2	**Advanced**	
	8.2.1 Intussusception	84.2%
	8.2.2 Ileus	78.3%
	8.2.3 Appendicitis	84.2%
	8.2.4 Hydronephrosis and Bladder Volume	89.7%
	8.2.5 Right Heart Strain	71.0%
	8.2.6 Identification of Edema, Inflammation, Infection, and Retained Foreign Bodies	71.7%

▶ **Table 2** (Continuation)

1.0	Technical Knowledge and Skills	STRONGLY AGREE+ AGREE (%)
	8.2.7 Identification of Fractures, Joint Dislocation, and Soft Tissue Trauma	84.6 %
	8.2.8 Guidance of Intubation of Trachea or NG Tube Placement	84.2 %
	8.2.9 Puncture of Spaces for Fluid Aspiration	86.8 %
9.0	**ENT**	
9.1	**Advanced**	
	9.1.1 Peritonsillar Abscess Identification and Drainage	71.7 %
10.0	**Procedures**	
10.1	**Basic**	
	10.1.1 Peripheral Intravenous Line Placement	97.4 %
	10.1.2 Central Line Intravenous Placement	94.8 %
	10.1.3 Pericardiocentesis	74.3 %
	10.1.4 Thoracentesis	87.1 %
	10.1.5 Paracentesis	87.1 %
	10.1.6 Ultrasound-Guided Arthrocentesis	75.0 %
	10.1.7 Abscess Identification and Drainage	89.7 %
	10.1.8 Foreign Body Removal	86,8 %
	10.1.9 Ultrasound-Guided Arterial Line Placement	94.2 %
10.2	**Advanced**	
	10.2.1 Suprapubic Aspiration/Catheter Placement	87.1 %
	10.2.2 Joint Aspiration	92.3 %
	10.2.3 Fascia Plane Blocks	89.7 %
	10.2.4 Joint Dislocation Reduction	74.3 %
	10.2.5 Lumbar Puncture	82.0 %
	10.2.6 Ultrasound-Guided Tracheal Intubation	71.7 %
	10.2.7 Gastric Tube Placement and Verification	71.4 %
11.0	**Integration into Clinical Scenarios/Syndromes**	
11.1	**Basic**	
	11.1.1 Cardiac Arrest	92.3 %
	11.1.2 General Trauma	94.7 %
	11.1.3 Undifferentiated Hypotension	84.2 %
	11.1.4 Volume Status Assessment and Fluid Responsiveness	79.4 %
	11.1.5 Undifferentiated Chest Pain	89.5 %
	11.1.6 Undifferentiated Dyspnea	73.6 %
	11.1.7 Undifferentiated Abdominal or Back Pain	85.4 %
	11.1.8 Undifferentiated Fever	70.8 %
11.2	**Advanced**	
	11.2.1 Acute Pregnancy Complaints	79.4 %
	11.2.2 Extremity Swelling and Pain	87.1 %
	11.2.3 Musculoskeletal Injury or Pain	79.4 %
	11.2.4 Acute Vision Change or Loss	82.0 %
	11.2.5 Acute Illness in Pediatrics	87.1 %
	11.2.6 EMS Integration	89.7 %
	11.2.7 Undifferentiated Fever	81.2 %

▶ **Table 3** Topics that reached ≥ 70 % agreement via "strongly agree" and "agree" without the neutral answers. CEUS: Contrast-enhanced ultrasound, TIPS: Transjugular Intrahepatic Portosystemic Shunt,MSK: musculoskeletal,VTI: Velocity Time Integral, ONSD: Optic Nerve Sheath Diameter, ENT: Ear, Nose, Throat, E-FAST:extended-Focused Assessment with Sonography in Trauma.

		STRONGLY AGREE + AGREE (%)	PERFORMED <100 EXAMS	NO ACCESS/ NO TRAINING	WITHOUT NEUTRAL ANSWERS
1.0	**Technical Knowledge and Skills**				
1.2	**Advanced**				
	Contrast/CEUS	45.8 %	19.0 %	57.4 %	70.7 %
2.0	**Chest Ultrasound**				
2.2	**Advanced**				
	Pleural Irregularities and Masses	62.5 %	23.4 %	25.5 %	86.5 %
	Differentiation of Lung Consolidations (Inflammatory, Vascular, Mechanical, Tumor)	66.6 %	27.6 %	21.2 %	88.8 %
	Diaphragm Function and Anatomical Abnormalities	60.4 %	27.6 %	31.9 %	80.5 %
	Vertical Lung Artifacts for Differentiation of Important Interstitial Lung Pathologies	58.3 %	25.5 %	23.4 %	87.4 %
3.0	**Abdominal and Retroperitoneal Ultrasound**				
3.2	**Advanced**				
	Renal Stone Localization	68.1 %	29.7 %	19.1 %	84.1 %
	Cysts or Masses or Signs of Infection/Inflammation in Abdominal Organs	64.5 %	34.0 %	21.2 %	86.0 %
	Recognizing Abdominal Catheters or Stents and Evaluation (i. e., Detection of a Renal Stent or TIPS)	51.0 %	34.0 %	29.7 %	77.2 %
4.0	**Genitourinary Ultrasound**				
4.2	**Advanced**				
	Uterine or Ovarian Masses or Cysts	66.6 %	42.5 %	19.1 %	77.9 %
	Adnexal Abnormalities in Pelvic Inflammatory Disease	47.9 %	29.7 %	46.8 %	71.8 %
	Scrotum-Hernia	66.6 %	36.1 %	36.1 %	91.3 %
	Testicular Hematoma or Masses	66.6 %	31.9 %	27.6 %	86.3 %
5.0	**Vessels**				
5.2	**Advanced**				
	Arterial Doppler of Torso Vessels (i. e., Subclavian Artery)	52.1 %	25.5 %	40.4 %	78.1 %
	Arterial Doppler of Neck and/or Head Vessels (i. e., Carotid or Vertebral Vessels)	64.6 %	34.0 %	25.5 %	83.1 %
	Hemodialysis Shunt Evaluation for Presence/Absence of Flow	41.6 %	29.7 %	53.1 %	76.7 %
6.0	**MSK and Soft Tissue**				
6.2	**Advanced**				
	Small Bone Fractures	69.2 %	19.1 %	12.7 %	87.0 %
	Joint Dislocation	64.5 %	29.7 %	27.6 %	88.4 %
7.0	**Ocular**				
8.0	**Pediatrics**				
8.1	**Basic**				
	Hematoma	60.4 %	17.0 %	34.0 %	96.6 %
	Puncture of Spaces for Fluid Aspiration	66.6 %	10.6 %	31.9 %	91.3 %
8.2	**Advanced**				
	Pyloric Stenosis	66.6 %	21.2 %	68.0 %	93.9 %
	VTI	54.1 %	29.7 %	40.4 %	99.8 %
	Valvular Assessment	57.4 %	38.2 %	38.2 %	86.9 %

▶ **Table 3** (Continuation)

		STRONGLY AGREE + AGREE (%)	PERFORMED <100 EXAMS	NO ACCESS/ NO TRAINING	WITHOUT NEUTRAL ANSWERS
	Pleural Irregularities and Masses	58.3%	31.9%	44.6%	87.4%
	Lumbar Puncture Guidance	64.5%	36.1%	44.6%	96.7%
	Evaluation for Testicular Torsion and Ovarian Torsion or Infection, Inflammation	68.7%	23.4%	42.5%	91.6%
	Peritonsillar Abscess	60.4%	21.2%	59.5%	90.5%
	Ocular Trauma and ONSD	64.5%	27.6%	51.0%	96.7%
	Venous and Arterial Doppler of Major Vessels	62.5%	25.5%	31.9%	93.7%
9.0	**ENT**				
9.2	**Advanced**				
	Salivary Gland Edema or Stones	56.2%	12.7%	63.8%	74.9%
	Sinusitis	46.8%	25.5%	65.9%	70.9%
	Neck Soft-Tissue Swelling and Masses (i. e., Ludwig's Angina)	60.4%	31.9%	44.6%	87.7%
10.0	**Procedures**				
10.1	**Basic**				
	Ultrasound-Guided Nerve Blocks	68.7%	14.8%	25.5%	82.3%
10.2	**Advanced**				
	Ultrasound-Guided Transthoracic Temporary Transvenous Pacer Wire Placement Localization in the Heart/Verification of Placement	64.6%	25.5%	57.4%	83.7%
11.0	**Integration into Clinical Scenarios/Syndromes**	–	–	–	–

▶ **Table 4** Topics that reached no agreement. E-FAST: extended-Focused Assessment with Sonography in Trauma, CEUS: Contrast-enhanced ultrasound, MSK: musculoskeletal, ENT: Ear, Nose, Throat.

		STRONGLY AGREE + AGREE (%)	PERFORMED <100 EXAMS	NO ACCESS/ NO TRAINING	WITHOUT NEUTRAL ANSWERS
1.0	**Technical Knowledge and Skills**				
1.2	**Advanced**				
	Microflow or B-Flow	42.5%	31.9%	48.9%	68.8%
2.0	**Chest Ultrasound**				
2.2	**Advanced**				
	Transesophageal Echo (TEE)	47.9%	21.2%	61.7%	67.5%
	Lung Doppler	35.4%	34.0%	44.6%	53.0%
3.0	**Abdominal and Retroperitoneal Ultrasound**				
3.2	**Advanced**				
	E-FAST Performed with Contrast/CEUS Use	45.8%	19.1%	70.2%	62.8%
4.0	**Genitourinary Ultrasound**	–	–	–	–
5.0	**Vessels**	–	–	–	–
6.0	**MSK and Soft Tissue**				
6.2	**Advanced**				
	Nerve Injuries and Entrapment Syndromes	39.5%	23.4%	57.4%	61.1%
7.0	**Ocular**				

▶ **Table 4** (Continuation)

		STRONGLY AGREE + AGREE (%)	PERFORMED <100 EXAMS	NO ACCESS/ NO TRAINING	WITHOUT NEUTRAL ANSWERS
7.2	**Advanced**				
	Orbital Fossa Assessment Including Doppler	29.1%	27.6%	65.9%	60.7%
8.0	**Pediatrics**	–	–	–	–
9.0	**ENT**				
9.1	**Basic**				
	Fluid Collection Jaw Bones (Dental Abscess)	31.2%	14.8%	68.0%	51.5%
10.0	**Procedures**				
10.2	**Advanced**				
	Ultrasound-Guided Cricothyroidotomy	51.2%	31.9%	53.1%	62.9%
11.0	**Integration into Clinical Scenarios/Syndromes**	–	–	–	–

▶ **Table 5** Final Compendium. CEUS: Contrast-enhanced ultrasound, TIPS: Transjugular Intrahepatic Portosystemic Shunt, VTI; Velocity Time Integral, CBD: Common Bile Duct, MSK: musculoskeletal, LV: Left Ventricle, ONSD: Optic Nerve Sheath Diameter, FAST: Focused Assessment with Sonography in Trauma, ENT: Ear, Nose, Throat, EMS: Emergency Medical Services.

1.0	**Technical Knowledge and Skills**
1.1	**Basic**
	1.1.1 Transducers
	1.1.2 Probe Movements
	1.1.3 Modes
	1.1.4 Planes
	1.1.5 Artifacts
	1.1.6 Storage and Documentation
	1.1.7 Safety and Material Management
	1.1.8 Disinfection of Equipment after Use
1.2	**Advanced**
	1.2.1 Advanced Knobology
	1.2.2 Advanced Doppler
	1.2.3 Power Doppler
	1.2.4 CEUS
2.0	**Chest Ultrasound**
2.1	**Basic**
	2.1.1 Basic Cardiac Views
	2.1.2 Pericardial Fluid
	2.1.3. Tamponade Signs
	2.1.4 Left Ventricular Function – Visual Assessment
	2.1.5 Right Ventricular Size, Dilatation, Function – Visual Assessment
	2.1.6 Inferior Vena Cava Size and Collapsibility
	2.1.7 Pleural Effusion
	2.1.8 Lung Congestion
	2.1.9 Consolidation
	2.1.10 Basic Lung Views (Anterior, Lateral, Posterior)
	2.1.11 Pneumothorax

▶ **Table 5** (Continuation)

2.2	**Advanced**
	2.2.1 Diastolic Dysfunction
	2.2.2 Regional Wall Motion Abnormalities
	2.2.3 Valvular Assessment
	2.2.4 VTI
	2.2.5 Pulmonary Hypertension Evaluation
	2.2.6 Thoracic Aorta
	2.2.7 Pleural Irregularities and Masses
	2.2.8 Differentiation of Lung Consolidations (Inflammatory, Vascular, Mechanical, Tumor)
	2.2.9 Diaphragm Function and Anatomical Abnormalities
	2.2.10 Vertical Lung Artifacts for Differentiation of Important Interstitial Lung Pathologies
3.0	**Abdominal and Retroperitoneal Ultrasound**
3.1	**Basic**
	3.1.1 Aortic and Iliac Aneurysm
	3.1.2 Free Intra-Abdominal Fluid Identification
	3.1.3 Hydronephrosis Assessment
	3.1.4 Bladder Distention
	3.1.5 Quantitative Bladder Volume Assessment
	3.1.6 Gallbladder and Gallbladder Wall Assessment
	3.1.7 Gallstones and Sludge
	3.1.8 Acute Cholecystitis
	3.1.9 Recognize the Sonographic Appearance and Location of other Organs
	3.1.10 Ureteral Jets
	3.1.11 General Ileus
3.2	**Advanced**
	3.2.1 Doppler of Abdominal Vessels and Branches
	3.2.2 Additional Abdominal FAST Views
	3.2.3 Hepatic and Splenic Lacerations
	3.2.4 Recognizing Abdominal Catheters or Stents and Evaluation (i. e., Detection of a Renal Stent or TIPS)
	3.2.5 CBD Assessment and Intrahepatic Biliary Dilatation
	3.2.6 Gallbladder Polyps and Masses
	3.2.7 Retroperitoneal Fluid or Hematoma
	3.2.8 Hemorrhage and/or Ischemia of Solid Abdominal Organs
	3.2.9 Cirrhosis and Ascites
	3.2.10 Hydroureter
	3.2.11 Appendicitis
	3.2.12 Diverticulitis
	3.2.13 Pneumoperitoneum
	3.2.14 Hernia
	3.2.15 Intussusception
	3.2.16 Splenomegaly
	3.2.17 Full or Empty Stomach (Gastroparesis)
	3.2.18 Renal Stone Localization
	3.2.19 Cysts or Masses or Signs of Infection/Inflammation in Abdominal Organs

▶ **Table 5** (Continuation)

4.0	**Genitourinary Ultrasound**
4.1	**Basic**
	4.1.1 Uterus
	4.1.2 Fetal Heart Rate and/or Fetal Movements in Pregnancy
	4.1.3 Free Fluid in Ruptured Ectopic
	4.1.4 Recognizing Intrauterine Pregnancy
	4.1.5 Fluid or Hematoma in the Scrotum
	4.1.6 Recognizing Scrotal Soft Tissue Free Air and Cellulitis
4.2	**Advanced**
	4.2.1 Placenta Location in Pregnancy
	4.2.2 Ovaries and Ovarian Torsion
	4.2.3 Uterine or Ovarian Masses or Cysts
	4.2.4 Adnexal Abnormalities in Pelvic Inflammatory Disease
	4.2.5 Scrotum-Hernia
	4.2.6 Scrotum-Epididymitis /Orchitis
	4.2.7 Scrotum-Hydrocele
	4.2.8 Testicular Hematoma or Masses
	4.2.9 Testis and testicular Torsion
5.0	**Vessels**
5.1	**Basic**
	5.1.1 Lower Extremity 3-Point Compression Exam
	5.1.2 Lower Extremity Focused Venous Doppler Exam
5.2	**Advanced**
	5.2.1 Venous Thrombosis of Torso or Neck Vessels
	5.2.2 Deep Vein Thrombosis of Upper Extremity
	5.2.3 Arterial Doppler of Extremities
	5.2.4 Arterial Doppler of Torso Vessels (i. e., Subclavian Artery)
	5.2.5 Arterial Doppler of Neck and/or Head Vessels (i. e., Carotid or Vertebral Vessels)
	5.2.6 Hemodialysis Shunt Evaluation for Presence/Absence of Flow
6.0	**MSK and Soft Tissue**
6.1	**Basic**
	6.1.1 Foreign Body Localization and Removal
	6.1.2 Abscess Detection and Drainage
	6.1.3 Cellulitis
	6.1.4 Free Air in Soft Tissue/Necrotizing Fasciitis
	6.1.5 Tendinopathy, Including Tendinitis
	6.1.6 Large Bone Fractures
	6.1.7 Large Joint Effusion
	6.1.8 Large Tendon Rupture
6.2	**Advanced**
	6.2.1 Muscle Rupture
	6.2.2 Bursitis
	6.2.3 Lymph Node Assessment
	6.2.4 Small Joint Effusion
	6.2.5 Small Bone Fractures
	6.2.6 Joint Dislocation

▶ **Table 5** (Continuation)

7.0	**Ocular**
7.1	**Basic**
	7.1.1 Retinal Detachment
	7.1.2 Vitreous Detachment or Hemorrhage
	7.1.3 Globe Rupture
	7.1.4 ONSD
7.2	**Advanced**
	7.2.1 Foreign Body Detection
	7.2.2 Papilledema
	7.2.3 Lens Dislocation
	7.2.4 Retrobulbar Hematoma and Air
8.0	**Pediatrics**
8.1	**Basic**
	8.1.1 Intra-Abdominal Free Fluid and FAST
	8.1.2 Pericardial Fluid
	8.1.3 LV Function Estimation
	8.1.4 Lung Congestion, Consolidation, Effusion, Pneumothorax
	8.1.5 Edema, Cellulitis, Effusions, and Fractures
	8.1.6 Hematoma
	8.1.7 Hydronephrosis and Bladder Volume
	8.1.8 Venous and Arterial Vessels Access
	8.1.9 Puncture of Spaces for Fluid Aspiration
8.2	**Advanced**
	8.2.1 Intussusception
	8.2.2 Ileus
	8.2.3 Appendicitis
	8.2.4 Pyloric Stenosis
	8.2.5 Hydronephrosis and Bladder Volume
	8.2.6 VTI
	8.2.7 Right Heart Strain
	8.2.8 Valvular Assessment
	8.2.9 Pleural Irregularities and Masses
	8.2.10 Identification of Edema, Inflammation, Infection and Retained Foreign Bodies
	8.2.11 Identification of Fractures, Joint Dislocation, and Soft-Tissue Trauma
	8.2.12 Lumbar Puncture Guidance
	8.2.13 Evaluation for Testicular Torsion and Ovarian Torsion or Infection, Inflammation
	8.2.14 Peritonsillar Abscess
	8.2.15 Ocular Trauma and ONSD
	8.2.16 Venous and Arterial Doppler of Major Vessels
	8.2.17 Guidance of Intubation of Trachea or Nasogastric Tube Placement
9.0	**ENT**
9.2	**Advanced**
	9.2.1 Peritonsillar Abscess Identification and Drainage
	9.2.2 Salivary Gland Edema or Stones
	9.2.3 Sinusitis
	9.2.4 Neck Soft-Tissue Swelling and Masses (i. e., Ludwig's Angina)

▶ **Table 5** (Continuation)

10.0	**Procedures**
10.1	**Basic**
	10.1.1 Peripheral Intravenous Line Placement
	10.1.2 Central Line Intravenous Placement
	10.1.3 Pericardiocentesis
	10.1.4 Thoracentesis
	10.1.5 Paracentesis
	10.1.6 Ultrasound-Guided Arthrocentesis
	10.1.7 Abscess Identification and Drainage
	10.1.8 Foreign Body Removal
	10.1.9 Ultrasound-Guided Arterial Line Placement
	10.1.10 Ultrasound-Guided Nerve Blocks
10.2	**Advanced**
	10.2.1 Suprapubic Aspiration/Catheter Placement
	10.2.2 Fascia Plane Blocks
	10.2.3 Joint Dislocation Reduction
	10.2.4 Lumbar Puncture
	10.2.5 Ultrasound-Guided Tracheal Intubation
	10.2.6 Nasogastric Tube Placement and Verification
	10.2.7 Ultrasound-Guided Transthoracic Temporary Transvenous Pacer Wire Placement Localization in the Heart/ Verification of Placement
11.0	**Integration into Clinical Scenarios/Syndromes**
11.1	**Basic**
	11.1.1 Cardiac Arrest
	11.1.2 General Trauma
	11.1.3 Undifferentiated Hypotension
	11.1.4 Volume Status Assessment and Fluid Responsiveness
	11.1.5 Undifferentiated Chest Pain
	11.1.6 Dyspnea
	11.1.7 Abdominal or Back Pain
	11.1.8 Undifferentiated Fever
11.2	**Advanced**
	11.2.1 Acute Pregnancy Complaints
	11.2.2 Extremity Swelling and Pain
	11.2.3 Musculoskeletal Injury or Pain
	11.2.4 Acute Vision Change or Loss
	11.2.5 Acute Illness in Pediatrics
	11.2.6 EMS Integration

as consensus was not reached (▶ **Table 4**). Unsurprisingly, these showed low familiarity or practical experience.

Emergency ultrasound practice varies widely across Europe. Some advanced topics are routine in certain countries but absent in others. Experts still supported including both basic and advanced topics, showing that diverse EM and ultrasound practices can coexist. The many indications reflect rapid PoCUS development and integration in EM. Although EM recognition is expanding, its status and training vary across Europe, as does ultrasound practice. No consensus on topics with limited training suggests availability bias.

This compendium is a resource and guide for early PoCUS programs. It is not meant to replace local or national governance, accreditation, or training, but to supplement them. The goal is to provide a framework ensuring training standards and quality performance. While PoCUS is evolving, this document should be read alongside European Training Requirements [3].

4.1. Practical Implementation

This compendium provides a flexible framework for national societies, training programs, and hospitals. National bodies may use it to map curricula and align certification standards. Training programs can translate the tiered structure into competency-based milestones and learning objectives. Institutions may apply it to define local scope of practice, structure training pathways, and support quality assurance and faculty development, while adapting implementation to local resources and clinical needs.

4.2 Limitations

This curriculum compendium has several limitations. The expert panel was limited to members of the EUSEM Ultrasound Section, which may not fully represent all European emergency medicine practice environments. Access to ultrasound equipment, training infrastructure, and advanced technologies varies substantially across Europe and likely influenced responses. Finally, the compendium is based on expert consensus rather than patient-centered outcome data. Therefore, inclusion of applications reflects perceived clinical relevance and feasibility rather than proven impact on outcomes.

5. Future Perspectives

As PoCUS expands, future opportunities will enhance care, education, and research. Key areas outline future developments and challenges in emergency ultrasound.

5.1 Technological Advancements

Ultrasound advances will transform emergency physician practice. Future innovations will focus on:

Miniaturization and Portability: The increasing availability of highly portable, wireless ultrasound devices will enable greater accessibility for practitioners in resource-limited settings or pre-hospital and out-of-hospital care. This will allow for more integrated and real-time diagnostic imaging in the field, further enhancing emergency medical services (EMS) and physician's offices.

Artificial Intelligence (AI) Integration: We expect that AI-assisted ultrasound will continue to grow rapidly and become a standard application. It will likely help by automating image interpretation and improving diagnostic accuracy. AI supports users by identifying structures, giving feedback, detecting pathologies, and reducing errors. We believe increased presence of AI integration could help achieve more consistent outcomes across diverse healthcare settings, including training, interpretation and decision-making applications [4, 36].

Cloud-Based Data Sharing and Telemedicine: We expect the use of secure cloud-based platforms for ultrasound image storage and sharing will rapidly increase over time and help facilitate real-time remote consultation and learning. Tele-ultrasound may become standard practice, especially in rural or under-resourced areas [4, 37].

5.2 Expansion of Ultrasound Education

In the coming years, the Ultrasound Section of the European Society for Emergency Medicine will continue its central role in expanding, standardizing, and harmonizing PoCUS education across Europe.

Detailed Curriculum: Future expansions will harmonize training across Europe, aiming for standardized practice while maintaining local flexibility.

Continued Efforts to Incorporate Ultrasound into Early Medical Education: As ultrasound technology becomes integral to clinical practice, future education initiatives should focus on increasing the current number of early PoCUS training programs, including medical school curricula. Because ultrasound has a long learning curve, early exposure builds proficiency [38].

Development of Advanced Subspecialty Training: There is considerable opportunity in Europe to establish a structured pathway for subspecialty training in emergency medicine ultrasound. Advanced PoCUS fellowships and certification could foster expertise in both broad and specialized areas, expanding beyond current levels [39]. Pursuing additional subspecialization certification pathways should also be a priority [40].

5.3 Cross-Border Collaboration and Research

As emergency ultrasound continues to grow in prominence, fostering collaboration among European countries and creating European Emergency Medicine PoCUS research networks will be crucial in addressing shared challenges and opportunities in emergency care.

Cross-Border Standardization and Credentialing: With the diversity of healthcare systems across Europe, there is a need for more unified standards for certification, credentialing, and for mutual recognition of ultrasound qualifications across borders, allowing for greater workforce mobility and standardization of care and quality [41, 42].

Research and Evidence-Based Practice: The next decade should increase multinational collaborations to refine PoCUS outcomes and validate new uses. Key areas include PoCUS impact on outcomes, radiation reduction, cost-effectiveness, and new protocols. Research regarding the integration of Artificial Intelligence (AI) into ultrasound diagnostics will also be important [36].

Improving Access in Low-Resource Settings: We should explore a pivotal role in extending PoCUS education and access to under-resourced regions, both within Europe and globally. This may involve partnerships with humanitarian groups and governments to provide training and equipment to underserved areas [43, 44].

5.4 Addressing Barriers to Implementation

Despite the advantages, barriers to widespread PoCUS adoption remain.

Resource Limitations: In many systems, especially resource-limited ones, ultrasound equipment costs remain prohibitive. Future initiatives have to focus on addressing these barriers. Advances are needed to make portable devices accessible and easy to maintain.

Training and Competency Challenges: Although education and training programs are expanding, ensuring PoCUS competency and consistent outcomes remains a challenge. This is true for busy emergency departments with varied populations. Continuing Professional Development (CPD) and credentialing may be needed to maintain standards.

6. Conclusion and Vision

This compendium is the first step toward a European curriculum. The future of PoCUS is promising with new technology. Emergency physicians must continue to master real-time PoCUS use, while the EM community works to reduce barriers and foster innovation. The EUSEM Ultrasound Curriculum Compendium will adapt to new technologies and needs.

In the long term, the Compendium will adapt dynamically to new technologies and evolving healthcare needs.

Acknowledgement

EUSEM and especially the EUSEM Ultrasound Section, have a pivotal role in promoting the integration of Emergency Ultrasound in everyday practice and training, by providing a structured and comprehensive guide like the proposed document. This curriculum is endorsed by EUSEM Ultrasound Section, EUSEM Board, EUSEM Education Committee and UEMS Section and Board for Emergency Medicine.

Conflict of Interest

E. Polyzogopoulou has received honorarium for lecture from GE Healthcare, unrelated to this work.
J. Conolly is Board Member of Winfocus (unpaid), Trustee of World Wide Radiology Charity, Echonous (machine placement) and an advisory member for Medtronics.
O. Hannula owns a small company, Ultra-Mestarit Oy, which provides ultrasound training to medical professionals.
N. Parri has received honoraria as a speaker from Angelini Pharma and Mindray for educational events.
A. Souayad has received honoraria for presentations from Mindray
C. Yap has received honoraria for teaching from GE Healthcare and FujiFilm
All other authors have nothing to declare.

Contributors Statement

Effie Polyzogopoulou: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. Senad Tabakovic: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. Tim Harris: Conceptualization, Investigation, Writing – review & editing. Rudolf Horn: Conceptualization, Methodology, Writing – review & editing. James Anthony Connolly: Conceptualization, Writing – review & editing. Beatrice Hoffmann: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. Joseph Osterwalder: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

References

[1] Jarman RD, McDermott C, Colclough A et al. EFSUMB clinical practice guidelines for point-of-care ultrasound: Part one (common heart and pulmonary applications) long version. Ultraschall in Med 2023; 44 (1): e1–e24

[2] Härtel C, Prosen G, Brown R et al. European core curriculum for emergency medicine. European Society for Emergency Medicine. 2017.

[3] UEMS. European Training Requirements for the Specialty of Emergency Medicine. UEMS; 2025. Available from: [accessed 8.22.2025].

[4] Osterwalder J, Polyzogopoulou E, Hoffmann B. Point-of-care ultrasound – history, current and evolving clinical concepts in emergency medicine. Medicina (Kaunas) 2023; 59 (12): 2179

[5] Rettenmaier G. Sonografischer Oberbauchstatus. Internist (Berl) 1976; 17 (10): 549–64

[6] Holm HH, Kristensen JK, Rasmussen SN et al. Indications for ultrasonic scanning in abdominal diagnostics. J Clin Ultrasound 1974; 2 (1): 5–15

[7] Kristensen JK, Buemann B, Kühl E. Ultrasonic scanning in the diagnosis of splenic haematomas. Acta Chir Scand 1971; 137 (7): 653–7

[8] Nowotny C, Niessner H, Thaler E et al. Sonography: a method for localization of hematomas in hemophiliacs. Haemostasis 1976; 5 (2): 129

[9] Ferrucci JT Jr. Body ultrasonography (second of two parts). N Engl J Med 1979; 300 (11): 590–602

[10] Afschrift M, de Sy W, Voet D et al. Fractured kidney and retroperitoneal hematoma diagnosed by ultrasound. J Clin Ultrasound 1982; 10 (7): 335–6

[11] Sukul P, Villen T, Bobbia X et al. Basic certification process for point-of-care ultrasound in emergency medicine: a European perspective. Eur J Emerg Med 2021; 28 (4): 254–6

[12] Weill F, Bihr E, Rohmer P et al. Ultrasonic study of hepatic and splenic traumatic lesions. Eur J Radiol 1981; 1 (4): 245–9

[13] Schulz RD, Willi U. Ultraschalldiagnostik nach stumpfen Bauchverletzungen im Kindesalter. Ultraschall in Med 1983; 4 (3): 154–9

[14] Hauenstein KH, Wimmer B, Billmann P et al. Die Rolle der Sonographie beim stumpfen Bauchtrauma. Radiologie 1982; 22 (3): 106–11

[15] Schmoller H, Kunit G, Frick J. Sonography in blunt renal trauma. Eur Urol 1981; 7 (1): 11–5

[16] Moore CL, Copel JA. Point-of-care ultrasonography. N Engl J Med 2011; 364 (8): 749–57

[17] Royal College of Emergency Medicine. Ultrasound in emergency medicine – level 1 instruction. RCEMLearning; 2025. Available from: [accessed 8.22.2025].

[18] Martinez M, Duchenne J, Bobbia X et al. Deuxième niveau de compétence pour l'échographie clinique en médecine d'urgence. Ann Fr Med Urgence 2018; 8 (3): 193–202

[19] Nederlandse Vereniging van Spoedeisende Hulp Artsen. Spoedechografie. NVSHA; 2025. Available from: [accessed 8.22.2025].

[20] Magyar Sürgősségi Orvostani Társaság. Point-of-care ultrasonográfia (POCUS) képzési irányelv. 2018. Available from: [accessed 8.22.2025].

[21] Škulec R, Cmorej CP, Durila M et al. Emergency medicine ultrasound curriculum for emergency medicine physicians. Anest Intenziv Med 2018; 29 (6): 338–45

[22] TUKMOS. Acil Tıp Uzmanlık Eğitimi Çekirdek Müfredatı (v.2.4). 2018. Available from: [accessed 8.22.2025].

[23] Vives M, Hernández A, González AD et al. Diploma on ultrasound training and competency for intensive care and emergency medicine. Rev Esp Anestesiol Reanim 2021; 68 (3): 143–8

[24] SWESEM. Core curriculum för akutsjukvård. Svensk Förening för Akutsjukvård; 2023. Available from: [accessed 8.22.2025].

[25] Helsedirektoratet. Læringsmål for akutt- og mottaksmedisin. 2023. Available from: [accessed 8.22.2025].

[26] Dansk Selskab for Akutmedicin. Ekspertniveau POCUS. 2022. Available from: [accessed 8.22.2025].

[27] Deutsche Gesellschaft für Ultraschall in der Medizin (DEGUM). Kurscurriculum Notfallsonografie. Accessed June 29, 2025 at: https://www.degum.de/fachgebiete/arbeitskreise/notfallsonografie/kurscurriculum.html

[28] Österreichische Gesellschaft für Ultraschall in der Medizin (ÖGUM). Notfallsonographie – Zertifizierung nach den Dreiländerrichtlinien. Accessed June 29, 2025 at: https://neu.oegum.at/wp-content/uploads/2020/10/Notfallsonographie_-_OEGUM_Zertifizierung_nach_den_Dreilaenderrichtlinien.pdf

[29] Schweizerische Gesellschaft für Ultraschall in der Medizin (SGUM-SSUM). Fähigkeitsausweise. Accessed June 29, 2025 at: https://sgum-ssum.ch/faehigkeitsausweise

[30] Osterwalder J. Das SGUM-Zertifikat Notfallsonographie. Schweiz Ärzteztg 2012; 912: 1210–1213

[31] Michels G, Greim CA, Krohn A et al. Empfehlungen zur Sonografieausbildung in der prähospitalen Notfallmedizin (pPOCUS): Konsensuspapier von DGINA, DGAI, BAND, BV-ÄLRD, DGU, DIVI und DGIIN. Anaesthesiologie 2023; 72: 654–661

[32] Osterwalder J, Tabakovic S, Jenssen C et al. Emergency point-of-care ultrasound stewardship – a joint position paper by EuSEM and EFSUMB and endorsed by IFEM and WFUMB. Ultraschall in Med 2023; 44: 379–388

[33] Sullivan GM, Artino AR Jr. Analyzing and interpreting data from Likert-type scales. J Grad Med Educ 2013; 5: 541–542

[34] Shang Z. Use of Delphi in health sciences research: a narrative review. Medicine (Baltimore) 2023; 102: e32829

[35] Rodgers M, Thomas S, Harden M et al. Developing a methodological framework for organisational case studies: a rapid review and consensus development process. Southampton: NIHR Journals Library 2016.

[36] Kim J, Maranna S, Watson C et al. A scoping review on the integration of artificial intelligence in point-of-care ultrasound: Current clinical applications. Am J Emerg Med 2025; 92: 172–181

[37] Recker F, Höhne E, Damjanovic D et al. Ultrasound in Telemedicine: A Brief Overview. Applied Sciences 2022; 12 (3): 958

[38] Kern J, Scarpulla M, Finch C et al. The assessment of point-of-care ultrasound in acute care settings is benefitted by early medical school integration and fellowship training. J Osteopath Med 2022; 123 (2): 65–72

[39] Lewiss RE, Tayal VS, Hoffmann B et al. The core content of clinical ultrasonography fellowship training. Acad Emerg Med 2014; 21 (4): 456–61. doi:10.1111/acem.129

[40] Singh Y, Tissot C, Fraga MV et al. International evidence-based guidelines on point-of-care ultrasound for critically ill neonates and children: statement of the POCUS Working Group of the European Society of Paediatric and Neonatal Intensive Care (ESPNIC). Crit Care 2020; 24 (1): 65

[41] Smalley CM, Fertel BS, Broderick E. Standardizing point-of-care ultrasound credentialing across a large health care system. Jt Comm J Qual Patient Saf 2020; 46 (8): 471–6

[42] Russell FM, Kennedy SK, Rood LK et al. Design and implementation of a basic and global point-of-care ultrasound certification curriculum for emergency medicine faculty. Ultrasound J 2022; 14 (1): 10

[43] Herrera PM, Blair PW, Siddharthan T et al. Implementation of an international severe infection point-of-care ultrasound research network. Mil Med 2024; 189 (5): e1246–52

[44] Becker DM, Tafoya CA, Becker SL et al. The use of portable ultrasound devices in low- and middle-income countries: a systematic review of the literature. Trop Med Int Health 2016; 21 (3): 294–311